The Impact of Learning HIV Status on Marital Stability and Sexual Behavior within Marriage in Malawi

Theresa Marie Fedor
Hans-Peter Kohler
Jere R. Behrman

March 30, 2012

Abstract

This paper assesses how knowledge of HIV/AIDS status is used among married individuals in ways that protect against HIV/AIDS risk. Utilizing a randomized experiment administered as part of the Malawi Longitudinal Study of Families and Health, we use two stage least squares probit models to estimate the effect that learning HIV status has on later chances of divorce, the number of sexual partners and the use of condoms within marriage. We find that knowledge of HIV status does not affect chances of divorce for either HIV negative or HIV positive respondents. Among HIV positive respondents, we observe increased condom use with spouses, as well as fewer sexual partners in the year of follow-up. HIV negative women also increase condom use with spouses after learning HIV negative status. These results imply an active response to learning HIV status that evokes protective behavior against future risk of HIV/AIDS for respondents and their spouses.

Introduction

In most of sub-Saharan Africa the risk of HIV/AIDS remains very high and many programs exist to promote preventative strategies in the form of behavioral changes such as the ABC's (abstinence, be faithful, and use condoms) of HIV/AIDS risk prevention (UNAIDS 2010). There has also been a push to promote and increase access to HIV/AIDS testing, or voluntary counseling and testing (VCT) (World Health Organization 2010). There are many potential benefits of increased HIV/AIDS testing, the most obvious of which is providing information to individuals about their own health status, giving them control over their own prevention and treatment. Provision of VCT is assumed to result in behavioral changes, such as the ABC's, that may prevent the further spread of HIV/AIDS. It is assumed that those who learn they are HIV positive will take precautions to protect others from future infection and that those who learn they are HIV negative will take measures to ensure their own protection (Thornton 2008). The validity of these assumptions is very difficult to assess, mostly because VCT produces self-selected samples of those seeking to know their HIV status (Kranzer et al. 2008). This selection bias in

the individuals who choose to be tested for HIV/AIDS exists because individuals who seek out testing may believe that they are at greater risk of HIV infection. For example, they may be more likely to suspect themselves of being HIV positive, to suspect a spouse of being HIV positive, or to suspect a spouse of being unfaithful. This self selection clearly biases conclusions about the effect of HIV testing on behavioral outcomes because the sample of individuals being tested is not random, and these individuals may differ in behavior as compared to those who are not tested. This has resulted in very little reliable evidence of the potential effect that VCT has on reducing HIV/AIDS risk and transmission. Furthermore, much of the evidence has been mixed (De Paula et al. 2011; Denison et al. 2008; Gregson et al. 1998; Grinstead et al. 2001; Porter et al. 2004; Stoneburner and Low-Beer 2004; Thornton 2008). This has lead to less enthusiasm for provision of VCT due to a lack of evidence of its efficacy in reducing HIV/AIDS risk, especially relative to other interventions whose effects are easily measurable, such as male circumcision, reductions in mother to child transmission and the role of antiretroviral treatment in reducing infectiousness (Behrman and Kohler 2011). However, we argue that provision of VCT is still an essential part of HIV/AIDS prevention and we find evidence that positive behavioral changes do occur after HIV status is known.

The main motivation of this paper is to assess how knowledge of HIV status is used within marriage and live-in partnerships in ways that may protect against HIV/AIDS risk. Results will contribute to knowledge about the degree to which assumed positive behavioral changes actually occur after HIV testing. We improve upon past research by measuring the effect of learning HIV status on behavioral change and protective efforts within marriage using a randomized experiment that circumvents issues of self selection into HIV testing. The analysis specifically assesses whether learning HIV status has an effect on later chances of divorce, the number of sexual partners after learning HIV status, or changes in condom use within marriage after learning HIV status.

We specifically focus on the effects of VCT on subsequent behavior within marital relationships for several reasons. First, since marriage is nearly universal in Malawi (Boileau et al. 2009; Macro International 2008), understanding how spouses respond to knowledge of HIV status is an important component of understanding HIV/AIDS transmission and prevention more generally. Second, some research suggests that most new HIV infections occur within marriage (Bongaarts 2007; Glynn et al. 2003), although these findings are somewhat contested. Third, individuals who are divorced are more likely to be HIV positive than individuals who are currently married or never married (Boileau et al. 2009; Macro International 2008). Even though it is well known that divorced individuals have higher rates of HIV/AIDS, the causal direction between divorce and HIV/AIDS risk is unclear (ibid.). Ambiguity exists as

to whether divorce leads to a higher risk of HIV infection, HIV infection leads to a higher risk of divorce or whether something else is driving both HIV risk and propensity to divorce. The use of longitudinal data and more rigorous statistical methods in order to clarify this causal direction is therefore an important aim for the current paper.

This paper is uniquely able to measure the impact of VCT on influencing subsequent behavior by using data from the Malawi Longitudinal Study of Families and Health (MLSFH).[1] MLSFH respondents were randomly incentivized through varying monetary rewards for picking up HIV test results and randomly varying distances to HIV result pick-up sites (or VCT sites). Respondents who came to pick up their results were motivated through these varied monetary incentives and distances to pick up site, rather than only being a self-selected group of individuals who chose to know their HIV status because of high perceived personal risk. The random incentives to learn one's HIV status effectively enable a reduction of the bias associated with self selection into HIV/AIDS testing. Furthermore, the longitudinal nature of the data allows for the investigation of the causal impact of learning one's HIV status on subsequent behavior as measured in follow-up waves of the survey. The most significant benefits of this study are the ability to address causality and to avoid the self selection problems associated with HIV testing by using the distance to the VCT center and the monetary incentives as instrumental variables in a two stage least squares estimation.

The findings presented here suggest that there is no effect of learning HIV status on divorce among HIV negative respondents, however, HIV negative women who learned their status are more likely to increase condom use with their spouse. HIV negative women are also more likely to have one partner during the year of follow-up, as compared to no partner. There are no observed behavioral changes among men after learning HIV status. There seems to be no effect of learning HIV status on the chances of divorce among HIV positive respondents. However, after learning HIV status, HIV positive individuals are more likely to increase condom use with their spouse or live in partner, and are likely to have fewer sexual partners after learning HIV status as compared to HIV positive respondents who did not learn their status. These findings support the assumptions made about behavior changes that could occur after provision of HIV testing, both in terms of the desire for HIV negative individuals to preserve their HIV negative status (at least for HIV negative women), as well as the uptake of altruistic behavior among HIV positive individuals who seem to take steps towards protecting their partners against HIV/AIDS infection.

[1] Also known as the Malawi Diffusion and Ideational Change Project or the MDICP

Literature Review

HIV Status and Divorce

In many places in sub-Saharan Africa, including rural Malawi, marriage is nearly universal (National Statistical Office (NSO) Malawi, and ORC Macro 2005). There is also a high amount of "churning" or divorce and remarriage (Ibid.). Furthermore, the likelihood of HIV infection is higher among those whose marriages have been disrupted. Individual who are divorced are more likely to be HIV positive than individuals who are currently married or never married (Boileau et al. 2009; Macro International 2008). However, it is difficult to determine the direction of causality that leads to the association between divorce and a greater likelihood of being HIV positive. It is conceivable that the risk of HIV/AIDS is higher because individuals who get divorced are simply more likely to have a higher number of sexual partners throughout their life, leading to higher chances of becoming HIV positive (divorce leads to HIV risk). It is also plausible that engaging in risky behavior, such as cheating on a spouse, leads to higher chances of both divorce and a higher risk of becoming HIV positive (risky behavior leads to both HIV risk and divorce). For example, there is a growing body of literature that describes ways in which individuals in high HIV risk populations may be turning to divorce as a preventative strategy, particularly for women who may use divorce as a means of reducing personal risk of HIV infection when they suspect their husbands of cheating (Reniers 2008; Schatz 2005; Smith and Watkins 2005). A third possibility is that knowledge of HIV status, in and of itself, leads to divorce. Several studies have provided evidence supporting this hypothesis, especially for HIV positive women (Gregson et al. 1998; Grinstead et al. 2001; Porter et al. 2004). In this paper we are able to test this specific possible relationship between divorce and HIV status. The first goal of this paper is to determine whether knowledge of HIV status affects subsequent chances of divorce among both HIV positive and HIV negative respondents.

Divorce has often been discussed as a risk management strategy for individuals protecting themselves against HIV risk (Gregson et al. 1998; Reniers 2008; Schatz 2005; Smith and Watkins 2005). Based on individual risk perception, one study finds that both men and women in Malawi increasingly use divorce as a risk aversion strategy (Reniers et al. 2009). Smith and Watkins find that women use divorce to reduce their risk of HIV infection, while men adopt other preventative behavioral changes, such as fewer partners or fewer extramarital partners, in order to mediate HIV risk (Smith and Watkins 2005). A similar study finds that women are less and less likely to tolerate their husband's extramarital partners due to the risk of HIV/AIDS, and use divorce as a means of reducing their risk when other

strategies to change their husband's behavior are unsuccessful (Schatz 2005). Furthermore, the cultural acceptance of women initiating a divorce may be increasing or only afforded to women in more recent times, specifically in cases of spousal infidelity because of the risk of their cheating spouse bringing HIV/AIDS into the household (ibid.).

However, from these studies we still cannot draw the conclusion that being HIV positive leads to divorce. It is quite possible that women divorce spouses because of the risky behavior itself, such as suspected infidelity, and not necessarily based on HIV status. Although changing social norms may now give women more freedom and choice to divorce based on concerns of HIV *risk*, it does not necessarily follow that women will divorce a spouse who is *known* to be HIV positive. It is still unclear whether HIV positive status, in and of itself, leads a spouse to divorce in an effort to protect him or herself from HIV risk. Conversely, it is not clear whether HIV negative status reduces the chance of divorce. There is reason to believe that individuals may actually be more likely to decide to stay with an HIV positive spouse, either to care for the spouse when he or she becomes ill, or under the assumption that both spouses must already be HIV positive if one spouse is HIV positive. One study found that religious leaders recommend divorcing a spouse suspected of infidelity, while remaining with a spouse known to be HIV positive in order to care for the spouse when he or she becomes sick with AIDS (Trinitapoli). This is described as a "window of opportunity" for preventing personal risk (Trinitapoli), and points to the difference in behavioral responses that may occur in situations in which risk is suspected, as compared to situations in which risk and HIV status are known. In contrast, other studies indicate that HIV positive individuals, especially women, suffer stigma and are more likely to get divorced after learning HIV positive status, although these studies were unable to fully correct for selection bias of those who chose to learn their HIV status (Gregson et al. 1998; Grinstead et al. 2001; Porter et al. 2004). The benefit of VCT is in providing individuals with concrete knowledge of HIV status, but given that risk perception is quite different from actual knowledge of HIV status, VCT also changes the situation considerably by moving from perceived risk to known risk. The first goal of this paper, of determining whether knowledge of HIV status affects subsequent chances of divorce among both HIV positive and HIV negative respondents, will provide solid empirical evidence of the chances of divorce after definite knowledge of HIV status.

