Patterns of uptake of HIV testing in Sub-Saharan Africa: 2003-2005

A cross-country comparison of Demographic and Health Survey data

Ide Cremin [1]

Simon Cauchemez [1]

Geoffrey P. Garnett [1]

Simon Gregson [12]

1. Department of Infectious Disease Epidemiology, Imperial College London
2. Biomedical Research and Training Institute, Harare, Zimbabwe

IUSSP 26th International Population Conference
Marrakech, Morocco, 27 September - 2 October 2009

Abstract

HIV testing and counselling is the entry point for HIV prevention, treatment and care services. However, in many countries with generalised epidemics the majority of infected individuals are unaware of their serostatus. Recently, there has been an expansion of testing services and a concomitant increase in treatment availability. Demographic and Health Survey data collected between 2003 and 2005 from 10 countries are used to describe the pattern of uptake of testing for HIV among sexually active individuals. Univariate and multivariate logistic regression are used to analyse the associations between socio-demographic and behavioural characteristics and the uptake of testing. Overall, knowledge of serostatus ranged from 2% among women in Guinea to 27% among women in Rwanda. Despite varied levels of testing, univariate analysis showed the profile of testers to be remarkably similar across countries, with respect to socio-demographic characteristics, including age group, education level, area of residence and socio-economic status. Overall, positive individuals are more likely to have tested and received their results than negative individuals, with the exception of those in Senegal and Guinea. Adjusted analyses indicate that a secondary or higher level of education and an awareness that treatment exists are the key determinants of testing, once other characteristics have been taken into account. This work provides a baseline for monitoring trends in testing and exploring changes in the profile of those who get tested as provision of services increase.

Introduction

HIV testing and counselling is the entry point for HIV prevention, treatment and care services (De Cock, Marum and Mbori-Ngacha 2003; UNAIDS 2001). Access to testing services has increased rapidly in recent years as provision of anti-retroviral treatment (ART) expands (WHO, UNAIDS and UNICEF 2007). In over 70 countries surveyed, the use of testing services has quadrupled from 4 million persons in 2001 to 16.5 million in 2005 (UNAIDS 2006).

It is important to monitor trends in testing uptake for three reasons. Firstly, it is useful to look at the patterns of uptake of testing with respect to socio-demographic characteristics, as this has implications for equitable access to treatment (Makwiza et al. 2009; Wringe et al. 2008). Secondly, in terms of prevention, analysing testing patterns with respect to behavioural indicators can help identify if those individuals most at risk of acquiring or transmitting infection are seeking testing. Finally, understanding the factors affecting the use of testing services is essential for the success of testing programmes in achieving high levels of coverage.

In the context of accelerating access to treatment, WHO and UNAIDS recently issued guidance on provider-initiated HIV counselling and testing in health facilities that recommends an "opt-out" approach (UNAIDS and WHO 2007). With an opt-out approach, individuals accessing clinical care will be routinely tested for HIV, unless they specifically refuse to do so. Prior to this, those going for HIV testing were generally a small self-selecting group of the wider population who chose to access testing services.

Conceptual framework

There are many possible motivations for seeking testing. At an individual level, marital status and psychosocial status (knowledge, risk perception, personal experiences of HIV morbidity & mortality) may influence the decision to test, as well as demographic characteristics such as age, gender and education (Creek et al. 2007; Hutchinson and Mahlalela 2006; Matovu et al. 2005; Sherr et al. 2007; Wringe et al. 2008). For example,

women are more likely to be offered an HIV test through ante-natal care (ANC), and therefore may be more likely to get tested. Concerns such as anxiety over past risky behaviour also may prompt an individual to seek testing (Maman et al. 2001; Morin et al. 2006). Poor health may be another motivator for testing, particularly if an individual is showing symptoms of an AIDS-related illness (Nyblade et al. 2001). In addition, the death of one's spouse, from AIDS or other ill health, may act as a motivator. Community factors such as levels of HIV-related stigma in the area (Kalichman and Simbayi 2003; Maman et al. 2001) and the accessibility of health services and testing facilities are crucial factors in the uptake of testing (Hutchinson and Mahlalela 2006). For example, treatment availability may strongly determine levels of testing.

Thus, based on existing research regarding individual determinants of testing uptake in various community-level studies, it is hypothesised that the uptake of testing will be positively associated with being female, reporting risky sexual behaviours, recent ill health and the awareness of treatment and negatively associated with living in a rural area and expressing stigmatising attitudes towards people living with HIV. The profile of those coming forward for testing has not previously been described at a nationally representative level in an African context, with the exception of married men in Uganda (Gage and Ali 2005).

The objectives of this analysis are to: (i) compare nationally representative trends in self-reported uptake of HIV testing and receipt of results in selected countries, (ii) characterise the profile of individuals who report to have tested for HIV with respect to socio-demographic characteristics and behavioural risk as well as expression of stigma and experience of AIDS.

Methods

Survey methodology

The Demographic and Health Survey (DHS) programme has been conducting household surveys since 1984 in developing countries. A wide range of demographic and reproductive health data are collected (Measure DHS 2009). A two-stage cluster design is

used to obtain samples which are representative at the national level, at the residence level (urban or rural) and at the regional level (Demographic and Health Surveys 1996). Given the focus of the survey, women of reproductive age (15-49 years) are the primary focus of the survey, although men aged 15-59 years are also included. Since 2001, survey questionnaires have included sections regarding HIV/AIDS and HIV testing. Standard questionnaires are used to allow for cross-country comparisons. Separate questionnaires are used for women and men.

Consenting participants provided blood for anonymous HIV testing, subsequent to the interview. Testing is carried out using dried blood spot samples of capillary blood from a finger prick collected on filter paper. A standard testing algorithm which uses two different HIV antibody enzyme-linked immunosorbent assays (ELISAs), based on different antigens, is used.

All participants receive referrals for free counselling, testing, and educational materials, whether or not they consent to anonymous testing. In some countries, mobile counselling and testing provided by the DHS programme, is made available after the interview, when the anonymous test has been completed.

Data and analysis

Surveys from 10 sub-Saharan Africa countries with data available on HIV testing and results collection were included in the analysis. The self-reported HIV testing data analysed here refer to a wide range of HIV testing services (e.g. from stand alone Voluntary Counselling and Testing (VCT) centres, from hospital- and clinic-based services, and through Prevention of Mother to Child Transmission programmes (PMTCT)), and not to the anonymous testing carried out through the DHS programme.

