



START CENTER
STRATEGIC ANALYSIS,
RESEARCH & TRAINING CENTER

DREAMS: INTERVENTIONS FOR HIGH-RISK MALE PARTNERS OF ADOLESCENT GIRLS AND YOUNG WOMEN

UNIVERSITY OF WASHINGTON STRATEGIC ANALYSIS, RESEARCH, & TRAINING (START) CENTER

JUNE 14, 2016

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INTRODUCTION

Adolescent girls are disproportionately affected by HIV. Adolescent girls and young women (AGYW, ages 15-24) account for 71% of new HIV infections among adolescents in sub-Saharan Africa (1). The DREAMS partnership aims to reduce HIV infections among AGYW in 10 sub-Saharan African countries. While most services are being delivered directly to AGYM and their families, one important component provides HIV testing and services to sexual partners of AGYM as a way of reducing their risk. Because testing among men in sub-Saharan Africa is low and because men generally present late for HIV testing and treatment, novel approaches are needed to access these men as part of overall DREAMS strategies. The University of Washington (UW) Strategic Analysis, Research, and Training (START) Center was tasked with providing a landscape analysis of research done in the past 15 years, with special focus on the most recent 5 years, in the 10 DREAMS countries or other sub-Saharan African countries, on the following:

1. Strategies and research to identify high-risk sexual partners for AGYW;
2. Successful methods for achieving high rates of HIV testing in these men; and
3. Strategies for linking HIV+ men to services, including ART.

The present report is a summary of the START team's key findings on these objectives.

METHODS

OBJECTIVE 1: IDENTIFYING HIGH-RISK SEXUAL PARTNERS FOR AGYW

The START team conducted targeted searches in PubMed and Google Scholar to identify research that examined characteristics of high-risk sexual male partners of AGYW and strategies for identifying partners. Ad hoc searches were conducted on common topics identified during the initial targeted searches. Exclusion criteria included: MSM, commercial sex workers, HIV treatment, and articles not related to examination of characteristics of high-risk sexual male partners of AGYW and strategies for identification of partners. Of the twenty-five articles reviewed in full, fifteen have been highlighted here in this review.

OBJECTIVE 2 & 3: IMPROVING PARTNER TESTING AND LINKAGE TO SERVICES

The START team conducted targeted searches in PubMed and Google Scholar to identify research that examined interventions intended to test males and link them to HIV services. Snowball citations were used to identify additional relevant articles. Exclusion criteria included: condom use behavior change communication, key populations (MSM, commercial sex workers, PMTCT), articles with no quantitative outcome, and articles not related to testing and treatment. Twenty-seven articles were included for full review.



KEY FINDINGS

OBJECTIVE 1: IDENTIFYING HIGH-RISK SEXUAL PARTNERS FOR AGYW

Objective 1 aimed to identify characteristics of high-risk sexual partners for AGYW and strategies of identification of partners in order to inform targeted outreach of partners for HIV testing and linkage to care. While literature identified factors of partnerships that may be associated with HIV infection among AGYW, such as intimate partner violence, condom use, and partner concurrency, few partner characteristics that could inform targeted outreach efforts were identified.

Age-disparate relationships, especially intergenerational relationships (partners >10 years older), have previously been linked to higher prevalence of HIV in AGYW. In a literature review of studies published from 1990 to 2010 examining sexual partner characteristics for STI transmission among adolescents, investigators found that of the ten HIV studies that assessed age-disparate relationships in low- and middle-income settings, eight of the studies reported a significant association between having older partners and HIV prevalence (2). In a South African study, researchers found that young females in age-discordant relationships were more likely to engage in certain sexual risk behaviors, such as frequent sex (aOR 1.77; 95% CI 1.20, 2.60) and having concurrent sex partners (aOR 1.77; 95% CI 1.22, 2.57), though HIV acquisition was not assessed (3). Recent studies suggest that age-disparate relationships are not associated with HIV acquisition. Two South African studies found no association between HIV acquisition and having a sexual partner >5 years older, nor was an association observed for partners >10 years (4, 5). In Uganda, one population-based prospective study found a significant association between HIV acquisition and older partners, but after adjusting for relationships type there was no association (6). In a cross-sectional Ugandan study, having a recent partner 5-9 years older or having a partner ≥10 years older was not associated with a positive HIV serostatus (7). Furthermore, in addition to reporting no associations between HIV acquisition and having a partner >10 years older, relationships with partners >10 years older or “sugar daddy” partnerships were less common than relationships with partners >5 but <10 years older (less than 10% vs. over 20% of all partnerships) (4, 5, 8, 9).