HIV Testing and Counseling and Risky Behavior

After assessing the amount of divorce that is or is not occurring in response to knowledge of HIV status, we also seek to find out the degree to which other preventative measures are taken among both

HIV negative and HIV positive individuals in order to protect themselves and/or their spouses from HIV risk. If individuals remain married after knowledge of HIV positive status, the degree to which they are likely to reduce risky behavior is highly consequential. HIV positive individuals may be more likely to increase efforts to protect their spouse, such as through condom use within marriage, as well as more likely to decrease the number of other sexual partners / extra marital partners. For HIV negative respondents, those who learn their status may make an active effort to protect their HIV negative status, even if that means protection from their spouses suspected behavior through condom use within marriage. Given the variation in responses to risky behavior articulated in the existing literature, one might expect that women who suspect a spouse of cheating to either divorce the spouse or to actively take measures to protect themselves against a cheating spouse. The second and third goals of this paper are therefore to assess how gaining knowledge of HIV status through VCT affects condom use within marriage and the number of sexual partners each respondent has during a survey year following knowledge of HIV negative status.

The results from research concerning the effect of VCT on behavior are mixed. Some studies find that VCT has no effect on risky behavior, a negative effect, or mixed evidence of both positive and negative behavioral changes (Kabiru et al. 2010; Matovu et al. 2005; Sherr et al. 2007). However, the majority of studies find that VCT has a positive impact on reducing risky sexual behavior and increasing condom use (De Paula et al. 2011; Denison et al. 2008; Gregson et al. 1998; Grinstead et al. 2001; Porter et al. 2004; Stoneburner and Low-Beer 2004; Thornton 2008).

The studies that find a negative or neutral effect of VCT on subsequent behavior often have methodological and sampling issues that are difficult to overcome and that may result in biased conclusions. Matovu et al. (2005) find no effect of VCT on either subsequent risky behavior or on new HIV incidence. However, they do find that there is self-selection of individuals who accept VCT in the study. Sherr et al. (2007) find that HIV positive women reported an increase in protected sex, while HIV negative individuals were more likely to have an increased number of sexual partners after learning HIV negative status. Kabiru et al. (2010) found an increase in protected sex among ever-pregnant females, but an increase in unprotected sex and risky sexual behavior among never-pregnant females and among males. For never-pregnant females, this result may point to an important distinction, that learning HIV negative status may allow women to pursue fertility goals, even if these results are officially coded as "risky behavior." Kabiru et al. (2010) also found that repeated HIV testing was associated with decreased risky behavior, pointing to the fact that individuals who are more likely to be tested or to be tested repeatedly, also may be more likely to act on the information gained through testing in order to

protect themselves and others. While this clearly highlights the self selection that exists in those who choose to be tested for HIV, it simultaneously highlights the behavioral responsiveness to HIV testing that is possible. These mixed results may seem to indicate increased risky behavior among HIV negative individuals as an unintended response to VCT, however, consideration of the complicated nature of the issue is necessary, given both the self-selection into HIV testing that exists and the potential conflicts between less risky sexual behavior (such as condom use and a reduced number of partners) with fertility and relationship goals.

Positive behavioral changes after VCT and/or learning HIV status are also found in several studies. These studies find that VCT and knowledge of HIV status result in less unprotected sex and reductions in risky behavior (Denison et al. 2008; Grinstead et al. 2001; Stoneburner and Low-Beer 2004). In other studies, reduced risky behavior occurs only among HIV positive individuals, while increased risky behavior or no effect is observed among HIV negative individuals (De Paula et al. 2011; Thornton 2008). These findings highlight the importance of examining the effect of VCT separately for HIV positive and HIV negative individuals.

To summarize, individuals who choose to be tested may be more likely to be HIV positive, to suspect a spouse of being unfaithful or to suspect a spouse of being HIV positive. This self selection can bias conclusions about the effect that HIV testing has on behavioral outcomes. This may be why many studies show little to no effect of HIV testing on subsequent behavior change, or even an increase in risky behavior (Kabiru et al. 2010; Matovu et al. 2005; Sherr et al. 2007). By comparison, only a few studies were able to use a less biased sample, but all of these studies found a significant effect of HIV testing on behavioral change, often in the form of reduced risky behavior (De Paula et al. 2011; Grinstead et al. 2001; Thornton 2008). Only one of these studies, Gregson et al. (2001), assesses changes in marital status but they assess marital status changes after VCT but before knowledge of HIV status. Although it has been suggested in other studies that assess the association between HIV positive status and history of divorce that individuals are more likely to remain married to an HIV negative spouse, or conversely, other individuals are more likely to choose to divorce an HIV positive spouse (Gregson et al. 1998; Porter et al. 2004; Reniers 2008; Schatz 2005), these studies are only able to address association and are unable to determine whether HIV positive status leads to the decision to divorce.

The current study will be the first to assess marital status change after knowledge of HIV status using a less biased sample than what is usually available to researchers. By using a study that randomly incentivizes individuals to learn their own HIV status, the current study is effectively able to circumvent the bias associated with self selection into HIV/AIDS testing. This allows a much more robust measure of the effect of HIV status on subsequent behavior because the sample being observed is random. Using the randomized VCT pick-up of HIV test results from the 2004 wave of the Malawi Longitudinal Study of Families and Health (MLSFH), a more accurate assessment can be made of what happens to a marriage during the two years following knowledge of HIV status. By comparing the likelihood of divorce, condom use with a spouse and the number of sexual partners at follow-up between those who find out their HIV status as compared to those who do not find out their HIV status, we were able to assess the assumed behavioral responses to knowledge of HIV status within marriage.

The aim of this paper is to determine whether providing knowledge of HIV status through VCT will result in changes in behavior among married people. This study will assess how VCT might affect behavior for married individuals in ways that may reduce chances of future HIV/AIDS transmission. Specifically, this aim will be achieved by addressing three goals: (1) whether gaining knowledge of HIV status through VCT affects the decision to divorce, (2) whether gaining knowledge of HIV status through VCT affects the number of sexual partners afterwards, and (3) whether gaining knowledge of HIV status through VCT affects condom use within marriage and live-in relationships.

Materials and Methods

Data and Sample

The MLSFH is a longitudinal study in Malawi that began in 1998 and was repeated in five subsequent waves between 2001 and 2010. In 1998, the MLSFH randomly selected households from which to interview ever married women and their husbands in three districts of rural regions in Malawi: Rumphi in the northern region, Mchinji in the central region and Balaka in the southern region. A fair amount of attrition has occurred since 1998, mostly due to migration,[2] however, in 2004 the baseline characteristics of the respondents were still comparable to other surveys conducted in Malawi (Anglewicz et al. 2009). Concerns with attrition after 2004 are discussed in detail below.

[2] Of the 1998 respondents, 17.07% were not found for re-interview in 2001 because of migration, comprising the majority of the 23.03% of attrition between 1998 and 2001. Similarly, of the 2001 respondents found for interview, 14.13% were not found for re-interview in 2004 due to migration, again representing the majority of the 26.14% total attrition between 2001 and 2004.

This paper uses a subsample of data from the 2004, 2006 and 2008 waves of survey interviews, as well as the supplemental 2007 survey of migrants. The 2004 survey wave includes the experimental design that randomized monetary incentives, encouraging respondents to return for their HIV test results. The 2006, 2007 and 2008 waves of data were used to assess the following behavioral changes: marital status changes, changes in condom use with a spouse and the number of sexual partners at follow-up. The majority of respondents in the final sample were found in the 2006 wave of data (approximately 91 percent of the final sample), but if the respondents were not found or not available for re-interview in 2006, the 2007 data was used when possible. If the respondents were not re-interviewed in 2006 or 2007, the 2008 data was used when possible. The sample was restricted to individuals who were married in 2004, agreed to an HIV test,[3] provided basic demographic data in 2004 and were also re-interviewed in 2006, 2007 or 2008.

Variables

Descriptive statistics for all variables are presented in tables 1a, 1b and 1c, separated by HIV status, sex and outcome variable used in the final analysis. In the 2004 wave of data collection respondents were offered voluntary counseling and testing (VCT) for HIV/AIDS in the context of a randomized experiment. In the MLSFH, respondents who agreed to HIV testing (approximately 90%) were randomly assigned a monetary incentive for picking up their results a few weeks later. The incentives ranged from no incentive to 300 Malawian kwacha which was equivalent to approximately two days' wages for most rural Malawians in 2004 (approximately three U.S. dollars in 2004). The location for pick up of HIV test results was also randomly assigned to respondents and varied in distance from the respondent's homes. The average distance to VCT pick up location from the respondent's home was two kilometers (standard deviation 1.26) and the maximum distance was 5.2 kilometers, although over 90 percent of respondents lived under four kilometers from his or her assigned VCT pick up location. This randomized study design allows the investigation of the causal impact of learning one's HIV status on subsequent outcomes.

The distribution of the monetary incentives was non-normal, with discontinuities near zero and incentives clustered around 50, 100, 200, 250 and 300 Kwacha. For this reason, the incentives were categorized as no incentive, 10-50 Kwacha, 60-100 Kwacha, 110-200 Kwacha, or 200-300 Kwacha. A term for distance to VCT center squared was added to the models to adjust for the possibility of non-linearity in the relationship between learning HIV status and distance to VCT.

[3] Minus approximately 10 respondents whose results were indeterminate.

Marital status change from 2004 to follow up[4] was created using marital history information and is categorized as still married or divorced. Marital status changes between 2004 and follow up due to widowhood were excluded from the analysis, but these cases constituted less than one percent of the sample. The small number of widowed respondents alleviates concerns of unequal attrition of HIV positive respondents due to death. The divorced category includes individuals who got divorced between 2004 and follow up,[5] and also those who were divorced and remarried before follow up. Polygamous men are also included in the analysis. The divorced category for polygamous men includes all men who divorced *any* of their wives between 2004 and follow up. These distinctions capture all individuals who were divorced from the spouse they were married to in 2004, when they learned their HIV status.