With regard to construction of the socio-demographic variables, a wealth index was used to capture poverty level. This index is constructed, by means of a principal component analysis, using any indicator variable that will reflect economic status (e.g. type of toilet and type of flooring) (Rutstein and Johnson 2004). Quintiles are calculated based on the

distribution of the household population, rather than on the distribution of households. To assess levels of uptake of HIV testing, participants were asked: Have you had a test for HIV before? This variable and data on receipt of test results were used to define an outcome variable for having tested and received the result (i.e. knowing one's status).

Univariate logistic regression models were fitted to analyse socio-demographic and behavioural characteristics, as well as expression of stigma and experience of AIDS, associated with the uptake of testing and results collection. Following this, a full model containing all variables identified *a priori* as characteristics of interest, with the aid of the conceptual framework, was fitted, to identify those characteristics which were independently associated with having received HIV testing & counselling. Multivariate results are presented for 4 countries: Zimbabwe, Lesotho, Rwanda and Senegal.

All analyses were carried out separately for males and females and restricted to the non-virgin population, as those who have never had sex have had no sexual exposure to HIV and thus are likely to have little impetus for seeking HIV counselling and testing. All analyses were carried out using sample weights provided by the DHS (Rutstein and Rojas 2006).

Results

Data overview and response rates

Table 1 shows the household and individual response rates for 10 completed surveys, as well as the response rates for HIV testing.

Country	Year	Household response rate (%)	Individual response rate (%)	N interviewed	N eligible for HIV testing	HIV response rate (%)
Zimbabwe	2005-06	95.0				
Male			81.9	7175	8761	63.4
Female			90.2	8907	9870	75.9
Senegal	2005	98.5				
Male			86.0	3761	4375	75.5
Female			93.7	14602	5350	84.5
Rwanda	2005	99.7				
Male			97.2	4820	4959	95.6
Female			98.1	11321	5837	97.3
Guinea	2005	99.2				
Male			94.5	3174	3360	88.2
Female			97.2	7954	4189	92.5
Cote D'Ivoire	2005	95.5				
Male			87.5	4503	5148	76.3
Female			89.8	5183	5772	79.1
Malawi	2004	97.8				
Male			85.9	3261	3797	63.3
Female			95.7	11698	4071	70.4
Lesotho	2004	95.2				
Male			84.6	2797	3305	68.0
Female			94.3	7095	3758	80.7
Cameroon	2004	97.6				
Male			93.0	5280	5676	89.8
Female			94.3	10656	5703	92.1
Kenya	2003	96.3				
Male			85.5	3578	4183	70.3
Female			94.0	8195	4303	76.3
Ghana	2003	98.7				
Male			93.8	5015	5345	80.0
Female			95.7	5691	5949	89.3

Table 1: Response rates, participation and HIV testing in selected DHS surveys. All data are unweighted, and are compiled from DHS country-specific data and final reports.
Footnote: All men in 50% of households were sampled in Rwanda, Guinea and Cameroon.

Overall, household response rates are high and range from 95.0% to 99.7%. In each survey, the individual response rate is higher among women than among men, and range from 81.9% among men in Zimbabwe to 98.1% among women in Rwanda. The largest gender differential in participation is observed in Malawi. HIV testing response rates

were lower than participation rates and ranged from 63.3% among men in Malawi to 97.3% among women in Rwanda. In each survey the HIV testing response rate was lower for men than for women.

Uptake overview

Levels of reported uptake of testing and results collection varied widely between countries (Figure 1). Uptake was highest among women in Rwanda, at 27.4% in 2005. The lowest levels of testing were observed in West African countries, Senegal and Guinea in particular. However, not all west African countries had low uptake; for example Cameroon had the third highest percentage of total persons tested. Overall, reported receipt of results was at a high level and ranged from 75% to 96%, with the exception of Senegal. Gender differentials in uptake were observed in many countries, for example, in Zimbabwe, Rwanda, Côte D'Ivoire, Lesotho and Cameroon, women were more likely to have tested and received their results, whereas, in Guinea uptake of testing and results collection was much higher among men.

