# Health Worker Absence, HIV Testing and Behavioral Change: Evidence from Western Kenya*

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**Abstract**

HIV testing and counseling for pregnant women has been scaled-up in sub-Saharan Africa on the grounds that it enables the delivery of medicines that prevent mother-to-child transmission of the virus and promotes behavioral changes among tested women. This paper uses longitudinal data from a high HIV prevalence region

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to study the take-up of HIV testing and the impact of learning HIV status on a wide array of behavioral outcomes. We show that health-worker absence is one of the important barriers to take-up of testing among pregnant women. Using health worker absence as an instrument for the endogenous choice of getting tested, we show that learning one's HIV status results in significantly higher probabilities of receiving medication that can prevent the transmission of HIV from mother to child as well as other valuable health services at the time of delivery. In contrast when we analyze the impact of learning HIV status on changes in sexual behavior we find reductions in condom use for women who test HIV-positive, which may imply an increase in new infections. Finally, we analyze the impact of testing information on investment decisions at the household level. We find that when women test negative for HIV there is an increase in children's schooling and livestock holdings, consistent with theory regarding life expectancy and intertemporal consumption and savings behavior.

# 1 Introduction

In recent years, through the combined effort of international organizations and national governments, considerable progress has been made in the fight against HIV/AIDS in developing countries. Perhaps most prominently, the availability of highly active antiretroviral therapy (HAART) to treat people with AIDS has expanded rapidly with coverage rates reaching nearly 30 percent in developing countries by the end of 2006. However, since treatment requires a substantial commitment of resources for the lifetime of the patient and 1.7 million adults and children became newly infected with HIV in sub-Saharan Africa alone last year, a number of authors have argued that the current mix of interventions is sub-optimally weighted towards treatment rather than HIV prevention (see, for example, Canning, 2006).

In order to be successful, interventions that seek to prevent HIV infection must generally bring about voluntary individual-level changes in sexual behavior (the prevention of mother-to-child transmission of HIV, as we note below, is an important exception). The provision of information has therefore been a key element of many prevention interventions, with the rationale being that individuals who are provided with information about risk-reducing strategies will adopt infection evading behavior. Indeed, popular descriptions of the decline in HIV prevalence in some parts of east Africa and elsewhere attribute much of the gains to information campaigns that encouraged people to change their sexual behavior (Allen and Heald, 2004). However, rigorous evaluation of the impact of information interventions is sparse and the few reliable studies suggest mixed results.[1]

Information can take many forms and be provided in different ways. One intervention that is being scaled-up in many countries – HIV testing and counselling services – provides person-specific information about one's own HIV status in a private setting and counsels

[1]Duflo et. al. (2006) find little evidence of HIV/AIDS education on early pregnancy using a randomized study in western Kenya. On the other hand, Dupas (2007) finds a large impact of targeted information on sexual behavior in western Kenya.

people on ways to avoid becoming infected or infecting their sexual partners. The scale-up of HIV testing and counselling has been driven by three important considerations. First, it is argued that voluntary testing and counseling needed to identify and refer infected individuals to expanding treatment programs that provide HAART. Second, in antenatal clinics (ANCs), it is argued that testing helps prevent new infections by identifying pregnant women who should receive (a) medications that prevent mother-to-child transmission (PMTCT) and (b) advice on whether to breastfeed newborn children.[2] Third, on the behavioral side, it is argued that testing and counselling for pregnant women and for the population more generally can provide individuals with information that may then motivate them to change their sexual behavior.[3] While the second reason highlights a medical channel through which testing and counselling can clearly reduce the number of new infections, the third reason highlights a behavioral channel where the effect on infections is theoretically ambiguous. If those who learn that they are infected have a greater concern about others, due to altruism or more direct concerns about intra-household welfare, the incidence of HIV is likely to fall. If, however, knowledge that one is infected makes an individual throw caution to the wind, then information about status could actually increase the number of new infections. Similarly, the uninfected could respond to the news by adopting safe sex measures or might become convinced that HIV is more difficult to contract than they had initially thought and engage in more risky behavior.