Condom use specifically with husbands, wives and live-in partners in 2004, 2006 and 2007 was used to determine whether or not there was a change in condom use among those who were married in 2004. Questions about condom use within marriage were not asked in 2008. The question specifically asks, "Have you ever used a condom with [NAME]? If so, how often did you use a condom with

[4] The robustness of the outcome variable for marital status change between 2004 and each specific follow up wave was checked by creating the variable in two different ways. The first marital change variable was created using marriage histories. This involved combining information from several variables: whether the respondent was still married to each spouse listed, whether marital status change was due to divorce or widowhood and the year that marital status changes occurred. Cross checks with other marriage information provided further evidence for the data's internal consistency. Variables used for these comparisons included marital status at follow up, the number of times ever married in 2004 and follow up, and the total number of current wives for polygamous men. The second marital change variable was created using changes in spouse IDs across waves. Marital histories are imperfect because they are subject to the respondent's subjective interpretation of their marital status and past marital status. This is especially problematic for respondents who were not officially married, but were living with a partner in 2004 (and thus were listed as married in 2004), and were no longer living with the partner at the time of follow up. Even when someone was officially counted as a spouse in 2004, respondents did not necessarily still claim this past "spouse" in marital histories collected in the follow up surveys. For this reason, spouse ID changes across waves are inconsistent with marital history status changes and are not useful outside of serving as a checking mechanism. Marital histories are preferred over spouse ID changes since the source of marital history information is the respondent themselves, while spouse ID changes come from cross-survey data checks. The version of marital status change based on marital histories was ultimately used due to the preference for information based on the respondent's perception of his or her own marital history. Even though marital status change based on ID numbers was not used directly, the information gained from comparing both versions enabled a further check of the accuracy in the final version of marital status change subsequent to VCT testing.

[5] Divorces occurring after 2006, as picked up in the 2007 and 2008 follow-up surveys, were excluded from the analysis for two reasons. First, the inclusion of these cases would have been statistically problematic because they have a longer exposure time than respondents found in the 2006 follow-up. Second, the theoretical justification is weak for including divorces that occur during the four years following knowledge of HIV status, rather than the two years following knowledge of HIV status. To test whether divorce or remaining married is a response to learning HIV status, restricting the analysis to divorces that occur in a shorter time frame after VCT testing is a more reasonable focus. After the exclusion of cases based on other sample restrictions, only 7 divorces occurring in 2007 and 2008 were dropped.

[NAME]?" The response categories move loosely from low to high frequency and are as follows: never, at the beginning, sometimes, almost every time and every time. Two of the categories for condom use, "at the beginning" and "sometimes," are conceptually difficult to distinguish between, making an ordinal assumption about the variable problematic and measures of change between categories potentially inaccurate. For this reason, these two categories are merged together so that categories become: never, sometimes, almost every time, and every time. If a respondent indicates a higher frequency category in 2006 or 2007 as compared to 2004 then condom use is coded as increasing. An indicator variable was then created, indicating increased condom use versus decreased or consistent condom use. Several other specifications of condom use and change in condom use were tried, all of which resulted in the same substantive conclusions when used as an outcome.[6]

To create the variable for the number of sexual partners in the last 12 months during the follow-up survey, the following question was used from the 2006, 2007 and 2008 survey waves: "How many sexual partners did you have in the past 12 months?" The variable is used as an outcome in the current analysis in two different forms: a continuous form[7] as well as a dichotomous form indicating zero versus one sexual partner in the year of follow-up.[8] The need for both of these variables is based on gender differences in the reported number of sexual partners (see table 1c). Only 0.01 percent of women reported two or more partners, while sufficient variation existed between zero or one partners (6.2 percent of women reported zero partners). In contrast, 22 percent of men reported two or more partners, while only 0.01 percent of men reported zero partners. Given the distribution of the number of sexual partners found in the data, the outcome for zero versus one partner is used for women while the outcome in used in continuous form for men. Results for both outcomes are given for HIV positive respondents because it combines both men and women due to the small sample size of HIV positive respondents.

For clarification, the number of sexual partners in the last 12 months is measuring a different group of women than the variable for divorce. This is due to the degree of marital churning that occurs

[6] For example, the level of condom use was assessed as a continuous outcome at follow-up, plus several dichotomous outcomes were created indicating less condom use at follow-up, a change in condom use from "never" to any condom use at follow-up and a simple measure of any condom use at follow-up. Increase in condom use as compared to "consistent" condom use at follow-up, meaning no change in condom use from 2004 to follow-up, was also explored but the number of consistent users was relatively small and required the exclusion of those who decreased condom use at follow-up, leading us to ultimately choose the above specification.

[7] Another outcome created for the number of partners in the last 12 months was a dichotomous variable for 0 or 1 partners as compared to 2 or more partners. Results were similar to those using the continuous form of this variable.

[8] A variable indicating an increase in the total number of sexual partners ever was also created, as well as dichotomous versions of this measure. They were found to be inferior and inconsistent as compared to the variables for the number of sexual partners in the last 12 months, most likely due to issues with misreporting.

in rural Malawi and in the sample. Of those who divorced after 2004, approximately 80 percent of them remarried by the follow-up survey. The number of sexual partners at follow-up is different from divorce in that it categorizes women who remarried into the group of "one partner" rather than in the "divorced" category. Therefore, while divorce measures which relationships end, the number of sexual partners measures which women are more likely to have a consistent partner, either by maintaining their original relationship or by transitioning to a new relationship. There also may be differences in the degree of commitment in the report of the number of sexual partners in the last 12 months, meaning that less significant sexual encounters would be reported as well as marriages and live-in partnerships. Therefore, the number of sexual partners in the last 12 months may be a better indication of overall risk because it captures any sexual behavior.

Several other control variables are used in the analysis including age in 2004[9], region of residence and level of education in 2004.[10] Region of residence in 2004 is either Rumphi in the north, Mchinji in central Malawi or Balaka in the south. Level of education is grouped as no schooling, at least some primary school, or at least some secondary school.[11] The number of control variables used in the analysis is purposefully limited to these basic socio-demographic characteristics in order to avoid inclusion of endogenous variables in the first stage prediction of knowing HIV status.

Analyses of Attrition

Any longitudinal data suffers some sample attrition, which can bias analyses if those who attrite are systematically different from those who do not, based on either observed or unobserved characteristics (Alderman et al. 2001; Anglewicz et al. 2009). Migration attrition after the 2004 wave of data was a particular concern for this study because individuals who choose to migrate are more likely to be HIV positive and are also more likely to move because of divorce (Anglewicz 2010). Two things were done to alleviate concerns that results were biased due to uneven attrition either on these observed characteristics or on other unobserved characteristics. First, data from a 2007 follow up survey, which specifically attempted to find respondents who were not interviewed in 2006 due to migration, was added to the follow-up sample. Of the 2004 respondents used in this study, approximately 18% were not found for re-interview in 2006 because of migration, comprising the

[9] Age in 2004 was estimated by the interviewer for 40 respondents (2.2 percent of the total sample), 33 from a 2004 estimate and 7 from a 2008 estimate.

[10] Age and level of education are taken from the 2004 data, but missing values in 2004 for these variables are imputed from the 2006, 2007 and 2008 data. In total, this represents 0.4 percent of the age variable and 13.5 percent of the education variable.

[11] The category for more than secondary school includes individuals with any education past secondary school (n=2).

majority of the approximately 30% attrition between 2004 and 2006 (Ibid.). The 2007 migration study sought to interview respondents who migrated internally within Malawi[12] and successfully interviewed 56% of these respondents (Ibid.). By including the respondents found in the 2007 migration data, we reduce the potential bias due to migrants differing from non-migrants post 2004, as well as underrepresentation of divorced individuals and HIV positive individuals.[13]

The second means of alleviating concerns of attrition bias in our results was performing additional analyses of attrition. These analyses were based on similar tests of attrition bias performed by several previous studies (Alderman et al. 2001; Anglewicz et al. 2009). First, descriptive comparisons between those who were re-interviewed and those who were not re-interviewed are given in table 2. Second, a series of logistic regressions predicting attrition based on 2004 characteristics is given in table 3. Last, a series of OLS and logistic regressions predicting several outcomes of interest from the 2004 data, which are chosen based on their ability to reflect outcomes of interest in this study, are given in table 4. This last series of regressions includes a global interaction of attrition and shows the degree to which attrition biases coefficients in regressions measuring similar outcomes to the outcomes of interest used in the current study.

Two Stage Least Squares Estimation

The principal goal of this research is to investigate the causal effects of learning one's HIV status in 2004 on subsequent marital and sexual behaviors. In order to determine the effect of knowing one's HIV status on subsequent outcomes, a two stage least squares probit model is estimated.[14] In the first stage, the monetary incentives and distance to VCT center are used as instruments to predict the likelihood of picking up VCT results and learning one's HIV status. In the second stage of the model, the causal effect of learning one's HIV status on: (1) changes in marital status, (2) condom use within marriage and (3) the number of sexual partners during the follow-up year, are estimated using the first stage predicted values of learning one's HIV status. The first stage of the two-stage least squares specification is as follows:

$$\widehat{Know}_i = \alpha_0 + \alpha_1 IncentiveAmount_i + \alpha_2 Distance_i + \alpha_3 Distance_i^2 + \boldsymbol{\beta_n'} \boldsymbol{X_i} + \nu_i$$

[12] Of the migrants not found in 2006, only 11% moved outside of Malawi.

[13] The distribution of individuals by follow-up survey supports this point. It is shown in crosstabs with marital status and HIV status in appendix table A. Appendix table A shows that individuals found in the 2007 survey, as well as the 2008 survey, are more likely to have divorced after 2004 and are more likely to be HIV positive.

[14] With the exception of the continuous outcome for the number of sexual partners in the year of follow-up, in which a two stage least squares linear regression model is estimated.

where $\widehat{Know}_i$ is the predicted value of learning HIV status (binary variable for picking up VCT test results), $IncentiveAmount_i$ is the amount of the incentive offered (0-300 Kwacha), $Distance_i$ is the distance to VCT center and $\boldsymbol{\beta}_n \boldsymbol{X}_i$ is a vector of covariates where n is the coefficient for each covariate i (age, education level and region). The second stage of the two-stage least squares specification is as follows:

$$\Pr(Y_i = 1 \mid \boldsymbol{X}) = \Phi(\beta_0 + \beta_1 \widehat{Know}_i + \boldsymbol{\beta}_n \boldsymbol{X}_i),\ given\ \varepsilon_i \sim N(0,1)$$

where Y_i is the final outcome variable, $\widehat{Know}_i$ is the predicted value of learning HIV status as estimated in the first stage model and $\boldsymbol{\beta}_n \boldsymbol{X}_i$ is a vector of covariates where n is the coefficient for each covariate i (age, education level and region). In short, this equation states that the probability of divorce occurring is equal to the cumulative distribution function of a standard normal distribution (Φ), given that the error terms are normally distributed and conditioning on the observable variables. The use of a binary endogenous regressor in models with limited dependent variables is contested, but should still generate similar average effects regardless of the nonlinearity of the model (Angrist 2001).