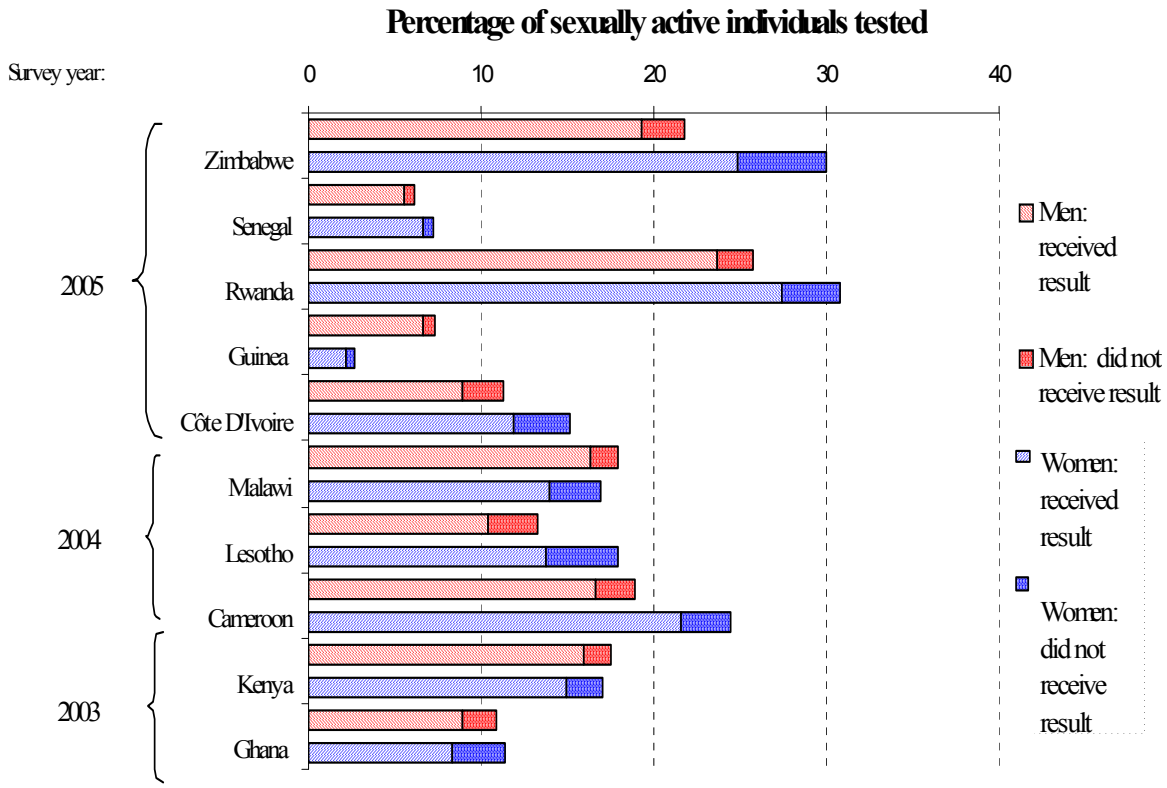

Figure 1. Uptake of testing and results collection among men and women in selected countries.

When asked about the last time they were tested, the majority of those who had tested reported to have done so within the last 12 months, indicating that increasing proportions of those knowing their status may be recent. Furthermore, within each survey, the majority of participants who reported not to have tested responded that they would like to be tested, indicating a considerable demand for HIV testing services.

Univariate analysis

Overall, positive individuals are more likely to have tested and received their results than negative individuals, with the exception of those in Senegal and Guinea (Figure 2). In countries with relatively low levels of HIV prevalence and low levels of testing, such as

those in west Africa, (i.e., Guinea, Senegal and Ghana), there is very large uncertainty around these odds ratios.

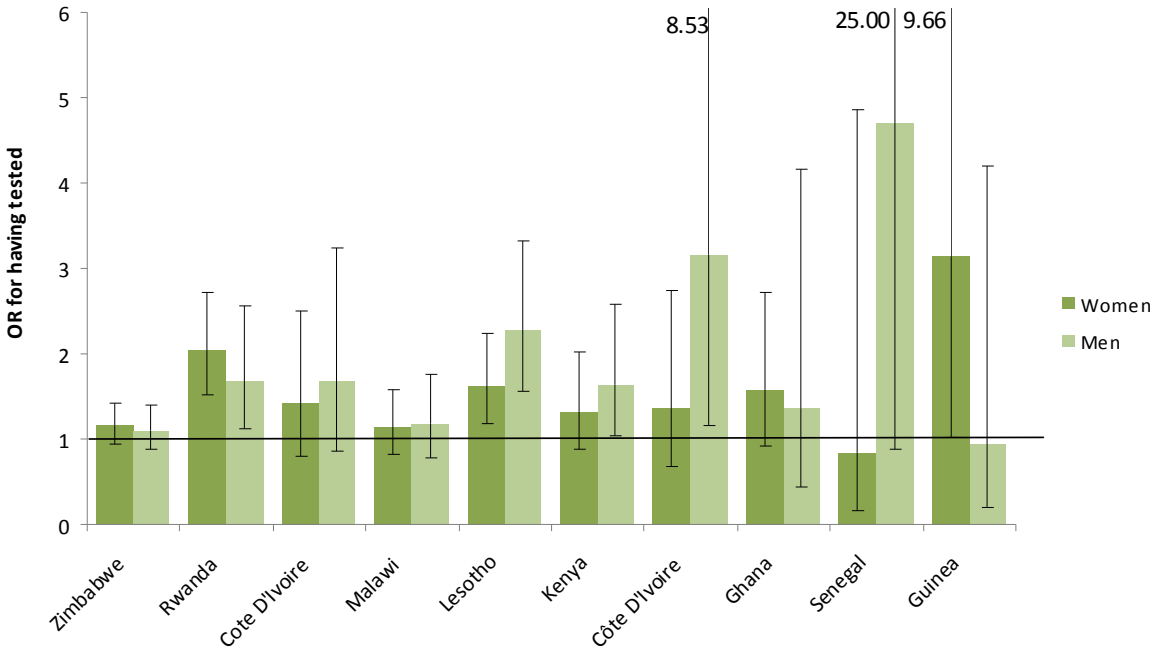

Figure 2. The odds ratios for having tested with respect to HIV status (positive vs negative), for men and women.

Among women, age was significantly associated with uptake of testing in all surveys. A decreasing level of uptake of testing and results collection with respect to increasing age was observed, with the exception of women in Senegal, where uptake was lowest amongst 15 to 24 year olds (Figure 3).

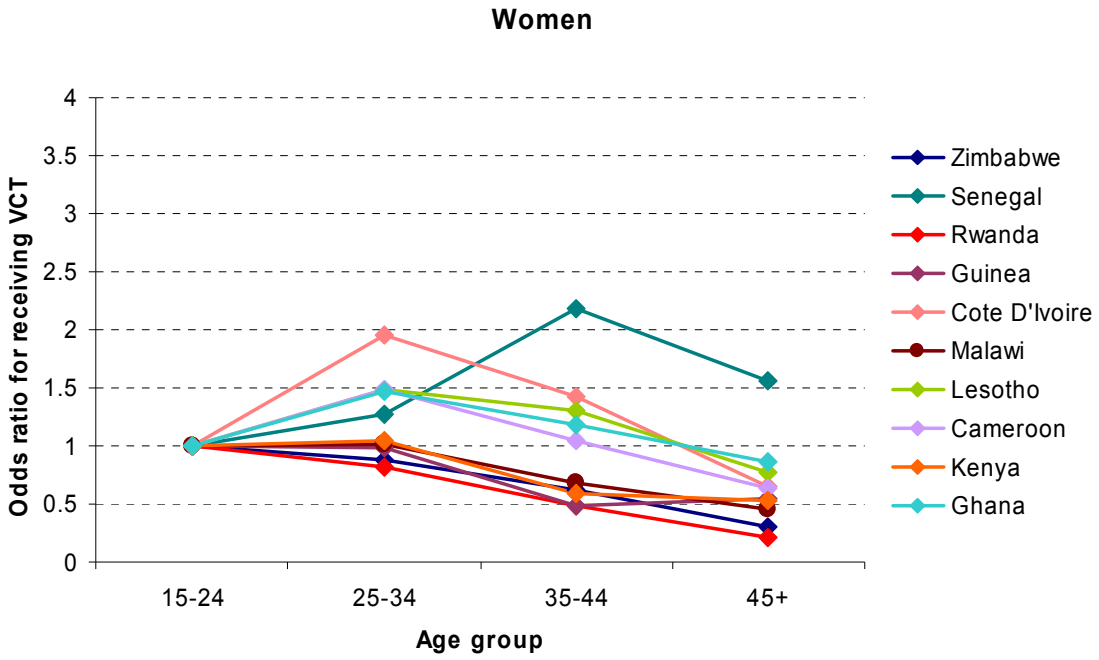

Figure 3. The odds ratio for having tested and received results by ten year age group, among women.