Other partner characteristics have been assessed including relationship type, partner occupation, other partnerships of partner, and partner education. Research suggests that currently married females are at lower risk of HIV compared to never married females (aIRR 0.26; 95% CI 0.16, 0.42) (10) and divorced females have a higher risk of HIV compared with never married females (aIRR 2.12; 95% CI 1.11, 4.05) (6). In one prospective Ugandan study, the risk of HIV acquisition among young females was higher if the partnership assessed was non-marital compared to marital (aIRR 1.60; 95% CI 1.11, 2.23) (6). Examining partner occupation, the literature review included two studies, one from Tanzania and one from South Africa, reporting higher odds of HIV associated with partners who were tour guides or mineworkers (2). In a more recent Ugandan study, having a partner working as a truck driver was associated with higher risk of HIV acquisition compared to non-truck drivers, but this association did not remain after adjusting for individual and partner characteristics (6). The investigators also assessed bar worker and found no



association. In another Ugandan study, no association was found between HIV acquisition and high-risk employment by the partner, including working in a bar, brewing alcohol, working in a restaurant, working in a hotel or guest house, fishing, truck or taxi driver, motor-cycle taxi rider, market vending, housekeeper, trading which required one to work away from one's community, and being in the army, police, or security work. Participants were not, however, restricted by age (11). Having a partner who has other partners has been observed to have an association with HIV. Three cross-sectional studies set in sub-Saharan Africa identified in the review found positive associations between HIV and having a partner with other partners (2). A Ugandan study observed a higher risk of HIV acquisition among females whose partners had one other sexual partner compared to females whose partners had no other sexual partners (IRR 1.83; 95% CI 1.22, 2.77). However, no significant association was observed for females who had partners with more than one other sexual partner, compared to females whose partners had no other partners, though a lack in significance could be due to sample size issues. After adjusting for partner relationship type, there was no association between HIV acquisition and having a partner with other sexual partners (6). Finally, one cross-sectional study was identified in the literature review that found having a partner educated to matric or higher was positively associated with HIV among South African female participants (2). In a Ugandan study, investigators observed a higher risk of HIV acquisition among females with partners who were currently not students compared to females with partners who were currently students, but there was no association after adjusting for partner relationship type (6). Refer to page 8 for a table of more information about studies that examine high-risk partner characteristics.

In addition to reviewing studies that examined characteristics of male sexual partners of AGYW, literature was reviewed for strategies to identify sexual partners. One general method is to identify characteristics of male sexual partners from AGYW. Michielson and colleagues examined the use of the "mailbox technique" to collect letters from Rwandan youths about sexuality and relationships (12). A study in Uganda utilized a case-control study design to compare qualitative data about key life events and goals, pregnancy and parenthood, HIV and reproductive health, and sexual relationships. HIV-positive cases were matched to HIV-negative controls on several demographic factors (13). The qualitative assessment allows for certain characteristics to be placed in context of the greater life picture. Investigators reported that HIV-positive respondents were qualitatively different than HIV-negative respondents, finding that HIV-positive respondents tended to have slightly more and shorter-term partnerships than HIV-negative respondents. They also found that HIV-positive respondents were less trusting and knew relatively less of their partners than HIV-negative respondents (13). The Ascertaining Sexual Relationship Types (ASERT) technique utilizes anonymous, group-based reporting by AGYW to characterize sexual partners of girls similar to them (14). The Priorities for Local AIDS Control Efforts (PLACE) identifies specific venues where individuals meet sexual partners and informs potential locations for targeted outreach (15). Know Your Epidemic is another strategy that could be employed to better understand the epidemic using surveillance data and other existing data sources (16); however, the Mode of Transmission (MOT) model metric should be used in conjunction with other data to guide prevention efforts as the MOT metric has limitations, including underestimation of epidemic drivers, especially in countries in the late epidemic phase, biased estimates when data quality is poor or does



not account for heterogeneity of region, and inability to describe the epidemic over time (17, 18). Finally, investigators have utilized phylogenetic data and mapping techniques to identify where male partners may be located (19).

OBJECTIVE 2 & 3: IMPROVING PARTNER TESTING

Objectives 2 and 3 seek to identify systems that refocus the manner in which testing and linkage to service is offered for men. This review found many alternative strategies to traditional clinic-based testing which showed higher uptake, particularly among first-time testers or those with advanced disease. Few studies were identified assessing strategies to improve linkage to antiretroviral therapy.