Regular probit and linear regression models are also included in the analysis for comparison, with the expectation that coefficients will change in the IV probit and IV regression models due to a reduction in omitted variable bias. The analysis was divided by HIV status because it is expected that the propensity to divorce, use condoms or have more sexual partners after learning HIV status will be very different for HIV negative versus HIV positive respondents. The analysis was further divided by sex for HIV negative respondents because men and women are subject to different processes within marriage when making decisions about divorce and sexual behavior. The analysis was not subdivided by sex for HIV positive respondents because of the small sample size for those who are HIV positive. Marginal effects of both the regular probit models and the second stage IV probit models are reported in tables 6, 7 and 8.

Results

Analysis of Attrition

As a first step in assessing the degree to which attrition after 2004 creates bias in the sample used in this analysis, table 2 presents descriptive comparisons between those who leave the sample and those who were found for re-interview in 2006, 2007 or 2008. These descriptive comparisons are based on observed characteristics from the 2004 wave of data and, as expected, indicate some differences between those who left the sample and those who were found during one of the follow-up waves. Those who leave the sample are slightly older, more likely to be from Balaka and are more likely to have

either no education or more education than average. A series of outcomes from the 2004 data, which are conceptually similar to the outcomes from follow-up waves used in the analysis presented in the two stage least squares estimation, are also reported in table 2. Those who are not re-interviewed after 2004 are less likely to have agreed to an HIV test and had fewer sexual partners in the last 12 months compared to those who were re-interviewed after 2004. Furthermore, among those who agreed to an HIV test, those who were not found for re-interview were far more likely to be HIV positive, to have not returned for their HIV test results, to have been offered a lower incentive amount for returning and lived further from the VCT pick-up site.

Table 3 presents the results of several logistic regression models predicting attrition after 2004. The first four models represent the bivariate relationships between attrition and variables from the 2004 data that are conceptually similar to the outcome variables in the later analysis: ever divorced, ever used a condom with spouse and the number of sexual partners in the last 12 months. Additionally, the degree to which agreeing to an HIV test predicts attrition is also assessed. Those who have ever been divorced and those who refused an HIV test are more likely to have left the sample. Again, this is as expected based on previous research (Anglewicz 2010; Anglewicz 2012). Furthermore, those who have had more sexual partners in the last 12 months are slightly less likely to have left the sample, although these results are only marginally significant, at a p-value just under the 0.10 level. In the fifth model, all four of the previous variables are included simultaneously. Attrition is associated with refusing an HIV test, the number of sexual partners in the last 12 months loses all statistical significance, ever having divorced retains only marginal significance and ever having used a condom with one's spouse gains marginal significance. A similar pattern is observed in the eighth model, which includes all four variables discussed above as well as control variables for sex, age, region and education. The only difference in the eighth model is that the variable for ever used a condom with a spouse gains more statistical significance, indicating that those who have used a condom with their spouse are more highly associated with attrition. Models six and seven comprise a sample of only those who have agreed to an HIV test and assess how the results of the HIV test are associated with attrition. Both with and without control variables, being HIV positive is strongly associated with attrition. Those who attrite were also offered a slightly lower incentive amount, lived further from the VCT pick up site and were less likely to return to the VCT pick up site to learn their HIV status.

The analyses of attrition up to this point seem troubling, indicating that the most important variables in the current analysis are associated with attrition, including ever having been divorced, agreeing to an HIV test, HIV status itself and whether respondents returned to learn their HIV test

results. However, as recommended by Alderman et al. (2001), a third set of attrition tests can still help to determine whether these real differences in observable characteristics between those who attrite and those who do not, are large enough to actually bias the coefficients in regression outcomes. In table 4 we present a series of logistic and OLS regressions using the outcomes of particular interest noted above. Included in these models are interactions between attrition and every variable in the model so that the significance of the difference between the outcomes by attrition status can be thoroughly analyzed. The interactions between each of the predictor variables and attrition are at the top of the table, followed by the coefficient for attrition (the first order effects of the predictor variables are not shown). The interaction coefficients indicate which variables differentially affect the outcomes by attrition status. Very few of these coefficients are statistically significant. Attrition in the southern region of Balaka is associated with significantly lower chances of agreeing to an HIV test and ever having been divorced, while attrition in Balaka is associated with a marginally significant increase in the association with having ever used a condom with one's spouse. Those who have more education also exhibit a marginally significant association between attrition and having ever been divorced.

The Chi-squared tests for the joint effect of attrition on the constant and the coefficients, listed at the bottom of table 4, indicate whether or not each model, overall, is biased by attrition. This is the most direct measure of how much attrition may be biasing results. The most useful of these joint tests is the test for the effect of attrition on the coefficients only, which indicates whether there are significant differences in the outcomes between those who attrite and those who do not, as evidenced by the slope of the coefficients. If these tests fail to indicate a significant difference between the attrition group and the non-attrition group, then we have evidence that the outcome variables are not significantly biased by attrition. For all four outcomes tested (agreement to an HIV test, ever having used a condom with one's spouse, ever having divorced and the number of sexual partners in the last 12 months) the chi-squared and F tests for the joint effect of attrition on the coefficients fail to predict a statistically significant difference in estimates between the attrition group and the non-attrition group. Therefore, while those who were lost to follow-up differ along several observable characteristics from those who were found for re-interview, the resulting bias is too small to significantly affect the parameter estimates for the four outcomes.

Two Stage Least Squares Estimation

The results from the first stage models for all outcome variables are shown in table 5. These outcomes are, of course, very similar to each other and only differ in the sample size generated by

restrictions for each specific outcome. The amount of the monetary incentive affects the propensity to pick up HIV test results, with higher incentive amounts resulting in a greater likelihood of picking up results among all outcomes. The statistical significance of the coefficients in table 4 for the incentive amounts shows that this is a relevant predictor of the endogenous variable, learning HIV status. The distance to the assigned VCT center is a less effective instrument for predicting pick up of HIV test results, but shorter distances to VCT sites still increase the propensity to pick up results in some instances. For the outcome "number of sexual partners in the year of follow-up," the distance to VCT center has an effect in models for both HIV negative women and HIV positive respondents. Furthermore, the F-statistic values for the first stage models provide further evidence of the strength of the instruments in predicting the endogenous variable. Generally, F-statistics above ten are sufficient for the predictive power of the instruments (Wooldridge 2009). The F-statistics in the models for HIV negative men and women range from 37.06 to 21.90, indicating good prediction of learning HIV status. Therefore, we can be confident in the ability of the instruments to randomize the sample of individuals choosing to learn their HIV status, at least among HIV negative respondents. The models for HIV positive respondents yield less confidence, resulting in F-statistics between 8.86 and 5.69. This inadequacy will be revisited in a later discussion of the results. Overall, the first stage of the model gives good evidence that respondents were selected into learning their HIV test results based on the monetary incentives offered, making it less likely that they were selecting themselves into learning results based on unobserved characteristics.

Tables 6, 7 and 8 report the marginal effects for probit and second stage IV probit model predictions of learning HIV status on subsequent behaviors, with the exception of the outcome for the number of sexual partners in the year of follow-up, a continuous outcome, in which case OLS and second stage IV regression coefficients are reported. Table 6 reports results for HIV negative women, table 7 for HIV negative men and table 8 for all HIV positive respondents. All three tables report the effect of learning HIV status on divorce and on increases in condom use with one's spouse after 2004. The OLS and IV regression coefficients for the effect of learning HIV status on the number of sexual partners in the year of follow-up are also reported for HIV negative men and for HIV positive respondents (tables 7 and 8), but not for HIV negative women since only 0.01 percent of women reported more than one sexual partner during the year of follow-up (see table 1c). The variable for zero versus one sexual partner during the year of follow-up is reported for women instead (table 6), in order to more accurately represent the variation in the number of sexual partners for women. Similarly, the variable for zero versus one sexual partner during the year of follow-up is not reported for men, given

that only 0.01 percent of men reported zero sexual partners, while 22 percent reported two or more sexual partners (see table 1c).

Table 6 presents the second stage results for the effect of knowing HIV status on subsequent behaviors among HIV negative women. Model 1 and model 2 report the second stage probit and IV probit results for the effect of knowing HIV status on divorce among HIV negative women. Model 1 indicates that learning one's HIV status for the first time decreases the risk of divorce by 2.8 percent in the following two years among HIV negative women. However, results from the second stage IV model (model 2) do not retain statistical significance for HIV negative women. This highlights the selection bias present in the non-instrumented models and the reduction in that bias through the instrumentation of learning HIV test results. In model 3, there is also an association between HIV negative women who learn their HIV status and having one sexual partner versus no sexual partner in the year of follow-up. This result retains only marginal significance in the IV model, but still suggests that learning HIV status may increase chances of women having a partner by 6.5 percent. The result for condom use shows the opposite pattern from the other two outcomes for women, with a non-significant coefficient for learning HIV status in the regular probit model but a significant relationship between learning HIV status and an increase in condom use in the IV model. Model 6 shows that learning HIV status increases condom use with one's spouse for HIV negative women by 15.5 percent.

Table 7 presents the second stage results for the effect of knowing HIV status on subsequent behaviors among HIV negative men. The results for the effect of knowing HIV status on subsequent divorce among HIV negative men are not significant in the regular probit model or in the IV probit model, signifying that learning HIV status has no effect on propensity to divorce among HIV negative men. Similarly, the number of sexual partners in the year of follow-up is not affected by learning HIV status in the OLS model or the IV regression model. Model 5 indicates that men may appear to increase condom use with their spouse after learning of their HIV negative status based on the regular probit model, but this result does retain statistical significance in the IV probit model. This leads us to the conclusion that the result of the regular probit model were an artifact of the bias in those who return to pick up their HIV test results.

Table 8 presents the second stage results for the effect of knowing HIV status on subsequent behaviors for HIV positive respondents. Results from the probit model for divorce among HIV positive respondents are shown in model 1 of table 6. Similar to the results for HIV negative women, these results seem to indicate that learning one's HIV status for the first time decreases the risk of divorce in

the two years following by almost 14% among HIV positive respondents. Similar to the results for HIV negative women, results from the second stage IV model (model 2) do not retain statistical significance for HIV positive respondents. There seems to be no effect of learning HIV status among HIV positive men and women. The results for both the number of sexual partners in the year of follow-up and the condom use with one's spouse during the follow-up year show the opposite pattern, seeming to indicate that learning HIV status has no effect on influencing partner number or condom use in the regular probit and OLS models. However, both variables show marginal significance in the IV models. Learning HIV status decreases the number of sexual partners in the year of follow-up for HIV positive respondents, but not from one to zero partners, which is consistent with divorce results that indicate individuals are no more likely to dissolve existing relationships based on knowledge of HIV status. This is more likely an indication that individuals are less likely to have multiple partners or new partners at follow-up after learning of their HIV positive status. Learning HIV status increases condom use with one's spouse after 2004 by 39 percent.