Among men, age was also significantly associated with uptake of testing, except in Guinea. The general trend was an increase in uptake from 15 to 24 up to 25-34, a subsequent plateau or slight decrease, followed by a decline in the oldest age group (Figure 4). This trend was most apparent in Lesotho. In general, men seeking testing were older than women seeking testing, across these 10 countries.

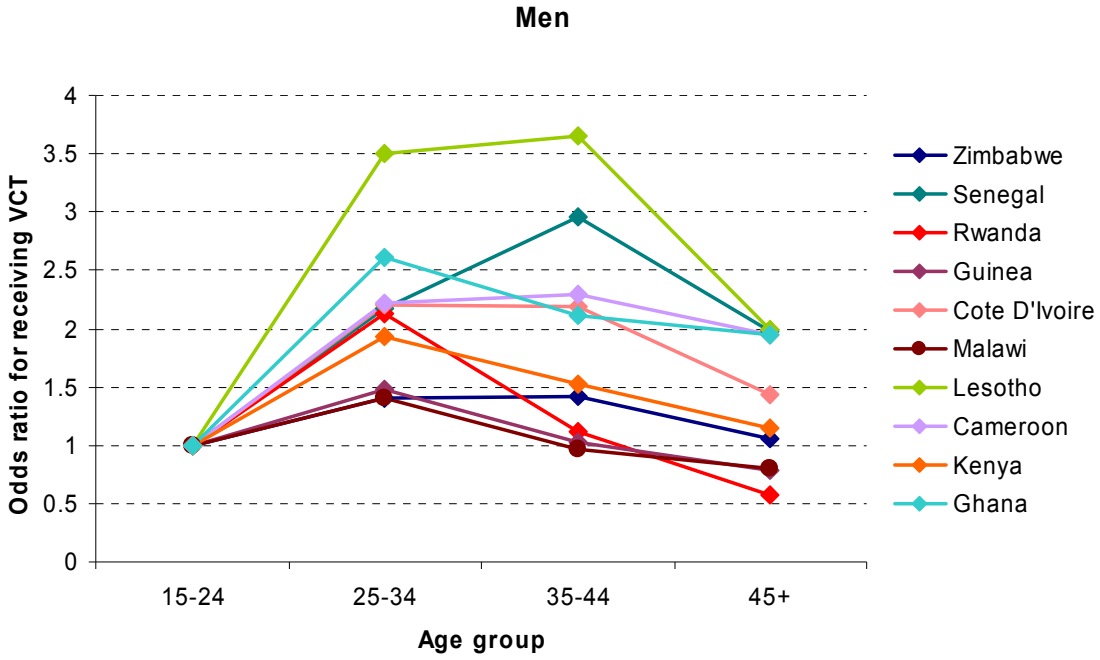

Figure 4. The odds ratio for having tested and received results by ten year age group, among women.

The majority of participants lived in rural areas, where uptake was significantly lower relative to those living in urban areas, in all surveys. Among women, the odds ratios (ORs) for uptake by residence (urban vs. rural) ranged from 1.7 in Lesotho to 5.2 in Rwanda, with Guinea being an outlier at 7.9 (figure 5). Similar trends were observed among men, where uptake in urban areas was between 1.9 and 4.3 times greater than in rural areas, in all countries The greatest differential with respect to urban or rural residence was observed in Guinea, among both men and women. Uptake was greatest in urban Rwanda at 58.6% and 41.9% among women and men, respectively. In addition to large differentials with regard to place of residence, strong regional differences within countries were also observed (i.e. much heterogeneity within rural areas).

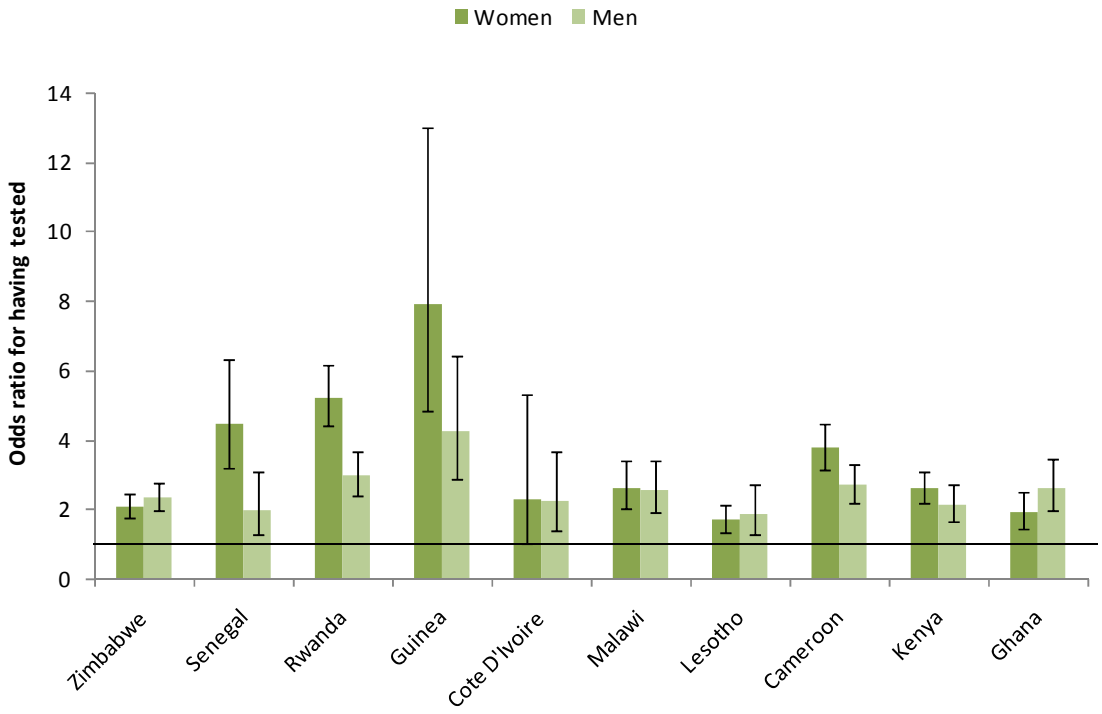

Figure 5. The odds ratio for having tested and received results by place of residence (urban vs rural), for women and men.