Studies on home-based testing showed high acceptability and uptake among men. In one cross-sectional house-to-house survey in Uganda, overall acceptance of HIV tests offered was 69%, and males were nearly twice as likely as females to accept an HIV test (OR 1.65) (20). Another retrospective analysis in Western Kenya also found that males were more likely to test than females, and that overall testing acceptance was 99.1% among adolescents and 98.3% among young adults (21). Finally, a study in sites in both urban and rural Kenya showed differences in testing among adolescent and adult men but high uptake overall. Among adult men, 79.9% in urban and 75.4% in rural settings accepted testing, while among adolescent men, 89.3% in urban and 86.7% in rural settings accepted testing (22).

Mobile testing also showed potential to reach men, and particularly opportunistic and first-time testers. In a cross-sectional study in South Africa comparing four models (clinic, stand-alone, rural mobile, and urban mobile testing), results showed that urban mobile clinics had the highest proportion of male clients (52%) and rural mobile clinics had the highest proportion of clients with no prior HCT (61%) or perceived risk (64%) (23). Another matched study in Cape Town comparing clients using clinic-based and mobile testing found that 51% of clients using mobile testing were male, compared to 27% in clinics (24). Finally, a cluster-randomized trial conducted in South Africa, Tanzania, and Zimbabwe showed that compared to clinic-based VCT, community-based VCT with a mobile component increased testing by 45% among men (25).

Several studies compared home-based and mobile testing. While results varied, both seemed to be more effective than clinic-based testing at reaching men. A cluster-randomized controlled trial in Lesotho found that home-based testing had higher uptake than mobile-based (92.5% vs. 86.7%) among people accessing services during a community-based multi-disease campaign (26). A study in Swaziland found that mobile testing reached a slightly higher proportion of adult men than home-based testing (42% vs. 39%) (27). Finally, a systematic review and meta-analysis of clinic- and community-based HCT strategies in sub-Saharan Africa showed that self-testing at home reaches the highest proportion of young adults, while mobile HIV testing reaches the highest proportion of men (28).



Incentivized testing, when combined with other strategies, was effective at targeting male first-time testers and those with HIV infection and/or advanced disease. A South African study comparing incentivized mobile, non-incentivized mobile, and clinic testing among men found that incentivized mobile testing was more likely than non-incentivized mobile testing to catch first-time testers (60.1% vs. 42.0%) and those with advanced disease (14.9% vs. 7.5%) (29). Similarly, in another study also in South Africa, incentivized mobile testers were less likely than non-incentivized mobile testers to have been tested previously (66.9% vs. 72.3%), and more likely to have newly diagnosed HIV infection (10.9% vs. 5.0%) (30). Finally, a study in Malawi found that for clinic-based testing, 77% of incentivized testers retrieved their results from the clinic, compared to 34% of non-incentivized testers. Even the smallest incentive amount doubled retrieval rate (31).

Other strategies, such as workplace testing and call centers for linkage, show potential but lack a strong evidence base in the literature and/or robust research at this time. In an evaluation of a community outreach program involving a call center to link testers to care, 51% of tested individuals were linked to care with a mean time of 31 days (32). A five-country analysis of VCT uptake among workers and spouses in Heineken brewing factories between 2001 and 2007 showed an annual testing uptake between 15% and 32%. HIV infected persons tended to test early: they accounted for 8.8% of testers in the first year and 3.0% in the subsequent study period (33). The table on page 14 summarizes the outcomes for the testing systems reviewed above.

RECOMMENDATIONS

- Age-disparate relationships do not seem to be associated with higher risk of HIV acquisition. Specifically, partnerships with men >10 years older and "sugar daddies" are less common than partnerships with men >5 years older. Outreach should not exclusively focus on older men.
- Interpret study results with caution. Findings may be dependent on study setting and may not be generalizable to different populations. Additionally, consider strengths and limitations of study design and quality of data when evaluating study results. Studies using phylogenetic data and assessing HIV incidence may provide stronger evidence of risk factors for HIV acquisition compared to studies assessing HIV prevalence. It is recommended that data gathered via literature review supplement results from country-/region-specific data analyses to help guide prevention strategies.
- Incentivized testing is effective at targeting male first-time testers and those with HIV infection and/or advanced disease, and should be considered as an outreach strategy.
- Mobile and home-based testing strategies perform similarly, and both demonstrate higher testing uptake among young men than clinic-based testing.



CONCLUSIONS

Age-disparate relationships, especially intergenerational relationships, may not increase risk of HIV incidence. Data specific to region of interest should be reviewed to provide a more informed assessment of high-risk male partners of AGYW. Studies that utilize phylogenetic data and examine HIV incidence provide stronger evidence of risk of acquisition compared to studies examining HIV prevalence. Testing and linkage efforts should focus on populations of younger men. Incentivized testing and non-clinic-based testing may be effective strategies to engage high-risk sexual partners of AGYW.