Given the theoretical ambiguity in possible responses to VCT interventions, it is not surprising that the empirical evidence on the impact of testing on the prevention of new infections is inconclusive. While Thornton (2006) finds limited changes in the demand for condoms in a low HIV prevalence area of Malawi, Coates et al. (2000) find large

[2]The WHO guidelines on breastfeeding for HIV positive mothers acknowledge the adverse effects of using formula in areas with a lack of potable water. The guidelines have been revised to encouraging breastfeeding for the first six months.

[3]Throughout the rest of this paper, we will use the phrase HIV testing interchanageably with the acronym HIV counseling and testing.

reductions in self-reported sexual behavior following testing. Despite the limited evidence on whether testing leads to behavioral changes, increasing the fraction of the population that has had an HIV test – by building additional VCT centers and encouraging their use – has been among the HIV prevention priorities of many countries. In Botswana, the government has gone as far as making HIV testing more routine by implementing opt-out testing procedures at every health center visit.

Even if HIV testing and couselling services can help identify HIV-positive individuals and induce changes in behavior among all those who get tested, a number of supply-side factors may serve as barriers to the take-up of these services. The state of public health provision in many countries affected by HIV/AIDS is characterized by high leakage of inputs as well as high levels of health provider absence (see, for example, Gauthier and Wane (2007) on leakage). A recent multi-country study of health provider absence found that about 35 percent of public health providers were not at work during unannounced visits (Chaudhury et al., 2005). The success of public provision of counselling and testing services will therefore depend on the availability of complementary inputs such as testing kits and trained personnel to test and counsel patients. While a few papers have looked at the impact of health provider absence on the quality and provision of health services (see Banerjee, Deaton, and Duflo, 2004), we are unaware of any studies that have looked at the impact of provider absence on health outcomes.[4] Given the importance of testing in determining PMTCT treatment eligibility and potentially motivating low risk behavior, health provider absence could have a very large adverse effect on new infections.

Finally the provision of information about a terminal disease such as HIV/AIDS provides an opportunity to characterize the impact of life expectancy on the forward looking behavior of individuals.[5] Theoretically, new information about expected longevity and

[4] Bjorkman and Svensson (2007) show a large positive impact of higher community monitoring on health outcomes that possibly operates through higher provider attendance. Duflo and Hanna (2005) and Das et al. (2007) look at the impact of teacher absenteeism on educational outcomes.

[5] It is worth noting for the sample of women we study, HIV testing and counselling provides information

health alter the relative incentives for consumption versus savings. Individuals with newly decreased life expectancy will have diminished investment incentives, while those with newly increased higher life expectancy will have incentives to invest more. These intertemporal investment allocations can be vital to household welfare and economic growth. Studying the impact of learning HIV status on investment behavior therefore contributes to a growing literature that explores the nexus between health, productivity and wealth (see Strauss and Thomas, 1998).

In order to understand the factors that limit the take-up of HIV testing as well as the various behavioral changes that result from receiving information about HIV status, we implemented a longitudinal survey of pregnant women in a high HIV prevalence area of western Kenya. Women in the sample are offered HIV testing and counselling as part of their antenatal care (ANC) in order for those who test HIV-positive to receive PMTCT medications and advice. Our analyses of the survey data address four broad questions. Since a PMTCT nurse counselor must be present at the ANC in order for women to get an HIV test, we first examine the impact of health worker absence on the likelihood that pregnant women are tested and counseled for HIV. Next we use the attendance patterns of the PMTCT nurse counselor as an instrumental variable to account for selection into testing and examine the impact of testing on different types of outcomes. Thus, our second set of analyses look at the impact on the take-up of medicines that can prevent mother to child transmission of HIV at delivery as well as the demand for other antenatal care services. Third, we study the impact of testing on changes in sexual behavior which is arguably the most important channel linking counselling and testing to the future incidence of HIV/AIDS. Finally, we explore the impact of counselling and testing on a range of forward-looking investment decisions at the household level that influence

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about one's own HIV status but is not accompanied by large immediate changes in the women's health status. In order to become pregnant, immune systems cannot be too compromised, and thus these women are unlikely to be experiencing any HIV-related morbidity.

individual welfare and economic growth.