Among women a strong significant positive association between wealth quintile and uptake of testing was observed (figure 6). Those women in the richest quintile are more likely to have tested than those in the poorest quintile (OR range 2.8 – 33.7). However, these differentials were largest in the West African countries which had relatively low testing uptake compared to other sub-Saharan African countries.

Figure 6. The odds ratio for having tested and received results by wealth quintile, for women

A similar trend was observed for men with respect to wealth index. Although significant, the differentials in uptake were not as great as those for women. Uptake was between 3 and 7 times greater among those in the richest quintile as compared to the poorest (figure 7).

Figure 7. The odds ratio for having tested and received results by wealth quintile, for men

Overall, with respect to socio-demographic characteristics the trends observed were remarkably similar across all countries analysed, for both men and women. Reported uptake of testing and results collection was varied with respect to various indicators of sexual behaviour. However, it was not possible to establish the temporal relationship between the reported behaviour and receiving a HIV test. Those who reported that they did not know someone who has AIDS, or has died of AIDS, were much less likely to report having tested. This trend was consistent across all countries. Uptake of testing and results collection was significantly lower among those expressing stigmatising attitudes towards HIV. This was true across all countries for both men and women.

Multivariate analysis

Table 2 shows the adjusted odds ratios for the determinants of testing and results collection, for women and men in four selected countries. Although univariate analyses found a positive HIV status to be significantly associated with having tested among men and women in Lesotho and Rwanda (Figure 2), adjusted analyses showed that being infected was only independently associated with having tested among men and women in Lesotho.

Univariate analyses also indicated age to be a significant determinant of testing among men and women in each of these four countries. However, this association was no longer significant in multivariate analyses, among women in Lesotho and Senegal and men in Zimbabwe. In general, trends in uptake with respect to age differed for men and women, with uptake being greatest among younger women, but lowest among younger men, except for men in Rwanda. However, divergent trends were observed among men, as the OR for uptake among the oldest age group (45 years and older) as compared to the youngest (15-24 years) ranged from 0.20 for men in Rwanda to 19.53 for men in Senegal.

Increased odds of testing and results collection were consistently observed with increasing level of education for both men and women, in all four countries. Although reporting a third level education was infrequent, it was strongly associated with increased HIV testing and results collection (OR range: 1.49 – 50.62). Living in an urban area was also associated with increased uptake in all four populations, but only remained significant in adjusted analyses for Rwanda. Similarly, an increasing level of wealth was strongly associated with increased uptake, but this association only remained a significant determinant in adjusted analyses among men and women in Zimbabwe and in Rwanda.

Generally, there was mixed evidence with respect to marital status and behavioural indicators and testing uptake. There was no evidence to suggest that infrequently reported, but high-risk behaviours, such as paying for sex among men, were independently associated with uptake of testing. Reporting to have had an STD in the last year was generally associated, but not significantly, with increased uptake.

An awareness of the existence of treatment was independently associated with increased uptake among men and women in all four countries, with the exception of men in Senegal. Those who agreed with stigmatising attitudes, such as people with AIDS should be ashamed, were less likely to have tested, with the exception of women in Zimbabwe. However, this association only remained significant among women in Rwanda. Knowing someone who has, or has died from, AIDS was associated with increased uptake among men and women in all four countries, with the exception of men in Lesotho.

Overall, univariate analyses showed remarkably similar trends across countries and many of these associations persisted at the multivariate level. However, the determinants independently associated with testing and results collection differed greatly across countries. The most consistent independently associated characteristics associated with testing across countries, for both men and women were level of education and awareness that treatment for HIV exists.

Discussion

These analyses provide a cross-sectional illustration of the highly varied levels of uptake of HIV counselling, testing, and results collection in these 10 African countries, each of which represents a very different epidemiological context in terms of HIV prevalence and access to testing services. Overall, knowledge of serostatus was limited during this period. Despite considerable variations in the percentage of individuals who had tested, from 2% to 27%, crude analyses indicated the trends in socio-demographic profile of testers (well-educated, wealthier individuals living in urban areas) were remarkably similar across countries. However, for selected countries, many of these associations did not persist as significant determinants of testing in adjusted analyses. Despite large differentials in uptake with respect to level of wealth and living in an urban area versus a rural area, multivariate analyses indicate that a secondary or higher level of education and an awareness that treatment exists are the key determinants of testing, once other possible factors have been taken into account.

The socio-demographic and behavioural-risk profile of individuals who test for HIV has implications for HIV prevention and equitable access to treatment. In terms of prevention, these analyses showed the behavioural profile of those coming forward for testing to be mixed. It is encouraging that testing is not preferentially attracting a "worried-well" low-risk group, but on the other hand, evidence that some high-risk behaviours, such as transactional sex, are not prompting testing may be of concern. In terms of testing as a means of identifying those in need of treatment, an over-representation of infected individuals is encouraging. However, in terms of equitable access to treatment, the emergence of those in with little or no education, living in rural areas in the poorest households, who were unaware of treatment, as an under-represented group among the profile of testers, may also be of concern.

The strongest independent predictor of testing among both sexes is level of education. For example, when compared to those with primary education, women in Senegal who had a third level education had 50 times the adjusted odds of having tested, although the confidence intervals around this estimate are large due to the small number of women in Senegal who have a third level education. Education has been found to be a key driver of the uptake of testing in many other studies. (Gage and Ali 2005; Hutchinson and Mahlalela 2006; Matovu et al. 2005; Sherr et al. 2007; Weiser et al. 2006; Wringe et al. 2008). This indicates that there may be a need to increase the awareness of the benefits of counselling and testing in a way that is accessible to those with little or no formal education.