Table 1. Objective 1 – Partner Characteristics

Characteristic	Outcome	Study Design	Location	Strengths	Weaknesses
Age-Disparate Relationships	Among ten studies in low- and middle-income countries assessing age-disparate relationships, eight studies found a positive association between older partner age and HIV prevalence; one of the eight studies found no significant association between older partner age and HIV incidence.	<u>Subjects</u> : 64 studies <u>Age (years)</u> : 15 to 24 years <u>Timeframe</u> : 1990 to 2010 <u>Design</u> : literature review of partner attributes associated with sexually transmitted infections among adolescents (2)	Various	<ul style="list-style-type: none"> Assessed large number of studies, dichotomized by setting (low-/middle-income vs. high-income) 	<ul style="list-style-type: none"> Quality of studies were not assessed
	Among participants aged <25 years at baseline, there was no significant association between having a primary partner >5 years older (aHR 1.13; 95% CI 0.80, 1.59) or >10 years older (aHR 1.24; 95% CI 0.57, 2.68) and HIV acquisition. Investigators also observed having a partner >10 years older was not common (4%). (Adjusted for married or living with a partner, partner provides financial or material support, partner has other partners, any curable STI at baseline, HSV-2 status and alcohol use, and stratified by site.)	<u>Subjects</u> : 3789 females, participants of VOICE trial <u>Age (years)</u> : eligible age range was 18 to 45 years <u>Timeframe</u> : 2009 to 2012 <u>Design</u> : data from first year of follow-up for randomized placebo-controlled trial assessing safety and effectiveness of oral tenofovir disoproxil fumarate, oral TDF plus emtricitabine, and vaginal 1% tenofovir gel for HIV-1 prevention; restricted analysis to primary partner, defined as "a man you have sex with on a regular basis or who you consider to be your main partner" (4)	Durban area (KwaZulu-Natal region), Johannesburg area, and Klerksdorp, South Africa	<ul style="list-style-type: none"> Assessed HIV acquisition vs. HIV prevalence Collected data in context of clinical trial; high retention Includes women from different regions of South Africa Large sample size 	<ul style="list-style-type: none"> Partner age of new primary partners was not collected; sensitivity analysis censoring participants whose primary partners changed showed similar results to main results Data was not collected for non-primary partners Study includes women enrolled in a clinical trial, so results may not be generalizable to general population
	No significant associations were observed between risk of HIV acquisition and having an older sexual partner on a continuous scale (HR 1.00; 95% CI 1.97, 1.03) or dichotomously at different age cut points (≥ 5 years older: HR 0.98; 95% CI 0.97, 1.03; ≥ 10 years older: HR 0.98; 95% CI 0.67, 1.43; ≥ 20 years older: HR 0.61; 95% CI 0.15, 2.46). Prevalence of having a partner ≥ 10 years older (9%) was less common than having a partner ≥ 5 years older (38%).	<u>Subjects</u> : 2444 females, population-based, open cohort <u>Age (years)</u> : 15 to 29 years <u>Timeframe</u> : January 2003 to June 2012 <u>Design</u> : data from population-based, longitudinal surveillance conducted by the Africa Centre for Health and Population Studies; assessed age-disparity in most recent sexual partner (0.8% of women reported more than one sexual partner in past year) in relation to HIV test (5)	KwaZulu-Natal, South Africa	<ul style="list-style-type: none"> Assessed HIV acquisition vs. HIV prevalence Longitudinal assessment of outcome and exposure variables Large sample size 	<ul style="list-style-type: none"> Suffered from attrition and non-response, but non-response was limited and results did not change with multiple imputation analysis Data obtained from women respondents, not from partners