The results for HIV positive respondents should be interpreted with caution, however, given the small sample size for HIV positive individuals and the low F-statistics from the first stage estimation of learning HIV status. As noted earlier, it would have been preferable to separate the analysis for men and women who are HIV positive. However, the small sample of HIV positive respondents, even when pooled for both men and women, still calls into question the validity of the results among those who are HIV positive. For example, the simplest calculation of the power of the HIV positive sample size for the divorce outcome (n=106) in detecting differences in divorce by knowledge of HIV status gives a power of only 0.59 at alpha = 0.10. The required sample size to attain a minimum desired power of 0.80, even at alpha = 0.10, is n = 156 at the minimum. This might also be an explanation for why the size and the significance of the coefficients for learning HIV status in the IV estimates are smaller than the regular probit models. If the IV probit models are underpowered, then the loss of size and significance for learning HIV status could be due to either a real difference in the models or to the small sample size.

Discussion and Limitations

The main motivation of this paper was to improve upon previous research measuring the effect of learning HIV status on later behaviors. Specifically, we sought to reduce the selection bias into HIV testing by using instrumental variables. The results from many studies are biased because they are unable to either eliminate selection, or to control for omitted variables that distinguish individuals who

seek out testing from those who do not. In contrast, conclusions regarding the effect that VCT testing has on marital stability and sexual behavior found in this study are more accurate.

After correcting for selection into HIV testing, we find that knowledge of HIV negative status among married women does not affect propensity to divorce. HIV negative women who know their status are not any less likely to divorce than HIV negative women who don't know their status. Before the correction for selection into HIV testing, the data indicated that HIV negative women who actually seek to know their HIV test results are less likely to divorce after learning their HIV negative status. This self selected group of women may display a difference in the desire to know their HIV status because of a strong perceived HIV risk or marital discord that already existed prior to testing. Seeking to learn HIV status in these cases may be a reaction to other events, such as turmoil within the marriage or risk perception, which are the actual drivers affecting chances of divorce. Therefore, although women who seek out testing might interpret their HIV negative status as proof of their spouse's faithfulness or as a reason not to divorce, learning HIV status does not independently influence marital stability for HIV negative women.

The number of sexual partners that a woman has during the year of follow-up adds to the story of how HIV status affects marital stability. As compared to HIV negative women who do not learn their negative status, HIV negative women who learn their status are more likely to have one partner as opposed to zero partners during the year of follow-up. Although the strength of the coefficient is reduced after adjusting for selection into learning HIV status, it is still marginally significant, suggesting that learning HIV negative status has an effect on partnership for HIV negative women. There are many reasons why this may be the case. Assurance of HIV negative status may be a signal to women about the faithfulness of their partner, making them more willing to stay with a partner. Alternatively, women who know they are HIV negative may feel more at ease with having a partner, knowing that they are not putting others at risk, or may feel more able to safely pursue their relationship and fertility intentions. Also, if HIV status is communicated to one's partner, men may see their partners' HIV negative status as an indication of their faithfulness and value as a partner, giving women greater status within their sexual relationships. If stigmatization of HIV positive women is partially driving the higher divorce rate among HIV positive women, as suggested in some previous research (Gregson et al. 1998; Porter et al. 2004), then it also makes sense that women who are known to be HIV negative are more highly valued in sexual relationships.

HIV negative women who learn their status are also more likely to increase condom use with their spouse or live-in partner during the year of follow-up as compared to HIV negative women who did not learn their status. Controlling for selection into HIV testing through the use of instrumental variables is especially important for the ability to accurately represent results in this case. In the regular probit model it appeared as though there was no effect of learning one's HIV status on condom use with spouses and live-in partners, but in the instrumental variable model we find a significant increase in condom use among HIV negative women who learn their status. This indicates that learning HIV negative status leads to active behavioral change for HIV negative women, with the goal of protecting themselves from the risk of HIV infection in the future. HIV negative women who know their status may have increased bargaining power within their relationships, making it possible to negotiate increased condom use in order to protect themselves against risk of future infection.

Overall, the effects of VCT are very encouraging for HIV negative women. In a context where there is a large amount of marital churning, it is not wholly unexpected to find that learning HIV negative status does not affect chances of divorce for HIV negative women. However, among those who divorce, knowing HIV negative status might improve a woman's ability and willingness to foster new relationships or to pursue fertility intentions, as evidenced by decreased chances of having no partner in the year of follow-up for HIV negative women who learn their status. The 16 percent increase in condom use with spouses and live-in partners observed among HIV negative women who learn their status is also a very promising result, indicating women's active participation in protecting themselves from future risk, at least within serious relationships.

The results are very different for HIV negative men. Learning HIV negative status appears to have no effect on divorce, the number of sexual partners in the year of follow-up or on condom use within marriage during the year of follow-up. Before adjustments were made for the selectivity of those who chose to know their HIV status, it appeared that HIV negative men who learned their status were more likely to increase condom use with their spouses and live-in partners, but the loss of significance for this result in the instrumental variable model leads to the conclusion that knowing HIV negative status has no direct impact on condom use within marriage for men.

For HIV positive respondents, we find that after correcting for selection into HIV testing, knowing HIV positive status has no effect on the propensity to divorce. Before controlling for selection into choosing to learn HIV status, those who are HIV positive appear to be slightly less likely to divorce. It is possible that those who seek out knowledge of HIV status, regardless of incentive amount received,

could be following the recommendations of religious leaders to get tested, and to stay with a spouse who is already HIV positive, in fulfillment of obligations to care for the sick (Trinitapoli). Of course, after controlling for selection into HIV testing, the lack of a significant difference between HIV positive individuals who learn their HIV status, as compared to those who do not learn their status, may indicate that only those who seek to know the results of their HIV test are actively using that information to make decisions about divorce. However, learning HIV positive status does result in fewer sexual partners during the follow-up year and a substantial increase in condom use with spouses and live-in partners, regardless of whether the individual was self motivated to learn their test results. The collective interpretation of these results is that married individuals who find out they are HIV positive are not more or less likely to divorce, but they are more likely to reduce risky behavior, such as multiple sexual partnerships, and they are likely to increase condom use with their spouse. This reflects the altruistic response to learning HIV status that is assumed in arguments to provide more access and promotion of VCT in areas of need. This reduction in the number of sexual partners and increase in condom use among married, HIV positive respondents is also supported by similar studies that find increases in preventative efforts among those who learn they are HIV positive (De Paula et al. 2011; Thornton 2008).

There are several potential limitations to this study. It is possible that the results from this study were underpowered for HIV positive individuals. Future research utilizing a larger sample of HIV positive individuals would be beneficial for assessing the effect of learning HIV positive status on marital stability and sexual behavior within marriage. The inability to separate the analysis for men and women among the HIV positive sample is not ideal either. It is unclear whether the results for divorce, for example, would have been different given the ability to separate the analysis by sex. In additional analysis, we did run models separated by sex for HIV positive respondents and the results seemed to indicate that HIV positive men may be significantly less likely to get divorced after learning HIV positive status, while there is no effect of learning HIV positive status on chances of divorce among HIV positive women (results not shown). Of course, these results were greatly underpowered, with sample sizes for men and women of 42 and 64, respectively. However, the observance of a difference between HIV positive men and HIV positive women follows the same pattern as was found in previous research that finds an increased chance of union dissolution for HIV positive women, but not for HIV positive men (Gregson et al. 1998; Grinstead et al. 2001; Porter et al. 2004), although the results differ in degree and the current study is more reliable in terms of being able to account for selection into HIV/AIDS testing. Reliance on self reported behavior is also a limitation of this study. It is well known that self reported sexual behavior is

often subject to inaccuracies (McCallum and Peterson 2012). However, differences between zero versus one partner for women should not be subject to the same degree of bias as other measurements, lending credibility to this aspect of the results. Furthermore, the conclusions for divorce are not subject to this bias.

It is also possible that there were other sources of learning HIV status. Respondents who did not pick up their VCT results from the 2004 MLSFH study could have learned their HIV status at another point in time before their next follow-up survey through MLSFH (meaning that there is heterogeneity in the endogenous variable). This would result in a downward bias in the results presented here. If we could be sure that those who did not pick up their HIV test results did not know their HIV status from any other source, at any time prior to the follow-up survey, then the results presented here would be stronger. This is a relevant concern given the general increase in the availability of HIV testing over time in Malawi and other parts of sub-Saharan Africa. Furthermore, the potential dilution of the presumed effect of picking up VCT test results in 2004 may be different for HIV positive respondents as compared to HIV negative respondents. HIV positive respondents potentially have a higher probability of seeking to learn HIV status outside of the VCT conducted as part of the MLSFH. It is also possible that HIV positive respondents were less likely to pick up their results in 2004 if they already knew their status from a test prior to the 2004 survey, although the majority of respondents indicated that this was their first HIV test. If any of these scenarios is true, then the effect of knowing HIV status on subsequent marital stability and sexual behavior for HIV positive respondents would again be biased downward, leading to conclusions of no effect even in cases where there is an effect. In short, if these downward biases did not exist, the concrete conclusions from this study would only be strengthened and the results that lack significance may have gained significance, indicating the existence of even more behavioral change, in addition to those that were already found.

Another potential limitation is that learning HIV status may not actually change belief of HIV status in the black and white manner that one would expect. Evidence has been found that even after learning of HIV positive status in 2004, a fair number of MLSFH respondents stated in 2006 that they had a low chance of being HIV positive (Delavande and Kohler 2011). Whether this response accurately reflects true belief, or whether it reflects social desirability bias in reporting of STI's, is unclear. However, if individuals learned their HIV status but did not truly believe the results, or if belief in results changed over time if illness and onset of AIDS did not occur, this would bias the results found here and could be responsible for the lack of significance in the results for divorce, especially among HIV positive respondents.

Another important point to recognize is the study design of this project. Although instrumental variable models reduce bias, they do not completely remove all bias stemming from omitted variables and selection. In general, the results of randomized experiments that incentivize certain behaviors, such as the one used in this analysis, have been highly contested (Deaton 2010; Easterly 2009; Heckman and Urzua 2009; Imbens 2010). It is possible that those at the margins of certain behaviors or characteristics may be more likely to engage in behavior that deviates from the norm in ways that specifically reduces the effectiveness of incentives designed to encourage pick-up of VCT results. This could lead to endogenity of the instruments if respondents choose to pick up results or not pick up results in a way that is still correlated with the heterogeneity in propensity to pick up HIV test results. Even though this may be true, it is also certainly true that the attempt to randomize the individuals who pick up HIV tests will result in a *less* biased sample, even if it is not a completely unbiased sample. Advocates of randomized experiments focus on the importance of the improvement in the ability to accurately measure the effect of such programs, and in the viability of results drawn from statistical methods that fully utilize the advantages inherent in such designs (Imbens 2010). In short, there is certainly value in study designs such as the MLSFH's randomized experiment for picking up VCT results. Admittedly, the study design does not magically eliminate all bias, but it does make significant progress in helping to resolve endogeneity issues and it results in improved measurement of the effect of HIV testing on behavioral change.