Increased uptake of testing among those living in urban areas, as compared to rural areas may be due to increased availability of services in urban areas as there is likely to be an urban bias in provision of testing services (i.e. initially setting up sites in urban areas and then gradually extending to rural areas). The finding that uptake increases substantially with increasing level of wealth is surprising, given that HIV counselling and testing services are generally provided for free. Disagreeing with stigmatising attitudes towards people with HIV was associated with increased odds of testing and results collection, but

not significantly so. This provides some evidence to suggest that AIDS-related stigma may be a barrier to testing in these populations.

Due to the cross-sectional nature of the data, a caveat regarding uptake with respect to HIV status is that some individuals may have seroconverted between the time they tested and when the DHS survey, and anonymous testing, was carried out. However, the majority of individuals reported to have tested quite recently (within the last year or two years), which would reduce this misclassification. Moreover, non-response for participation in the DHS HIV testing, among men in particular, may bias these results with respect to HIV status. However, it has recently been shown that non-response did not bias prevalence estimates in six selected DHS surveys, all of which are included in this analysis (Reniers and Eaton 2009). With respect to self-reported data regarding the uptake of testing, one may expect social desirability bias to lead to underreporting of testing among those who have previously tested positive.

In this analysis it was not possible to test the hypothesis that individuals, if infected, may only seek testing once they are showing symptoms of advanced HIV infection and suspect that they may be infected. However, a population-based study in Rakai, Uganda, has found evidence that counselling and testing is associated with reported illness and potential AIDS-related symptoms among women, but not men (Nyblade et al. 2001). It was also not possible to test the hypothesis that death of one's spouse may prompt an individual to seek testing. Although knowing someone who has, or has died from, AIDS was associated with increased uptake, data on the relationship to that person was not available. However, this indicator may be capturing denial of AIDS, rather than experiencing bereavement. For example, in Lesotho, only 28% of women and 29% of men reported knowing someone with, or who had died from, AIDS, despite Lesotho having high HIV prevalence.

A clear relationship between uptake of testing and prevalence at a national level is not apparent. Rwanda with a HIV prevalence of less than 5% had the highest level of uptake overall, whereas Lesotho, with the highest HIV prevalence had a much lower uptake.

However, provision of testing services and demand for testing also play an important role in determining the level of uptake of testing. The finding that an awareness of treatment is a predictor of testing is not surprising. However, none of these surveys were carried out in the context of treatment availability, although the timing of some surveys, such as that in Malawi, coincided with the initiation of ART programmes. Lack of treatment is a key impediment to uptake of testing, as in the absence of treatment, knowing that one is infected may be viewed as futile (Day et al. 2003).

A key determinant of testing, not included in these analyses, is availability of and access to testing services. Ideally, the denominator for these analyses would be those who have access to testing services and then analyse who chooses to test. Future analyses of testing uptake should focus on analysing the extent to which increasing availability of (i) testing services and (ii) ART, influences the profile of those who test.

As testing services and treatment become more widely available, uptake of testing is expected to increase. For example, in Botswana, a greater than two fold increase in testing prevalence was observed between 2001 and 2004, during which time universal access to ART and opt-out testing were introduced nationally (Weiser et al. 2006). However, even in this context, where knowledge of serostatus in a recent population-based study was 48%, significant differentials with respect to socio-demographic characteristics, HIV-related stigma and measures of healthcare access and utilization persisted.

The current levels of uptake of testing in these countries are certainly higher, as testing services continue to be scaled up in the context of the shift towards provider initiated opt-out testing and increased access to treatment. Monitoring the socio-demographic and behavioural characteristics of testers will provide useful information for the evaluation of these programmes. This work provides a baseline for monitoring trends in testing and exploring changes in the profile of those who get tested as provision of services increase.

ACKNOWLEDGEMENTS

We acknowledge ORC Macro for granting access to the DHS data. We wish to thank K. Marsh and J. Eaton for helpful discussions.

REFERENCES

Creek, T.L., R. Ntumy, K. Seipone, M. Smith, M. Mogodi, M. Smit, K. Legwaila, I. Molokwane, G. Tebele, L. Mazhani, N. Shaffer, and P.H. Kilmarx. 2007. "Successful introduction of routine opt-out HIV testing in antenatal care in Botswana." *J Acquir Immune Defic Syndr* 45(1):102-107.

Day, J.H., K. Miyamura, A.D. Grant, A. Leeuw, J. Munsamy, R. Baggaley, and G.J. Churchyard. 2003. "Attitudes to HIV voluntary counselling and testing among mineworkers in South Africa: will availability of antiretroviral therapy encourage testing?" *AIDS Care* 15(5):665-672.

De Cock, K.M., E. Marum, and D. Mbori-Ngacha. 2003. "A serostatus-based approach to HIV/AIDS prevention and care in Africa." *Lancet* 362(9398):1847-1849.

Demographic and Health Surveys. 1996. "Basic Documentation - 6. Sampling manual. Available at: http://www.measuredhs.com/pubs/pdf/DHSM4/DHS_III_Sampling_Manual.pdf."

Gage, A.J.and D. Ali. 2005. "Factors associated with self-reported HIV testing among men in Uganda." *AIDS Care* 17(2):153-165.

Hutchinson, P.L.and X. Mahlalela. 2006. "Utilization of voluntary counseling and testing services in the Eastern Cape, South Africa." *AIDS Care* 18(5):446-455.

Kalichman, S.C.and L.C. Simbayi. 2003. "HIV testing attitudes, AIDS stigma, and voluntary HIV counselling and testing in a black township in Cape Town, South Africa." *Sex Transm Infect* 79(6):442-447.

Makwiza, I., L. Nyirenda, G. Bongololo, T. Banda, R. Chimzizi, and S. Theobald. 2009. "Who has access to counseling and testing and anti-retroviral therapy in Malawi - an equity analysis." *Int J Equity Health* 8:13.

Maman, S., J. Mbwambo, N.M. Hogan, G.P. Kilonzo, and M. Sweat. 2001. "Women's barriers to HIV-1 testing and disclosure: challenges for HIV-1 voluntary counselling and testing." *AIDS Care* 13(5):595-603.