Among female participants, risk of HIV acquisition was observed to be higher among those with older partners (IRR 2.59; 95% CI 1.62, 4.14), but was no longer significant after adjusting for relationship type (nonmarital vs. marital) with partner (aIRR 1.08; 95% CI 0.65, 1.78)	<u>Subjects</u> : 1969 males and 2826 females, population-based cohort <u>Age (years)</u> : 15 to 24 years <u>Timeframe</u> : 2005 to 2011 <u>Design</u> : longitudinal assessment of 4 rounds of data collection for HIV infection; partner-related information on up to 4 sexual partners in the past year (6)	Rakai, Uganda	<ul style="list-style-type: none"> • Population-based • Assessed HIV acquisition vs. HIV prevalence • Large sample size 	<ul style="list-style-type: none"> • Partner characteristics were assessed through self-report of female respondent (not partner)
Among female participants aged 16-24 years, the prevalence of having a last partner ≥ 5 years older was 36% and ≥ 10 years older was 7%.	<u>Subjects</u> : 3530 males and 3946 females, nationally representative sample <u>Age (years)</u> : 16 to 49 years <u>Timeframe</u> : June to August 2009 <u>Design</u> : data from the second National HIV Communication Survey and restricted to the three most recent partners reported by respondents in order (8)	South Africa	<ul style="list-style-type: none"> • Nationally representative data • Large sample size 	<ul style="list-style-type: none"> • Response rate was low (58%) • Did not assess risk of HIV acquisition • Partner age was collected from respondent report
Regardless of sex or age of respondent, prevalence of “sugar daddy” relationships were rare in this community. The greatest age gap was found in spousal relationships vs. casual relationships.	<u>Subjects</u> : 1349 males and 2768 females <u>Age (years)</u> : 15 years or older <u>Timeframe</u> : not specified <u>Design</u> : data from large HIV surveillances in sub-Saharan Africa, in community in rural South Africa; assessed more recent sexual partners (up to three) (9)	South Africa	<ul style="list-style-type: none"> • Assessed age-gap in relation to relationship type • Large sample size 	<ul style="list-style-type: none"> • Did not assess risk of HIV acquisition
Among female participants aged 15-24 years, no association was found between HIV-positive serostatus and having a recent partner 5-9 years older (aOR 1.04; 95% CI 0.72, 1.50) or having a recent partner ≥ 10 years older (aOR 1.50; 95% CI 0.99, 2.30). (Adjusted for age, area of residence, educational attainment and marital status, transactional sex in last 12 months, lifetime number of sexual partners, age of sexual debut)	<u>Subjects</u> : 3479 males and 4627 females <u>Age (years)</u> : 15 to 24 years <u>Timeframe</u> : February to September 2011 <u>Design</u> : data from the Uganda AIDS Indicator Survey (I=UAIS), a nationally representative, population-based survey of HIV serological status (7)	Uganda	<ul style="list-style-type: none"> • Population-based • Large sample size 	<ul style="list-style-type: none"> • Cross-sectional design does not allow for causal inference • Data based on retrospective reporting through face-to-face interviews, may be subject to recall bias and underreporting of socially undesirable behaviors