Conclusion

Results from this study support assumptions about behavioral changes that may occur after knowledge of HIV status is gained through VCT, while avoiding common methodological issues of selection into HIV testing, and also deciphering the causal direction between divorce and HIV positive status. Results are also useful in furthering our understanding of how married individuals react to information about HIV status and by giving further insight into the process by which HIV is spread. The decision to divorce or not to divorce based on knowledge of HIV status has consequences for HIV prevention and transmission. Assessing how individuals make decisions about partner retention and selection after gaining information about HIV status gives important insight into less obvious or direct aspects of future personal risk and the risk of future sexual partners. Combining this evidence with results about how gaining knowledge of HIV status affects the number of sexual partnerships and condom use within relationships, gives a clearer picture of how relationships and HIV prevention are jointly navigated in a high HIV context.

To summarize the results from this study, knowledge of HIV status does not lead to increased chances of divorce among married individuals who learn HIV status, regardless of whether that status is positive or negative. Unobserved characteristics of individuals who want to know their status are more likely to be responsible for the higher rates of divorce observed among HIV positive individuals.[15] The observed reduction in risky behavior among HIV positive respondents and HIV negative women, in the form of a reduced number of sexual partners during the year of follow-up among those who are HIV positive and increased condom use with spouses among HIV negative women and HIV positive respondents, are also important. Taken together, these results imply an active response to knowledge of HIV status that evokes behavioral responses that are self protective as well as altruistically driven attempts to reduce the risk of others.

The increased chance of HIV negative women to have one, rather than zero sexual partners during the year of follow-up is also very interesting. This seems to imply that women who know they are HIV negative have more social status and/or are more cognizant of the lack of risk they impose on others when making relationship and sexual partner choices. It is possible that HIV negative women who are unaware of their HIV status are more cautious in the absence of concrete knowledge of HIV status. These results are also interesting because it contradicts some of the previous research that finds an increase in risky sexual behavior among HIV negative respondents (De Paula et al. 2011; Kabiru et al. 2010; Sherr et al. 2007). It is also important to recognize the difference between measuring zero versus one partner, and measuring the number of partners continuously, because these two measures have very different implications. Taking a more holistic view, knowledge of HIV negative status allows women freedom to pursue relationship and fertility desires with their spouses and partners after alleviation of concern for their HIV status. Of course, in the absence of clear knowledge of a spouse's and partner's HIV status this may indeed be detrimental if the spouse is HIV positive and the couple assumes their HIV statuses must be the same. However, given the increase in condom use with spouse's and partner's among HIV negative women who learn their status, it seems that overall, individuals are making informed decisions about their sexual partnerships and their sexual behavior that result in an increase in risk aversive behavior.

The push to provide more HIV/AIDS testing is based on the assumption that HIV negative individuals will protect themselves against future risk of infection and HIV positive individuals will be altruistically motivated to take precautions to protect others. Results from the current study support

[15] Such as more risky sexual behavior or more sexual partners in the past.

these assumptions, at least within marriage. Several other studies also show that individuals who learn their HIV status are responding by taking precautions to protect themselves and others, including reductions in risky sexual behavior and increases in condom purchases, especially among HIV positive individuals (De Paula et al. 2011; Denison et al. 2008; Thornton 2008). It is also important to acknowledge that regardless of the outcomes, voluntary counseling and testing provides the opportunity to gain knowledge about one's own health, which is important for both prevention and treatment. Giving individuals the opportunity to gain knowledge and control of their own health will always be a positive result of VCT.

References

Alderman, H., J.R. Behrman, H. Kohler, J.A. Maluccio, and S. Watkins. 2001. "Attrition in Longitudinal Household Survey Data: Some Tests for Three Developing-Country Samples." *Demographic Research* 5(4):79-124.

Anglewicz, P. 2010. "Migration, Marital Dissolution, and HIV Infection in Malawi." *Unpublished Manuscript* .

Anglewicz, P., J. Adams, F. Obare, H. Kohler, and S. Watkins. 2009. "The Malawi Diffusion and Ideational Change Project 2004–06: Data collection, data quality, and analysis of attrition." *Demographic Research* 20:503-540.

Anglewicz, P. 2012. "Migration, Marital Change, and HIV Infection in Malawi." *Demography* 49(1):239-265.

Angrist, J.D. 2001. "Estimation of Limited Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice." *Journal of Business & Economic Statistics* 19(1):pp. 2-16.

Behrman, J. and H. Kohler. 2011. "Rethink HIV Assessment Paper: Sexual Transmission of HIV." Copenhagen Consensus Center and Rush Foundation.

Boileau, C., S. Clark, S. Bignami-Van Assche, M. Poulin, G. Reniers, S. Watkins, H. Kohler, and S. Heymann. 2009. "Sexual and Marital Trajectories and HIV Infection Among Ever-married Women in Rural Malawi." *Sexually Transmitted Infections* 85:i27-i33.

Bongaarts, J. 2007. "Late marriage and the HIV epidemic in sub-Saharan Africa." *Population Studies* 61(1):73-83.

De Paula, A., G. Shapira, and P.E. Todd. 2011. "How Beliefs about HIV Status Affect Risky Behaviors: Evidence from Malawi." *University of Pennsylvania* PIER Working Paper 11-005.

Deaton, A. 2010. "Instruments, Randomization, and Learning about Development." *Journal of Economic Literature* 48(2):424-455.

Delavande, A. and H. Kohler. 2011. "The Impact of HIV Testing on Subjective Expectations and Risky Behavior in Malawi." *Unpublished Manuscript* .

Denison, J.A., K.R. O'Reilly, G.P. Schmid, C.E. Kennedy, and M.D. Sweat. 2008. "HIV Voluntary Counseling and Testing and Behavioral Risk Reduction in Developing Countries: A Meta-analysis, 1990–2005." *AIDS and Behavior* 12(3):363-373.

Easterly, W. 2009. "Can the West Save Africa?" *Journal of Economic Literature* 47(2):373-447.

Glynn, J.R., M. Caraël, A. Buvé, R.M. Musonda, and M. Kahindo. 2003. "HIV Risk in Relation to Marriage in Areas With High Prevalence of HIV Infection." *JAIDS: Journal of Acquired Immune Deficiency Syndromes* 33(4):526.

Gregson, S., T. Zhuwau, R.M. Anderson, and S.K. Chandiwana. 1998. "Is there evidence for behavior change in response to AIDS in rural Zimbabwe?" *Social Science & Medicine* 46(3):321.

Grinstead, O.A., S.E. Gregorich, K. Choi, and T. Coates. 2001. "Positive and Negative Life Events After Counselling and Testing: the Voluntary HIV-1 Counselling and Testing Efficacy Study." *AIDS* 15:1045-1052.

Heckman, J.J. and S. Urzua. 2009. "Comparing IV with Structural Models: What Simple IV Can and Cannot Identify." *National Bureau of Economic Research Working Paper 14706* .

Imbens, G.W. 2010. "Better LATE Than Nothing: Some Comments on Deaton (2009) and Heckman and Urzua (2009)." *Journal of Economic Literature* 48(2):399-423.

Kabiru, C.W., N. Luke, C.O. Izugbara, and E.M. Zulu. 2010. "The correlates of HIV testing and impacts on sexual behavior: evidence from a life history study of young people in Kisumu, Kenya." *BMC Public Health* 10:412-423.

Kranzer, K., N. McGrath, J. Saul, A.C. Crampin, A. Jahn, S. Malema, D. Mulawa, P.E.M. Fine, B. Zaba, and J.R. Glynn. 2008. "Individual, household and community factors associated with HIV test refusal in rural Malawi." *Tropical Medicine & International Health* 13(11):1341-1350.

Macro International, I. 2008. "HIV Prevalence Estimates from the Demographic and Health Surveys." .

Matovu, J.K.B., 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* 19:503-511.

McCallum, E.B. and Z.D. Peterson. 2012. "Investigating the Impact of Inquiry Mode on Self-Reported Sexual Behavior: Theoretical Considerations and Review of the Literature." *Journal of Sex Research* 49(2):212-226.

National Statistical Office (NSO) Malawi, and ORC Macro. 2005. "Malawi Demographic and Health Survey 2004." .

Porter, L., L. Hao, D. Bishai, D. Serwadda, M.J. Wawer, T. Lutalo, R. Gray, and T.R.P. Team. 2004. "HIV Status and Union Dissolution in Sub-Saharan Africa: The Case of Rakai, Uganda." *Demography* 41(3):pp. 465-482.

Reniers, G. 2008. "Marital Strategies for Regulating Exposure to Hiv." *Demography* 45(2):417-438.

Reniers, G., T. Araya, Y. Berhane, G. Davey, and J.S. Eduard. 2009. "Implications of the HIV testing protocol for refusal bias in seroprevalence surveys." *BMC Public Health* 9:1-9.

Schatz, E. 2005. "'Take your mat and go!': Rural Malawian Women's Strategies in the HIV/AIDS Era." *Culture, Health & Sexuality* 7(5):479-492.

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.

Smith, K.P. and S.C. Watkins. 2005. "Perceptions of risk and strategies for prevention: responses to HIV/AIDS in rural Malawi." *Social Science & Medicine* 60(3):649-660.

Stoneburner, R.L. and D. Low-Beer. 2004. "Population-Level HIV Declines and Behavioral Risk Avoidance in Uganda." *Science* 304(5671):714-718.

Thornton, R.L. 2008. "The Demand for, and Impact of, Learning HIV Status." *American Economic Review* 98(5):1829-1863.

Trinitapoli, J. "AIDS & Religious Life in Africa: Rethinking How Demographic Processes Shape Religious Teachings and Authority." *Unpublished Manuscript* .

UNAIDS. 2010. "Report on the Global HIV/AIDS Epidemic." New York: World Health Organization and UNAIDS. Available online at http://www.unaids.org.

Wooldridge, J.M. 2009. *Introductory Econometrics: A Modern Approach*. 4th ed. Mason, OH: South-Western Cengate Learning.

World Health Organization. 2010. "Priority Interventions - HIV/AIDS Prevention, Treatment and Care in the Health Sector." V2. Available online at http://www.afro.who.int/en/clusters-a-programmes/atm/acquired-immune-deficiency-syndrome/aids-publications.html.