Matovu, J.K., R.H. Gray, F. Makumbi, M.J. Wawer, D. Serwadda, G. Kigozi, N.K. Sewankambo, and F. Nalugoda. 2005. "Voluntary HIV counseling and testing acceptance, sexual risk behavior and HIV incidence in Rakai, Uganda." *Aids* 19(5):503-511.

Measure DHS. 2009. "Available from: http://www.measuredhs.com/."

Morin, S.F., G. Khumalo-Sakutukwa, E.D. Charlebois, J. Routh, K. Fritz, T. Lane, T. Vaki, A. Fiamma, and T.J. Coates. 2006. "Removing barriers to knowing HIV status: same-day mobile HIV testing in Zimbabwe." *J Acquir Immune Defic Syndr* 41(2):218-224.

Nyblade, L.C., J. Menken, M.J. Wawer, N.K. Sewankambo, D. Serwadda, F. Makumbi, T. Lutalo, and R.H. Gray. 2001. "Population-based HIV testing and counseling in rural Uganda: participation and risk characteristics." *J Acquir Immune Defic Syndr* 28(5):463-470.

Reniers, G.and J. Eaton. 2009. "Refusal bias in HIV prevalence estimates from nationally representative seroprevalence surveys." *Aids* 23(5):621-629.

Rutstein, S.O.and K. Johnson. 2004. "DHS Comparative Reports. The DHS Wealth Index. Available at: http://www.measuredhs.com/pubs/pdf/CR6/CR6.pdf."
Rutstein, S.O.and G. Rojas. 2006. "Guide to DHS Statistics. Available at: http://www.measuredhs.com/pubs/pdf/DHSG1/Guide_DHS_Statistics.pdf."

Sherr, L., B. Lopman, M. Kakowa, S. Dube, G. Chawira, C. Nyamukapa, N. Oberzaucher, I. Cremin, and S. Gregson. 2007. "Voluntary counselling and testing: uptake, impact on sexual behaviour, and HIV incidence in a rural Zimbabwean cohort." *Aids* 21(7):851-860.

UNAIDS. 2001. "The impact of Voluntary Counselling and Testing: a global review of the benefits and challenges ". Geneva: UNAIDS.

UNAIDS "2006 Report on the Global AIDS Epidemic." Geneva: UNAIDS.

UNAIDS and WHO. 2007. "Guidance on provider-initiated HIV testing and counselling in health facilities."

Weiser, S.D., M. Heisler, K. Leiter, F.P. Korte, S. Tlou, S. Demonner, N. Phaladze, D.R. Bangsberg, and V. Iacopino. 2006. "Routine HIV Testing in Botswana: A Population-Based Study on Attitudes, Practices, and Human Rights Concerns." *PLoS Med* 3(7):e261.

WHO, UNAIDS, and UNICEF. 2007. "Towards Universal Access: Scaling up priority HIV/AIDS interventions in the health sector. Progress Report."

Wringe, A., R. Isingo, M. Urassa, G. Maiseli, R. Manyalla, J. Changalucha, J. Mngara, S. Kalluvya, and B. Zaba. 2008. "Uptake of HIV voluntary counselling and testing services in rural Tanzania: implications for effective HIV prevention and equitable access to treatment." *Trop Med Int Health* 13(3):319-327.

Adjusted odds ratios for hypothesised determinants of HIV testing for men and women in selected countires

Determinants	Zimbabwe		Lesotho	
	Women	Men	Women	Men
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
HIV status: positive vs negative	1.10 (0.86 - 1.40)	1.10 (0.83 - 1.47)	**1.50 (1.06 - 2.12)***	**1.85 (1.19 - 2.87)***
Demographic characteristics:				
Age group: 15-24	1	1	1	1
25-34	**0.72 (0.59 - 0.87)**	1.52 (1.00 - 2.30)* ‡	1.11 (0.71 - 1.71)*	**4.27 (1.94 - 9.39)***
35-44	**0.52 (0.39 - 0.69)***	1.37 (0.83 - 2.26)*	0.95 (0.60 - 1.49)*	**4.27 (1.72 - 10.60)***
45+	**0.30 (0.18 - 0.50)***	1.42 (0.81 - 2.49)	0.82 (0.43 - 1.57)	**3.52 (1.33 - 9.30)***
Education: none	0.88 (0.45 - 1.70)*	1.63 (0.37 - 7.07)	0.47 (0.14 - 1.57)*	0.66 (0.36 - 1.21)
primary	1	1	1	1
secondary	**1.61 (1.28 - 2.04)***	**1.76 (1.24 - 2.50)***	0.99 (0.70 - 1.41)*	**1.80 (1.10 - 2.95)***
higher	**4.13 (2.37 - 7.21)***	**3.16 (1.82 - 5.50)***	1.49 (0.50 - 4.38)*	2.50 (0.62 - 10.12)*
Marital status: married	1	1	1	1
never married	0.70 (0.36 - 1.36)	0.73 (0.38 - 1.41)	0.84 (0.44 - 1.61)	0.91 (0.42 - 2.01)*
previously married	0.96 (0.51 - 1.80)	**0.22 (0.07 - 0.65)**	1.20 (0.64 - 2.27)	1.58 (0.42 - 5.91)
Residence: urban vs rural	1.19 (0.75 - 1.87)*	1.14 (0.75 - 1.73)*	1.48 (0.99 - 2.20)* ‡	1.22 (0.70 - 2.14)*
Poverty: richest quintile vs poorest	**2.24 (1.29 - 3.90)***	**2.63 (1.35 - 5.13)***	1.41 (0.75 - 2.65)*	1.11 (0.47 - 2.63)*
Sexual health & behaviour:				
Condom use at last intercourse: yes vs no	0.86 (0.59 - 1.26)	**1.60 (1.14 - 2.25)***	1.37 (0.90 - 2.08)*	**1.81 (1.18 - 2.78)***
Extra-marital partners in last year: yes vs no	1.00 (0.60 - 1.66)	1.16 (0.70 - 1.92)	0.80 (0.48 - 1.33)	**0.54 (0.32 - 0.90)**
Lifetime partners:				
Women / Men				
1 / 1	1	1	—	1
2 / 2	0.94 (0.73 - 1.22)	0.71 (0.47 - 1.05)	—	1.23 (0.51 - 2.99)
>2 / 3	0.96 (0.71 - 1.30)	**0.64 (0.41 - 0.99)**	—	1.51 (0.64 - 3.54)
4		**0.48 (0.28 - 0.81)**		0.78 (0.30 - 2.05)
>4		0.81 (0.55 - 1.17)		1.28 (0.61 - 2.70)*
Ever paid for sex (men only): yes vs no	—	1.02 (0.48 - 2.14)	—	—
Had an STD in last year: yes vs no	1.20 (0.77 - 1.87)*	1.33 (0.64 - 2.77)	0.97 (0.44 - 2.16)	1.85 (0.65 - 5.28)
Treatment awareness: yes vs no/unsure	**1.84 (1.48 - 2.29)***	1.22 (0.92 - 1.62)*	**1.64 (1.15 - 2.34)***	**1.64 (1.07 - 2.50)***
Expression of stigma & experience of AIDS:				
People with AIDS should be ashamed: agree vs disagree/don't know	1.13 (0.91 - 1.41)*	0.96 (0.72 - 1.29)*	—	—
AIDS bereavement: yes vs no	1.08 (0.87 - 1.34)*	**1.32 (1.05 - 1.65)***	**2.15 (1.59 - 2.91)***	0.95 (0.57 - 1.58)*