	<p>Factors associated with a higher probability of being in an age-disparate relationship were being in a casual (vs. main) partnership (aOR 1.50; 95% CI 1.06, 2.13), having frequent sex (aOR 2.04; 95% CI 1.39, 3.00), having concurrent partnerships (aOR 1.71; 95% CI 1.19, 2.46), having greater than 2 lifetime sexual partners vs. less than 2 partners (aOR 2.29; 95% CI 1.52, 3.45).</p> <p>Factors associated with a lower probability of being in an age-disparate relationship were having a partner enrolled in school vs. not enrolled (aOR 0.20; 95% CI 0.14, 0.30), always using a condom (aOR 0.53; 95% CI 0.32, 0.88), using a condom at last sex (aOR 0.70; 95% CI 0.50, 0.98), and having a high (vs. low) SRPS* (aOR 0.54; 95% CI 0.32, 0.93).</p> <p>(Adjusted for young woman's age, primary source of income, and food insecurity)</p> <p>*SRPS: sexual relationship power scale measures whether young women perceived they had decision-making power during interactions with current or most recent partner</p> <p>Females in age discordant relationships are more likely to engage in frequent sex (aOR 1.77; 95% CI 1.20, 2.60) and have concurrent partnerships (aOR 1.77; 95% CI 1.22, 2.57). (Adjusted for young woman's age, partnership status, partner enrolled in school, relationship ongoing, cohabiting, and relationship duration)</p>	<p><u>Subjects</u>: 656 females <u>Age (years)</u>: eligible 13 to 20 years <u>Timeframe</u>: March 2011 to December 2012 <u>Design</u>: data from RCT HPTN 068 trial to determine whether cash transfers conditioned on school attendance resulted in reduced sexual risk and HIV incidence; age disparate relationship defined as >5 years older (3)</p>	Mpumalanga, South Africa	<ul style="list-style-type: none"> • Focuses on younger age group 	<ul style="list-style-type: none"> • Did not assess risk of HIV acquisition • Relied on women to report partner characteristics • Cross-sectional design does not allow for causal inference
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Type of Relationship	Among female participants, risk of HIV acquisition was higher among respondents having a non-marital relationship with partner (aIRR 1.60; 95% CI 1.11, 2.23). Divorced females had a higher risk of HIV acquisition compared to never married females (aIRR 2.12; 95% CI 1.11, 4.05), but currently married females had a non-significant lower risk of HIV acquisition compared to never married females (aIRR 0.75; 95% CI 0.44, 1.26). (Adjusted for significant respondent and partner characteristics, including respondent community (rural vs. trading village), marital status, symptomatic genital warts, and partner alcohol use before sex and frequency of using condom with partner in the past year)	<u>Subjects</u> : 1969 males and 2826 females, population-based cohort <u>Age (years)</u> : 15- to 24-year-olds <u>Timeframe</u> : 2005 to 2011 <u>Design</u> : longitudinal assessment of 4 rounds of data collection for HIV infection; partner-related information on up to 4 sexual partners in the past year (6)	Rakai, Uganda	<ul style="list-style-type: none"> • Population-based • Assessed HIV acquisition vs. HIV prevalence • Large sample size 	<ul style="list-style-type: none"> • Partner characteristics were assessed through self-report of female respondent (not partner)
	Among female participants, risk of HIV acquisition among currently married participants was lower than never married participants (aIRR 0.26; 95% CI 0.16, 0.42). (Adjusted for age and education)	<u>Subjects</u> : 17946 males and 24944 females, open cohort <u>Age (years)</u> : 15 to 49 year <u>Timeframe</u> : 2000 to 2002, 2003 to 2006, and 2007 to 2011 <u>Design</u> : data from the Rakai Community Cohort Study, an open cohort with annual surveys of residents in 50 communities (10)	Rakai, Uganda	<ul style="list-style-type: none"> • Assessed HIV acquisition vs. HIV prevalence • Large sample size 	<ul style="list-style-type: none"> • Majority of participants were 30+ years
Partner Occupation	Two cross-sectional studies found a significant association between occupation and HIV. In Tanzania, higher odds of HIV were associated with having a partner who was a tour guide or mineworker compared to a partner in a professional occupation (OR 4.51; 95% CI 1.36, 14.97), but after adjustment the association was no longer significant (aOR 3.02; 95% CI 0.79, 15.11). Partner being a driver or in the army/police force/security guard was also assessed and found not significant. In South Africa, the odds of HIV were associated with having a sexual relationship with a mineworker (OR 4.3; 95% CI 1.9, 9.7) and remained significant after adjusting for age, living in squatter settlement,	<u>Subjects</u> : 64 studies <u>Age (years)</u> : 15- to 24-year-olds <u>Timeframe</u> : 1990 to 2010 <u>Design</u> : literature review of partner attributes associated with sexually transmitted infections among adolescents (2)	Various	<ul style="list-style-type: none"> • Assessed large number of studies, dichotomized by setting (low-/middle-income vs. high-income) 	<ul style="list-style-type: none"> • Quality of studies were not assessed



	lifetime partners, and number of sexual acts with casual partner (aOR 3.1; 95% CI 1.2, 7.8). The association was not significant with the addition of positive HSV-2 serostatus.				
	Among female participants, risk of HIV acquisition was higher for those with a partner working as a trucker compared to non-trucker partners in crude analyses (IRR 2.63; 95% CI 1.45, 4.78), but this association did not remain significant in adjusted analyses (not shown). Having a partner working as a bar worker was not found to significantly associated with higher risk of HIV acquisition in crude (IRR 1.81; 95% CI 0.26, 12.71) and adjusted analyses (not shown).	<u>Subjects</u> : 1969 males and 2826 females, population-based cohort <u>Age (years)</u> : 15- to 24-year-olds <u>Timeframe</u> : 2005 to 2011 <u>Design</u> : longitudinal assessment of 4 rounds of data collection for HIV infection; partner-related information on up to 4 sexual partners in the past year (6)	Rakai, Uganda	<ul style="list-style-type: none"> • Population-based • Assessed HIV acquisition vs. HIV prevalence • Large sample size 	<ul style="list-style-type: none"> • Partner characteristics were assessed through self-report of female respondent (not partner)
	Among female participants, there was no association between risk of HIV acquisition and having a partner in high-risk employment (HR: 1.09; 95% CI 0.88, 1.35). High risk employment includes: working in a bar, brewing alcohol, working in a restaurant, working in a hotel or guest house, fishing, truck or taxi driver, motor-cycle taxi rider (boda-boda cyclist), market vending, housekeeper, trading which required one to work away from their community, and being in the army, police, or security work.	<u>Subjects</u> : 5783 males and 7497 females, open population-based cohort <u>Age (years)</u> : 15- to 49-year-olds <u>Timeframe</u> : 2003 to 2011 <u>Design</u> : longitudinal data from Rakai Community Cohort Study (11)	Rakai, Uganda	<ul style="list-style-type: none"> • Population-based • Assessed HIV acquisition vs. HIV prevalence • Large sample size 	<ul style="list-style-type: none"> • Did not stratify by age group
Other Partnerships of Partner	Three cross-sectional studies set in sub-Saharan African countries found a positive association between HIV and having a partner with other partners.	<u>Subjects</u> : 64 studies <u>Age (years)</u> : 15- to 24-year-olds <u>Timeframe</u> : 1990 to 2010 <u>Design</u> : literature review of partner attributes associated with sexually transmitted infections among adolescents (2)	Various	<ul style="list-style-type: none"> • Assessed large number of studies, dichotomized by setting (low-/middle-income vs. high-income) 	<ul style="list-style-type: none"> • Quality of studies were not assessed