Our study is based on a sample of nearly 600 pregnant women who were enrolled during their first antenatal care visit at a rural health center. At the time of enrollment, which took place before the women were seen by any staff at the ANC, an intake survey (wave 1) was administered to elicit information on the women's socioeconomic characteristics. The intake survey was followed by a longer socioeconomic survey (wave 2) that was administered at the women's homes a few months after delivery.

We begin by documenting a moderate level of health provider absence and a *large* impact of health provider absence on HIV testing rates. Over the course of eight months of enrollment, the PMTCT nurse counselor was absent on 10 percent of the days when the ANC was open. First time visitors who arrived on a day when the lone PMTCT nurse counselor was absent were nearly 60 percentage points less likely to have tested for HIV over the course of their pregnancy. We argue that the absence of the PMTCT nurse on the first antenatal care visit provides a useful and plausibly exogenous source of variation that is orthogonal to the demand for testing. Since only 77 percent of women actually receive an HIV test during the course of their pregnancy, we use the presence of the PMTCT nurse on the day of the first ANC visit as an instrumental variable for having received counselling and testing information.

Our results indicate that PMTCT nurse absence, through its effect on the likelihood of being tested, has a large effect on whether or not preventive treatment is obtained by pregnant women who test HIV-positive. Our instrumental variables estimates suggest that women who test HIV-positive are over 20 percentage points more likely to report receiving medications than women who do not get tested. Based on the medical efficacy of the PMTCT medication in preventing transmission and reasonable assumptions about the prevalence rate among non-testers and health worker absence, the estimated effects imply that 0.37 -1.46 infant HIV infections/1,000 live births could be prevented if nurse absence were eliminated. In addition, women who test HIV-positive are about 20 percentage points less likely to breastfeed their child, which is another important channel of mother-to-child transmission of HIV. Our results also reveal an increase in demand for additional health care services that increase the probability of a safe delivery – women who get tested are about 22 percentage points more likely to have sought the assistance of a professional nurse or doctor during delivery and 21 percentage points more likely to deliver at a hospital than women who do not get tested for HIV.

Using the same instrumental variable strategy, we examine the aggregate impact of testing on sexual behavior and household investment decisions. While this aggregate impact combines potentially heterogeneous behavioral responses which depend on whether the result of the test is positive or negative, it informs us about the likely impact of expanding HIV testing on outcomes at the population-level. In general we find small and statistically insignificant aggregate impacts of testing for most of our outcome variables.

The results are different, however, when we estimate the impact of testing and counseling on behavioral outcomes by HIV status. Compared to women who test HIV-negative, we find that women who test HIV-positive have a *decrease* of about 17 percentage points in the probability of having used a condom during the last sexual encounter (compared to women who do not get tested, the decrease is 12 percentage points). Similarly, HIV-positive individuals are less likely to report disclosure of their status to their spouses than women who test HIV-negative. We find no significant difference in the reported number of partners between women who test HIV-negative and HIV-positive.[6]

Our results also suggest that compared to women who do not get tested for HIV, those who test HIV-negative have changes in forward-looking behavior that are consistent with the predicted response to a longer planning horizon. Households of women who test HIV-negative are more likely to increase their livestock holdings and their children are more likely to be enrolled in school. The opposite effects do not hold as strongly for women

[6] These results are based on a sample of recently pregnant women and are probably not representative of the broader sexually active adult population.

who test HIV-positive. Contrary to prevailing assumptions about the AIDS epidemic and fertility, we do not find any evidence of changes in fertility preference in response to learning HIV status.

The final part of our analysis further examines the heterogeneity of the responses by women who get tested for HIV. First, we analyze whether the behavioral responses among women who test HIV-positive are different for the sub-group that self-selects into a comprehensive HIV care and treatment program that is available freely at the health center. We find robust evidence that women enrolled in the care and treatment program are more likely to undertake a number of health seeking behaviors (receipt of PMTCT medications, larger number of antenatal care visits, and reduction in breastfeeding) and there is suggestive evidence that they are less likely to reduce their condom use and alter their investment decisions compared to women who test HIV-positive but do not enroll in the care and treatment program.