Adjusted odds ratios for hypothesised determinants of HIV testing for men and women in selected countires

Determinants		Rwanda		Senegal	
		Women	Men	Women	Men
		AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
HIV status: positive vs negative		1.18 (0.71 - 1.94)*	0.99 (0.54 - 1.82)*	0.46 (0.03 - 8.26)	1.45 (0.18 - 11.66)
Demographic characteristics:					
Age group:	15-24	1	1	1	1
	25-34	**0.61 (0.47 - 0.80)***	0.83 (0.56 - 1.23)*	0.74 (0.28 - 1.95)	**17.91 (1.88 - 170.81)***
	35-44	**0.33 (0.24 - 0.44)***	**0.35 (0.23 - 0.54)**	2.33 (0.95 - 5.69)*	**22.76 (1.80 - 287.35)***
	45+	**0.13 (0.07 - 0.23)***	**0.20 (0.13 - 0.32)***	1.15 (0.41 - 3.25)	**19.53 (1.75 - 217.39)***
Education:	none	0.81 (0.62 - 1.05)*	0.77 (0.56 - 1.06)*	0.91 (0.37 - 2.22)*	0.89 (0.21 - 3.76)*
	primary	1	1	1	1
	secondary	**1.65 (1.15 - 2.36)***	**1.45 (1.03 - 2.04)***	**2.21 (1.12 - 4.36)***	**4.36 (1.13 - 16.80)***
	higher	7.73 (0.85 - 70.45)*	**4.47 (1.75 - 11.43)***	**50.62 (14.35 - 178.60)***	**9.40 (2.19 - 40.34)***
Marital status:	married	1	1	1	1
	never married	0.66 (0.31 - 1.40)	**0.43 (0.20 - 0.95)**	0.56 (0.05 - 5.78)	0.92 (0.10 - 8.25)*
	previously married	0.78 (0.30 - 2.05)*	2.35 (0.72 - 7.71)	**4.70 (1.95 - 11.34)***	
Residence:	urban vs rural	**3.68 (2.68 - 5.06)***	**1.77 (1.28 - 2.45)***	1.73 (0.71 - 4.20)*	1.01 (0.35 - 2.88)*
Poverty:	richest quintile vs poorest	**1.61 (1.09 - 2.37)***	**1.93 (1.29 - 2.88)***	3.24 (0.90 - 11.64)*	a
Sexual health & behaviour:					
Condom use at last intercourse [b] :	yes vs no	0.92 (0.51 - 1.66)*	**2.00 (1.05 - 3.78)***	2.04 (0.85 - 4.92)*	0.58 (0.07 - 4.71)
Extra-marital partners in last year:	yes vs no	0.79 (0.42 - 1.49)*	0.69 (0.40 - 1.19)*	0.93 (0.50 - 1.72)*	1.14 (0.34 - 3.91)
Lifetime partners:					
Women	Men				
1	1	1	1	—	—
2	2	1.06 (0.81 - 1.39)	**1.46 (1.08 - 1.98)***	—	—
>2	3	0.84 (0.56 - 1.26)	1.40 (0.98 - 2.00)*	—	—
	4		**1.99 (1.32 - 3.00)***		—
	>4		**1.74 (1.16 - 2.60)***		—
Ever paid for sex (men only):	yes vs no		1.02 (0.65 - 1.61)*	—	3.25 (0.35 - 29.95)
Had an STD in last year:	yes vs no	1.30 (0.54 - 3.14)*	1.86 (0.74 - 4.69)*	0.54 (0.12 - 2.40)	c
Treatment awareness:	yes vs no/unsure	**2.99 (2.06 - 4.35)***	**1.99 (1.23 -3.21)***	1.73 (0.98 - 3.06)* [‡]	0.97 (0.30 - 3.20)*
Expression of stigma & experience of AIDS:					
People with AIDS should be ashamed:	agree vs disagree/don't know	**0.75 (0.60 - 0.93)***	0.90 (0.70 - 1.16)*	0.60 (0.34 - 1.06)*	0.59 (0.23 - 1.54)*
AIDS bereavement:	yes vs no	1.26 (0.93 - 1.71)*	**1.98 (1.25 - 3.13)***	**4.01 (1.84 - 8.72)***	1.54 (0.57 - 4.21)

Table 2: Adjusted odds ratios for hypothesised determinants of HIV testing for men and women in selected countries.

In Lesotho, data on "People with AIDS should be ashamed" were not available for neither men nor women, lifetime partners data were not available for women, and ever paid for sex was not available for men. In Senegal data on lifetime partners were not available for neither men nor women. Bold type indicates differences significant at the 95% level

a Condon use refers to last partner, rather than specifically last sex, for men in Lesotho

b AOR = 2.26e+07 due to large differentials wrt level of wealth and <2% uptake in the reference group (poorest quintile)

c Variable dropped due to small sample size in comparison group (those reporting an STD in last year)

AOR Adjusted odds ratio

‡ Bordeline significance

* Indicates significant in univariate analysis ($p<0.05$)