Table 1a. Descriptive Statistics for Divorce - Means and Standard deviations

	HIV negative women		HIV negative men		HIV positive	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Divorced between 2004 and follow-up	0.05	0.21	0.04	0.20	0.19	0.39
Returned for HIV Results/Know HIV Status	0.72	0.45	0.71	0.45	0.64	0.48
Incentive Amount Offered						
None	0.24	0.43	0.24	0.43	0.28	0.45
10-50 Kwacha	0.20	0.40	0.19	0.39	0.18	0.39
60-100 Kwacha	0.20	0.40	0.19	0.40	0.20	0.40
110-200 Kwacha	0.22	0.42	0.25	0.43	0.19	0.39
210-300 Kwacha	0.14	0.35	0.13	0.34	0.15	0.36
Distance to VCT center	1.96	1.23	2.05	1.28	1.86	1.35
Age	34.10	11.27	40.49	12.66	35.72	10.38
Region						
Mchinji (center)	0.30	0.46	0.30	0.46	0.27	0.45
Balaka (south)	0.36	0.48	0.35	0.48	0.46	0.50
Rumphi (north)	0.34	0.48	0.35	0.48	0.26	0.44
Education:						
No Education	0.27	0.44	0.17	0.38	0.23	0.42
Primary	0.67	0.47	0.68	0.47	0.70	0.46
Secondary or more	0.06	0.25	0.15	0.36	0.08	0.27
Observations	1,008		775		106	

Table 1b. Descriptive Statistics for Condom Use with Spouse - Means and Standard deviations

	HIV negative women		HIV negative men		HIV positive	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Increase in Condom Use with Spouse	0.15	0.36	0.16	0.37	0.28	0.45
Returned for HIV Results/Know HIV Status	0.75	0.43	0.73	0.45	0.70	0.46
Distance to VCT center	1.98	1.21	2.08	1.28	1.78	1.22
Incentive Amount Offered						
None	0.23	0.42	0.23	0.42	0.28	0.45
10-50 Kwacha	0.21	0.41	0.19	0.39	0.17	0.37
60-100 Kwacha	0.21	0.41	0.19	0.40	0.20	0.40
110-200 Kwacha	0.22	0.41	0.26	0.44	0.22	0.41
210-300 Kwacha	0.13	0.34	0.13	0.33	0.14	0.34
Age	34.35	11.20	40.79	12.60	36.53	9.97
Region						
Mchinji (center)	0.27	0.45	0.29	0.45	0.27	0.45
Balaka (south)	0.36	0.48	0.36	0.48	0.45	0.50
Rumphi (north)	0.36	0.48	0.36	0.48	0.28	0.45
Education:						
No Education	0.26	0.44	0.17	0.38	0.18	0.38
Primary	0.68	0.47	0.68	0.47	0.76	0.43
Secondary or more	0.06	0.25	0.15	0.35	0.07	0.25
Observations	758		595		74	

Table 1c. Descriptive Statistics for Number of Sexual Partners in follow-up year - Means and Standard deviations

	HIV negative women		HIV negative men		HIV positive	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Number of Sexual Partners in follow-up year						
Zero	0.050		0.013		0.159	
One	0.940		0.769		0.788	
Two	0.001		0.176		0.018	
Three	0.000		0.031		0.027	
Four or More	0.002		0.011		0.009	
Returned for HIV Results/Know HIV Status	0.72	0.45	0.71	0.45	0.63	0.49
Distance to VCT center	1.98	1.23	2.05	1.29	1.94	1.35
Incentive Amount Offered						
None	0.24	0.42	0.24	0.43	0.27	0.45
10-50 Kwacha	0.21	0.40	0.19	0.39	0.20	0.40
60-100 Kwacha	0.20	0.40	0.20	0.40	0.19	0.39
110-200 Kwacha	0.22	0.42	0.24	0.43	0.19	0.39
210-300 Kwacha	0.14	0.34	0.13	0.34	0.15	0.36
Age	34.10	11.33	40.55	12.71	35.44	10.00
Region						
Mchinji (center)	0.29	0.46	0.29	0.46	0.34	0.47
Balaka (south)	0.36	0.48	0.36	0.48	0.42	0.50
Rumphi (north)	0.35	0.48	0.35	0.48	0.24	0.43
Education:						
No Education	0.27	0.44	0.17	0.38	0.23	0.42
Primary	0.67	0.47	0.68	0.47	0.70	0.46
Secondary or more	0.07	0.25	0.15	0.36	0.07	0.26
Observations	1,004		750		113	

Table 2. 2004 Descriptive Statistics among those Married in 2004 by Attrition Status at Follow-up

	Re-Interviewed		Not Reinterviewed		Difference		
	Mean	Std Dev	Mean	Std Dev	Means	t-test	p-value
Male	0.42	0.49	0.39	0.48	0.03	1.49	0.14
Age	36.37	12.37	38.98	15.60	-2.61	-4.59	0.00
Region:							
Mchinji (center)	0.35	0.48	0.32	0.47	0.02	1.19	0.24
Balaka (south)	0.33	0.47	0.37	0.48	-0.04	-1.99	0.05
Rumphi (north)	0.32	0.47	0.31	0.46	0.02	0.81	0.42
Education:							
No Education	0.23	0.42	0.25	0.43	-0.02	-1.29	0.20
Primary	0.67	0.47	0.62	0.48	0.05	2.21	0.03
Secondary or more	0.10	0.30	0.13	0.33	-0.02	-1.62	0.11
Observations	2,637	79.93%	662	20.07%			
Outcomes of Interest:							
Agreed to HIV test	0.91	0.29	0.86	0.35	0.05	2.61	0.01
Ever used a condom with spouse	0.19	0.39	0.22	0.41	-0.03	-0.93	0.35
Ever divorced, as of 2004	0.40	0.49	0.45	0.50	-0.06	-1.64	0.10
Number of sexual partners in last 12 months	1.12	0.47	1.05	0.51	0.08	2.32	0.02
Among those who agreed to VCT:							
Distance to VCT center	1.99	1.26	2.32	1.41	-0.33	-3.52	0.00
Incentive Amount Offered	103.02	95.04	88.28	90.57	14.75	2.14	0.03
Returned for HIV Results/Know HIV Status	0.71	0.45	0.55	0.50	0.16	4.85	0.00
HIV Positive	0.06	0.23	0.22	0.42	-0.16	-8.83	0.00
Observations	1,889	90.04%	209	9.96%			

Table 3. Odds Ratios Predicting Attrition between 2004 and Follow-up among those married in 2004

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ever divorced	1.354**				1.401*	1.221	1.162	1.400*
	(0.181)				(0.244)	(0.235)	(0.242)	(0.264)
Ever used a condom with spouse		1.126			1.405*	1.197	1.285	1.530**
		(0.203)			(0.277)	(0.262)	(0.293)	(0.315)
Number of sexual partners in the last 12 months			0.785*		0.864	0.839	0.772	0.716
			(0.114)		(0.193)	(0.207)	(0.199)	(0.166)
Agreed to HIV test				0.606**	0.577**			0.584**
				(0.118)	(0.142)			(0.145)
HIV positive						4.679***	4.430***	
						(1.137)	(1.095)	
Incentive amount offered						0.998*	0.998**	
						(0.001)	(0.001)	
Distance to VCT center						1.267***	1.198***	
						(0.083)	(0.082)	
Returned for HIV test results						0.577***	0.565***	
						(0.116)	(0.117)	
Male							0.945	1.068
							(0.196)	(0.201)
Age							1.004	0.996
							(0.009)	(0.008)
Region (Mchinji)								
Balaka							1.514*	2.219***
							(0.369)	(0.471)
Rumphi							0.646	0.739
							(0.181)	(0.197)
Education (no education)								
Primary							1.228	1.338
							(0.296)	(0.289)
Secondary or more							0.828	1.085
							(0.398)	(0.463)
Constant	0.100***	0.102***	0.146***	0.188***	0.137***	0.077***	0.071***	0.109***
	(0.009)	(0.008)	(0.025)	(0.034)	(0.047)	(0.027)	(0.038)	(0.055)
Observations	2,450	2,193	2,410	2,356	1,957	1,759	1,756	1,954
Model Wald Chi-Squared	5.074	0.425	2.801	6.048	10.06	67.68	81.19	41.82
Model Wald p-value	0.0243	0.514	0.0942	0.0139	0.0395	0	0	8.09e-06
Pseudo R-squared	0.00314	0.000309	0.00178	0.00376	0.00912	0.0703	0.0857	0.0384
-2 Log Likelihood	-804.8	-687.5	-784.2	-800.4	-546.5	-447.4	-432.9	-523.0

Standard errors in parentheses; Reference categories in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4. OLS and Logit Models Predicting Key Outcome Variables by Attrition between 2004 and Follow-up among those married in 2004

	(1)	(2)	(3)	(4)
	Logit - Agreed to HIV test	Logit - Ever used condom with spouse	Logit - Ever divorced as of 2004	OLS - Num. of partners in last 12 months
Interactions with Attrition:				
Male*Attrition	-0.271	0.285	0.527	-0.031
	(0.454)	(0.427)	(0.335)	(0.069)
Age*Attrition	0.002	0.022	-0.010	-0.000
	(0.017)	(0.016)	(0.013)	(0.003)
Region Interactions:				
Rumphi*Attrition	-0.914	0.961	-0.470	-0.036
	(0.682)	(0.602)	(0.472)	(0.095)
Balaka*Attrition	-1.330**	0.931*	-0.758**	0.034
	(0.614)	(0.510)	(0.366)	(0.077)
Education Interactions (no educ):				
Primary*Attrition	-0.424	-0.607	-0.730*	-0.003
	(0.552)	(0.534)	(0.408)	(0.086)
Secondary*Attrition	-1.048	-0.281	-1.338*	0.224
	(0.797)	(0.827)	(0.773)	(0.145)
Attrition (effect of attrition on constant)	0.945	-0.881	1.355**	-0.098
	(0.958)	(0.854)	(0.665)	(0.139)
Constant	2.137***	-0.411	-2.528***	1.129***
	(0.318)	(0.268)	(0.205)	(0.042)
Observations	2,347	2,168	2,424	2,384
Model Wald Chi-Squared	15.92	116.7	343.2	.
Model Wald p-value	0.254	0	0	0
-2 Log Likelihood	-738.0	-994.5	-1463	-1506
Pseudo R-squared	0.0107	0.0554	0.105	
Adjusted R-squared				0.0650
Chi2 test for joint effects of attrition on (F test for OLS regression in model 4):				
Constant only	0.97	1.06	4.15	0.5
	[0.324]	[0.302]	[0.042]	[0.478]
Coefficients only, not constant	7.33	10.39	8.14	0.63
	[0.291]	[0.109]	[0.228]	[0.709]
Constant and coefficients	15.26	13.69	9.29	1.67
	[0.033]	[0.057]	[0.233]	[0.111]

Notes: Standard errors in parentheses; numbers in brackets [] represent probability > chi2; first order effects not shown; *** p<0.01, ** p<0.05, * p<0.1