Lastly, we explore how the behavioral responses differ by the degree of surprise and the extent of updating based on differences in self-reports of the subjective belief about being HIV-positive (before and after the HIV test). Boozer and Philipson (2000), for example, argue that the amount of new information contained in an HIV test result–as measured by the difference between the test result and subjective beliefs before the test–determines the magnitude of the behavioral response. Our results do not show consistent differences in behavioral outcomes based on the degree of surprise and updating among pregnant women. This finding is consistent with the idea advanced by Lowenstein et. al (2001), which would suggest that learning status definitively is a more salient feature of the test result than the size of the informational update.

The remainder of the paper is organized as follows. Section 2 provides background information on HIV testing and counselling during antenatal care and describes the data, Section 3 presents the empirical strategy, Section 4 presents results on the effects on health-worker absence, the relationship between HIV testing and subjective beliefs about

HIV status, as well as the main results on the impact of learning HIV status on behavior. Section 5 concludes.

## 2 Background and Data

The data used in this study were collected by the authors between July 2005 and October 2006. The first wave of data was collected as an in-clinic survey between July 2005 and February 2006. The second wave was a household-based survey implemented between May 2006 and February 2007. The study enrolled a sample of pregnant women attending an antenatal clinic at a rural health center in western Kenya. The health center is located in Maseno Division, a region that has a population of over 60,000 individuals and lies within Kenya's Nyanza Province. The health center serves a predominantly rural population even though a number of patients from the peri-urban areas of Maseno division use the clinic. The ethnic composition of clinic users is predominantly Luo although about 10 percent of the sample are Luhya. HIV prevalence in Nyanza Province is the highest of all the provinces in Kenya. Data from the 2003 Demographic and Health Survey (DHS) suggests that 18.3 percent of adult women in the province are HIV-positive, compared to a national average of just under 7 percent. The health center offers outpatient, inpatient and antenatal care services. It also includes an HIV care and treatment clinic that is managed by the Academic Model for Prevention and Treatment of HIV/AIDS (AMPATH) program. The AMPATH program provides PMTCT services for pregnant women who are HIV-positive as well as highly active antiretroviral therapy (HAART) for patients who have developed AIDS at no cost to the patient.

Typically, women make two to three visits to the antenatal clinic during their pregnancy. In addition to receiving routine antenatal care, women are offered HIV testing and counselling during their first visit. If they decline the test during the first visit or if a PMTCT nurse counsellor is not present, the women are generally offered HIV testing and counselling during subsequent visits. Women who test HIV-positive are counselled on ways to prevent transmission of the virus to her partner and her child. For PMTCT, the women are typically referred to the AMPATH's HIV clinic, which is in the same health center. AMPATH provides a full course of HAART to these women during the period before and after delivery (there is no charge for the treatment, and the administrative data from AMPATH allow us to establish whether the women in the study enroll in AMPATH). Women are also encouraged to deliver at the health center if possible.

Enrollment into the study was limited to pregnant women visiting the ANC for the first time between July 2005 and February 2006. During enrollment, a short intake questionnaire was administered *prior* to the beginning of the HIV testing and counselling (this is referred to as wave 1 of the study). This questionnaire obtained information on socioeconomic status, fertility preferences, HIV knowledge and subjective beliefs about a woman's own HIV status as well as her partner's. Data on the presence of the PMTCT nurse on any given day, whether the pregnant women consented to the HIV test, and the test result itself (with patient consent) were obtained from the administrative records of the antenatal clinic. Since patients who did not test during the first visit could test on subsequent visits to the ANC, the administrative records were used to routinely update the HIV testing status of enrolled women. During the first wave, we also obtained consent from the women to visit them at their homes after delivery.[7] Only a handful of first round respondents did not consent to be visited. 591 women who were interviewed at the clinic during wave 1 were located in wave 2, and sample attrition between rounds was under 10 percent.[8] The second wave of the study was part of a large community-based study of maternal health. This wave of the study included a longer survey questionnaire that included a household roster, questions on education, health, consumption, marriage,

[7]Using the expected date of delivery from the administrative records, household visits for the intake respondents were scheduled for approximately two months after delivery.