	<p>Among female participants, crude analyses found that respondents who had a partner who had 1 other sexual partner in the past year had a higher risk of HIV acquisition compared to women with partners who did not have any other sexual partner in the past year (IRR 1.83; 95% CI 1.22, 2.77). The relationship was not significant for partners having more than 1 other sexual partner in the past year and no association was found after adjustment. (Adjusted for significant respondent and partner characteristics, including respondent community (rural vs. trading village), marital status, symptomatic genital warts, and partner alcohol use before sex and frequency of using condom with partner in the past year)</p>	<p><u>Subjects</u>: 1969 males and 2826 females, population-based cohort <u>Age (years)</u>: 15- to 24-year-olds <u>Timeframe</u>: 2005 to 2011 <u>Design</u>: longitudinal assessment of 4 rounds of data collection for HIV infection; partner-related information on up to 4 sexual partners in the past year (6)</p>	Rakai, Uganda	<ul style="list-style-type: none"> • Population-based • Assessed HIV acquisition vs. HIV prevalence • Large sample size 	<ul style="list-style-type: none"> • Partner characteristics were assessed through self-report of female respondent (not partner)
Partner Education	<p>This review includes a cross-sectional study found having a partner educated to matric or higher was positively associated with HIV among South African female participants (OR 1.91; 95% CI 1.30, 2.78).</p>	<p><u>Subjects</u>: 64 studies <u>Age (years)</u>: 15- to 24-year-olds <u>Timeframe</u>: 1990 to 2010 <u>Design</u>: literature review of partner attributes associated with sexually transmitted infections among adolescents (2)</p>	Various	<ul style="list-style-type: none"> • Assessed large number of studies, dichotomized by setting (low-/middle-income vs. high-income) 	<ul style="list-style-type: none"> • Quality of studies were not assessed
	<p>Among female participants, having a partner currently a non-student was significantly associated with HIV acquisition (IRR 2.13; 95% CI 1.17, 3.08), but there was no association after adjusting for partner relationship type (aIRR 0.93; 95% CI 0.56, 1.54).</p>	<p><u>Subjects</u>: 1969 males and 2826 females, population-based cohort <u>Age (years)</u>: 15- to 24-year-olds <u>Timeframe</u>: 2005 to 2011 <u>Design</u>: longitudinal assessment of 4 rounds of data collection for HIV infection; partner-related information on up to 4 sexual partners in the past year (6)</p>	Rakai, Uganda	<ul style="list-style-type: none"> • Population-based • Assessed HIV acquisition vs. HIV prevalence • Large sample size 	<ul style="list-style-type: none"> • Partner characteristics were assessed through self-report of female respondent (not partner)