Table 5. First Stage Estimates of Learning HIV Status

	Divorced after 2004			Number of sexual partners in year of follow-up / Zero versus one sexual partner in year of follow-up			Increase in condom use with spouse/partner after 2004		
	(1) HIV Negative Women	(2) HIV Negative Men	(3) All HIV Positive	(4) HIV Negative Women	(5) HIV Negative Men	(6) All HIV Positive	(10) HIV Negative Women	(11) HIV Negative Men	(12) All HIV Positive
Incentive Amount (relative to no incentive)									
10-50 Kwacha	0.333***	0.391***	0.324**	0.333***	0.384***	0.267**	0.340***	0.393***	0.372**
	(0.050)	(0.055)	(0.133)	(0.048)	(0.054)	(0.114)	(0.053)	(0.063)	(0.164)
60-100 Kwacha	0.478***	0.446***	0.684***	0.480***	0.442***	0.675***	0.452***	0.477***	0.720***
	(0.041)	(0.051)	(0.118)	(0.040)	(0.052)	(0.117)	(0.043)	(0.056)	(0.126)
110-200 Kwacha	0.531***	0.528***	0.706***	0.528***	0.531***	0.707***	0.510***	0.537***	0.617***
	(0.038)	(0.044)	(0.118)	(0.039)	(0.047)	(0.101)	(0.041)	(0.050)	(0.141)
210-300 Kwacha	0.576***	0.587***	0.591***	0.583***	0.580***	0.574***	0.518***	0.584***	0.645***
	(0.043)	(0.044)	(0.125)	(0.044)	(0.044)	(0.121)	(0.049)	(0.049)	(0.160)
Distance to VCT (km)	-0.073	-0.004	-0.164	-0.076*	-0.016	-0.251*	-0.070	0.024	-0.177
	(0.044)	(0.044)	(0.158)	(0.045)	(0.043)	(0.140)	(0.051)	(0.051)	(0.227)
Distance to VCT squared	0.010	-0.000	0.040	0.010	0.002	0.052**	0.008	-0.004	0.040
	(0.008)	(0.008)	(0.028)	(0.009)	(0.008)	(0.026)	(0.010)	(0.009)	(0.045)
Age	-0.001	0.002*	0.004	-0.001	0.002*	0.003	-0.001	0.002	0.004
	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)	(0.006)
Region (relative to Mchinji - central)									
Rumphi - north	-0.025	-0.072	-0.201	-0.020	-0.068	-0.153	0.005	-0.058	-0.165
	(0.038)	(0.048)	(0.149)	(0.039)	(0.049)	(0.124)	(0.042)	(0.053)	(0.153)
Balaka - south	-0.057	-0.068*	-0.237**	-0.059	-0.056	-0.175*	-0.011	-0.051	-0.229**
	(0.039)	(0.039)	(0.092)	(0.040)	(0.038)	(0.092)	(0.046)	(0.045)	(0.098)
Education (relative to no education)									
Primary	-0.095***	-0.046	-0.044	-0.101***	-0.040	-0.025	-0.081**	-0.048	0.044
	(0.028)	(0.036)	(0.089)	(0.030)	(0.038)	(0.101)	(0.033)	(0.036)	(0.143)
Secondary	-0.203***	-0.130**	-0.109	-0.224***	-0.132**	0.033	-0.246***	-0.179***	0.168
	(0.061)	(0.057)	(0.239)	(0.061)	(0.061)	(0.242)	(0.070)	(0.067)	(0.261)
Male			-0.054			0.032			-0.077
			(0.085)			(0.087)			(0.102)
Constant	0.581***	0.375***	0.384	0.591***	0.379***	0.424**	0.596***	0.327***	0.399
	(0.080)	(0.077)	(0.241)	(0.079)	(0.079)	(0.197)	(0.093)	(0.093)	(0.403)
Observations	1,008	775	106	1,004	750	113	758	595	74
R-squared	0.256	0.255	0.419	0.257	0.255	0.380	0.235	0.267	0.405
F-statistic	35.57	22.49	8.859	37.06	21.90	8.460	25.59	21.56	5.685

Note: Robust standard errors clustered by village are in parentheses. OLS coefficients reported for outcomes. Significance levels are as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Second Stage Estimates for HIV negative women

Outcomes:	Divorced after 2004		One sexual partner in year of follow-up (as compared to no partner)		Increase in condom use with spouse/partner after 2004	
	(1) Probit - HIV Negative Women	(2) IV - HIV Negative Women	(3) Probit - HIV Negative Women	(4) IV - HIV Negative Women	(5) Probit - HIV Negative Women	(6) IV - HIV Negative Women
Learned HIV Status	-0.028*	-0.019	0.051***	0.065*	0.033	0.155**
	(0.015)	(0.031)	(0.019)	(0.036)	(0.028)	(0.072)
Age in 2004	-0.001	-0.001	-0.001**	-0.002**	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Region (relative to Mchinji - central)						
Rumphi - north	-0.020	-0.023	0.009	0.012	0.132***	0.128***
	(0.014)	(0.018)	(0.018)	(0.020)	(0.042)	(0.038)
Balaka - south	0.040***	0.039***	-0.008	-0.009	0.055	0.049
	(0.014)	(0.013)	(0.019)	(0.021)	(0.034)	(0.033)
Education (relative to no education)						
Primary	0.011	0.013	0.017	0.020	0.041	0.053
	(0.013)	(0.015)	(0.018)	(0.019)	(0.030)	(0.032)
Secondary	0.047	0.040	0.024	0.038	0.112	0.123**
	(0.046)	(0.029)	(0.018)	(0.037)	(0.078)	(0.062)
Constant						
Observations	1,008	1,008	993	993	758	758
R-squared						
Pseudo R-squared	0.0573		0.0568		0.0716	
Chi-Squared	31.03		32.18		38.56	
Chi-Squared p-value	2.50e-05		1.51e-05		8.72e-07	
Model Wald Chi-Squared		.		21.38		.
Model Wald p-value		.		0.0016		.

Note: Robust standard errors clustered by village are in parentheses. Marginal effects are reported for all binary outcomes, OLS coefficients reported for continuous outcomes. Significance levels are as follows: *** p<0.01, ** p<0.05,

Table 7. Second Stage - HIV negative men

Outcomes:	Divorced after 2004		Number of sexual partners in year of follow-up (continuous)		Increase in condom use with spouse/partner after 2004	
	(1) Probit - HIV Negative Men	(2) IV - HIV Negative Men	(3) OLS - HIV Negative Men	(4) IV - HIV Negative Men	(5) Probit - HIV Negative Men	(6) IV - HIV Negative Men
Learned HIV Status	0.015	0.031	-0.063	-0.040	0.066**	0.028
	(0.013)	(0.037)	(0.052)	(0.103)	(0.033)	(0.078)
Age in 2004	-0.001**	-0.002**	-0.002	-0.002	-0.006***	-0.006***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Region (relative to Mchinji - central)						
Rumphi - north	-0.003	-0.002	0.188**	0.191***	0.103**	0.093**
	(0.018)	(0.020)	(0.072)	(0.072)	(0.044)	(0.039)
Balaka - south	0.004	0.005	0.130*	0.130*	0.038	0.037
	(0.016)	(0.018)	(0.067)	(0.067)	(0.036)	(0.034)
Education (relative to no education)						
Primary	0.021	0.026	-0.059	-0.058	-0.051	-0.052
	(0.016)	(0.021)	(0.092)	(0.091)	(0.050)	(0.046)
Secondary	0.020	0.022	-0.116	-0.112	-0.027	-0.037
	(0.029)	(0.024)	(0.124)	(0.125)	(0.062)	(0.070)
Constant			1.352***	1.336***		
			(0.136)	(0.152)		
Observations	775	775	750	750	595	595
R-squared			0.017	0.017		
Pseudo R-squared	0.0360		.		0.0529	
Chi-Squared	10.69		.		22.27	
Chi-Squared p-value	0.0985		0.0565		0.00108	
Model Wald Chi-Squared		.		13.09		.
Model Wald p-value		.		0.0417		.

Note: Robust standard errors clustered by village are in parentheses. Marginal effects are reported for all binary outcomes, OLS coefficients reported for continuous outcomes. Significance levels are as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 8. Second Stage - HIV positive for men and women combined

Outcome:	Divorced after 2004		Number of sexual partners in year of follow-up (continuous)		One sexual partner in year of follow-up (as compared to no partner)		Increase in condom use with spouse/partner after 2004	
	(1) Probit - All HIV Positive	(2) IV - All HIV Positive	(3) OLS - All HIV Positive	(4) IV Reg - All HIV Positive	(5) Probit - All HIV Positive	(6) IV - All HIV Positive	(7) Probit - All HIV Positive	(8) IV - All HIV Positive
Learned HIV Status	-0.136*	-0.065	-0.084	-0.350*	0.096	-0.185	0.151	0.388*
	(0.074)	(0.157)	(0.124)	(0.181)	(0.060)	(0.124)	(0.098)	(0.222)
Male	-0.078	-0.078	0.513***	0.529***	0.248***	0.365***	0.286**	0.247***
	(0.073)	(0.079)	(0.156)	(0.147)	(0.068)	(0.098)	(0.128)	(0.090)
Age in 2004	-0.004	-0.005	-0.009*	-0.008	-0.004	-0.005	-0.012*	-0.011**
	(0.004)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.007)	(0.005)
Region (relative to Mchinji - central)								
Rumphi - north	-0.002	0.014	0.276**	0.205	0.118**	0.135	0.213	0.246**
	(0.115)	(0.127)	(0.133)	(0.141)	(0.050)	(0.123)	(0.145)	(0.101)
Balaka - south	0.002	0.004	0.215*	0.203	0.086	0.077	-0.097	-0.061
	(0.077)	(0.079)	(0.124)	(0.131)	(0.067)	(0.101)	(0.128)	(0.100)
Education (relative to no education)								
Primary	0.024	0.030	0.000	-0.010	-0.032	-0.053	-0.124	-0.114
	(0.092)	(0.092)	(0.091)	(0.088)	(0.062)	(0.070)	(0.208)	(0.176)
Secondary	0.048	0.057	-0.083	-0.117	-0.350	-0.269	-0.251**	-0.343
	(0.204)	(0.186)	(0.298)	(0.296)	(0.315)	(0.185)	(0.100)	(0.242)
Constant			0.990***	1.146***				
			(0.205)	(0.214)				
Observations	106	106	113	113	107	107	74	74
R-squared			0.169	0.126				
Pseudo R-squared	0.0704		.		0.194		0.125	
Chi-Squared	9.185		.		16.37		8.247	
Chi-Squared p-value	0.240		0.105		0.0219		0.311	
Model Wald Chi-Squared				16.54		32.94		
Model Wald p-value				0.0206		0.000		

Note: Robust standard errors clustered by village are in parentheses. Marginal effects are reported for all binary outcomes, OLS coefficients reported for continuous outcomes. Significance levels are as follows: *** p<0.01, ** p<0.05, * p<0.1.