[8]In the majority of cases we could not complete the household interview because the respondent could not be located, despite strenuous efforts to track down respondents as far as Nairobi.

sexual behavior, assets, income, and transfers. Interviews were also conducted with the husband or cohabiting partner of the each woman (if he was present). The geographical coordinates of households and anthropometric data on women and children were also collected during the home visits.

In order to ensure comparability of our data with nationally representative data, questions were worded similarly to those in the DHS. Care was taken to ensure that interviews were conducted with sufficient privacy. Wave 1 of the study lasted approximately 40 minutes, including the time taken for obtaining informed consent. Three experienced female enumerators conducted the interviews in Kiswahili, Luo or Luhya depending on the language preferences of the subjects. Due to the time and space constraints in administering the survey at the antenatal clinic, a relatively small number of questions could be asked. This implies a limited number of outcomes for which panel information (i.e., from wave 1 and wave 2) is available.

The average age of 591 women interviewed in both waves of the survey is 24.7 years, and 59 percent of them report having completed primary school. Just over 33 percent of the women report being married, while 40 percent report living with their partner and 20 percent report being unmarried or living separately from their partner. On several important dimensions, our sample is comparable to the 2003 DHS sample from Nyanza Province. Nearly three quarters of the women in both samples live in houses that have a roof made out of durable materials. Along the dimension of desired fertility, both samples report a similar average desired number of 4 children. Knowledge about HIV/AIDS is very high in both samples. Nearly 90 percent of women in both samples report knowing that an individual who appears healthy can have HIV and that HIV can be transmitted from a mother to a child. A similar proportion of women in both samples report knowing someone who has died of HIV/AIDS. In terms of subjective beliefs about one's own HIV status, just over 30 percent of women in both samples report having a moderate or high chance of being HIV-positive. Finally, testing rates appear considerably higher in our sample; women enrolled at the ANC are 3 times more likely to have tested. This difference is also likely driven by the temporal differences (see Wilson (2007) on testing and the availability of ARVs).[9]

# 3 Empirical Strategy

Our main econometric challenge for estimating the impact of HIV testing on behavioral outcomes is the fact that a considerable proportion of women who receive antenatal care at the clinic do not actually get tested for HIV. In our sample, just over 75 percent of women get tested during any of their visits to the clinic. Ordinary least squares estimates of the impact of testing may therefore be biased since unobservables that drive the testing decision could be related to changes in the behavioral outcomes. We address this selection issue using an instrumental variables strategy. On about 10 percent of the days when the ANC is open, the PMTCT nurse who is supposed to conduct HIV counseling is absent from the hospital, even though the pregnant women still receive standard prenatal care from different nurses. The PMTCT nurse's absence status on the day of a woman's first visit is strongly associated with whether that woman tests at some point during her pregnancy. This effect holds even after controlling for the day of the week and is uncorrelated with the background variables of the women in our sample. Even though some of the women who show up on days with an absent PMTCT nurse do eventually get tested for HIV on subsequent visits, absence of the PMTCT nurse at the first prenatal visit is a strong predictor of HIV testing during pregnancy.

The first step of our empirical strategy is to estimate the overall effect of testing on a range of behavioral outcomes. The estimation of the overall impact of testing is of

[9] There is a sharp difference in mosquito net ownership: nearly twice as many women in our sample report owning a mosquito net compared to the DHS sample. The difference likely arises from the temporal difference and the aggressive marketing and distribution of mosquito nets that has taken place in this area in the intervening period.

interest because it allows us to understand how the expansion of HIV testing could affect the course of the HIV epidemic as well as socioeconomic responses at the household level. We propose the following first difference regression equation:

(1) $\Delta y_i = \beta_o + \beta_1 \Delta X_i + \gamma_1 T_i + (\varepsilon_{it+1} - \varepsilon_{it})$,

where $\Delta y$ is the change in one of our outcome variables of interest (such as sexual behavior, child investments, fertility preferences) between the two survey rounds, $X$ are controls, and $T$ is an indicator for receiving an HIV test during a visit to the prenatal care clinic between the survey rounds. The coefficient of interest is $\gamma_1$, which indicates the change in behavior between rounds for women who had an HIV test. Since our first wave questionnaire was administered at the clinic and had to be very brief, it included fewer questions than the extensive household survey that we implemented in the field in the second round. Therefore a number of our outcomes of interest are only measured in the second wave and for these variables we will run a levels regressions instead of the first difference regressions described above.