Table 2. Objectives 2 & 3 – Testing and Linkage Interventions

Outreach strategy	Outcome	Study	Country	Strengths	Limitations
Home-based HIV counseling and testing	Males almost twice as likely as females to accept HIV test (OR=1.65), 15-24 ages range most likely to accept test. Among those offered, overall acceptance of test 69%	Cross-sectional house-to-house survey to test level of acceptance for home-based testing in residents age ≥ 15 (20)	Uganda	Study includes general population rather than just high-risk groups	Study population primarily women (78%)
	81.7% overall acceptance of HBTC in urban and rural site. For adult men, 79.9% in urban and 75.4% in rural, adolescent men 89.3% in urban and 86.7% in rural	Cross-sectional house-to-house survey to test level of acceptance for home-based testing in children and adults (22)	Kenya	Large sample size, high uptake and acceptance of testing	Survey took place in population already engaged in public health research, self-reported HIV testing history
	99.1% test acceptance among adolescents, 98.3% among young adults. In younger adults, females less likely to test than males (AOR: 0.69, 95% CI: 0.65 to 0.73)	Retrospective analysis of home-based testing data for individuals age ≥ 13 in Western Kenya (21)	Kenya	First study to provides an age comparison of factors associated with HIV testing uptake and prevalence, large sample includes diverse cultural and ethnic groups	Potential reporting errors
	Home-based testing had higher HTC uptake than mobile-based (92.5% versus 86.7% among people accessing services during multi-disease campaigns)	A cluster-randomized controlled trial comparing home-based and mobile HCT (26)	Lesotho	Robust study design and large sample	Neighbored clusters might have led to cross-contamination, non-random sampling of households for home-based testing may have introduced bias
Mobile-based counseling and testing	Mobile testing reached a higher proportion of adult men than home-based testing (42% vs. 39%)	A feasibility and effectiveness study comparing mobile and home-based testing strategies in rural Swaziland (27)	Swaziland	Large sample size	For home-based testing, one-third of reported household members not home on day of testing
	Among 4 interventions, urban mobile clinics had highest proportion of male clients (52%) and rural mobile clinics had highest proportion of no prior HCT (61%) or perceived risk (64%)	A cross-sectional study of routine HCT data collected in South Africa between January 2009 and June 2012 (23)	South Africa	Large sample size covering 3 years of HCT	Missing data for some variables and across HCT sites over study period
	CBVCT with mobile component increased testing by 45% among men and 15% among women, compared to SVCT	A cluster-randomized trial comparing community-based VCT (with mobile component) to clinic-based VCT (25)	South Africa, Tanzania, Zimbabwe	Robust study design, demonstrated effective method of reaching men	Lower than ideal HIV prevalence/participation for study at some sites, missing data on number of tests provided



	In matched study, 51% of clients in mobile were male, compared to 27% in clinics. Mobile also more likely to catch opportunistic testers.	A matched study to compare clients using mobile- and clinic-based testing in Cape Town (24)	South Africa	Detailed demographic data, study design	Communities not randomly selected, small sample size and geographic scope limits generalizability
	Incentivized mobile testing more likely than voluntary mobile/clinic testing to catch first-time testers (60.1% vs. 42.0%) and those with advanced disease (14.9% vs. 7.5%)	Retrospective analysis of incentivized mobile, voluntary mobile, and stationary clinic-based testing among men (incentive was food voucher with worth equivalent of USD\$10.30) (29)	South Africa	Large sample size, first study to compare incentivized mobile testing with other services (voluntary mobile and clinic)	Study design not robust, self-reported HIV testing history
Incentivized strategies	Incentivized mobile testers were less likely to have been tested previously (66.9% vs 72.3%), and more likely to have newly diagnosed HIV infection (10.9% vs. 5.0%)	A study comparing incentivized and voluntary testers using a mobile HCT service in a peri-urban township (incentive was food voucher worth equivalent of USD\$9.60) (30)	South Africa	Population-based study with large sample size	Self-reported HIV testing history, possible confounding in difference between two testing groups
	77% of incentivized testers retrieved results from clinic, compared to 34% of non-incentivized testers. Even the smallest incentive amount doubled retrieval rate.	Analysis of the effects of randomly assigned monetary incentives of the retrieval of HIV testing results in clinics (incentive was randomly assigned cash voucher between 1 and 3 dollars) (31)	Malawi	First study to analyze the impact of randomized incentives and travel cost on obtaining HIV results	Unclear how many participants randomly assigned no incentive did not attend VCT, 9% test refusal
Other strategies	51% of tested individuals linked to care, with mean time of 31 days. Linkage lower in males (46.6%)	An evaluation of a community outreach program involving a call center to link testers to care (32)	South Africa	Large sample size compared to previous similar studies, and includes urban and rural areas	No comparison group without call-center component or inclusion of before/after data for this intervention, does not include data on care retention
	Annual uptake between 15% and 32%, with proportion of HIV+ infected persons among testees 8.8% in first year and 3.0% in following period	An analysis of VCT uptake among workers and spouses in Heineken brewing factories between 2001 and 2007 (33)	DRC, Republic of Congo, Rwanda, Burundi, Nigeria	Large sample size and geographic spread	Higher uptake among female employees and female spouses suggests there is still work to be done on reaching males
Systematic reviews of testing strategies	Self-testing at home reached highest proportion of young adults, while mobile HIV testing reaches the highest proportion of men	A systematic review and meta-analysis of clinic and community-based HCT strategies in sub-Saharan Africa (28)	Sub-Saharan Africa	Includes analysis of 126 individual studies	Studies heterogeneous, assessment of linkage to care and estimates of coverage vary across studies



	Mobile testing outperformed standard VCT in getting men to test. Home-based testing was also effective, but less so than mobile testing.	A systematic review of strategies to increase testing among men in sub-Saharan Africa (34)	Sub-Saharan Africa	First systematic review on this topic	n/a
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