We use the presence or absence of the PMTCT nurse on the day of the first ANC visit to deal with the endogeneity of taking the test. As discussed previously, the PMTCT nurse is absent from the antenatal clinic on 10 percent of the days when the ANC is open. In specification (1) above, we instrument for $T_i$ with an indicator for the nurse's presence on the day of first prenatal visit.

However, there are many reasons to expect the behavioral response to testing for HIV will depend on the test result that is obtained. Compared to a woman who learns she is HIV-negative, a woman who tests HIV-positive will face different incentives to change her behavior (due to the fact that she is more likely to transmit the virus to her child or partner, as well as the fact that her life expectancy may be revised). Indeed, as discussed by Boozer and Philipson (2000), the effects of learning HIV status may be underestimated if we do not adequately control for amount and type of new information gained from learning HIV status. Below we propose an empirical strategy to estimate the impact of testing by HIV test result. Assuming we had information on the HIV status of all women in the sample, we could estimate the following equation:

(2) $\Delta y_i = \beta_o + \beta_1 \Delta X_i + \gamma_1 T_i + \gamma_2 HIV\_POS_i + \gamma_3 T_i * HIV\_POS_i + \Delta\varepsilon_i$

where $HIV\_POS_i$ is an indicator variable taking value 1 if the woman is known to be HIV-positive during the course of her pregnancy. The instruments are indicators for nurse's presence and the interaction term, nurse presence*$HIV\_POS$, for $T_i$ and $T_i * HIV\_POS_i$ respectively. This IV strategy permits the estimation of the causal effect of testing HIV-negative ($\gamma_1$) as well as the causal effect of testing HIV-positive ($\gamma_1 + \gamma_3$).The latter effect would be estimated by comparing the trends in the outcome variable for HIV-positive women who do learn their status from testing to the trends for HIV-positive women who do not learn their HIV status. The need to control for effect of being HIV-positive ($\gamma_2$), independent of whether women get tested and learn their status definitively, stems from the possibility that these women may have beliefs about their status or trends in characteristics that differ from those of HIV-negative women and cause them to modify their behavior over time.

But in practice we do not know the HIV status of women who do not get tested during their pregnancy and therefore cannot estimate $\gamma_2$. The challenge therefore is to create proper comparison groups for women who get tested and learn they are HIV-negative and HIV-positive. Under a plausible structural assumption that $\gamma_2 = 0$ in the equation above we instead estimate the following specification:

(3) $\Delta y_i = \beta_o + \beta_1 \Delta X_i + \gamma_1 T_i + \gamma_2 T_i * HIV\_POS_i + \gamma_3 * \pi_i + \Delta\varepsilon_i$

This specification contains an additional variable ($\pi_i$) that controls for the subjective beliefs that women have about their chances of having HIV/AIDS during wave 1 of the survey (i.e. just before their first antenatal clinic visit). A formal interpretation of our structural assumption is that:

(4) $E[\Delta y_i^{+ve} | T_i = 0, \pi_i, \Delta X_i] = E[\Delta y_i^{-ve} | T_i = 0, \pi_i, \Delta X_i]$

In words, if a woman does not get tested, then there will be no difference in expected changes in $y$ over time whether her true status is HIV-positive or HIV-negative *after controlling for her subjective beliefs at the time of her first ANC visit* and any other changes in observable characteristics. One concern might be that there are unobserved differences in unobserved health trends between HIV-positive and -negative women, which in turn affect their trends in $y$. However, this is unlikely to be the case since pregnant women who happen to be HIV-positive are likely to be in the early stages of HIV infection which means that they are asymptomatic and generally healthy. We therefore assume that for women who do not get tested, their subjective beliefs about HIV status during the first wave of the study are a sufficient statistic for actual HIV status. This implies that their actual (unobserved) HIV status should not exert any independent effects on behavior. As we show below, the data on pre-testing subjective beliefs contain meaningful information about underlying status, and they are even updated accurately upon learning HIV status.

In addition to estimating equation (3), we also test whether there are different responses *among* the HIV-positive women to learning one's HIV status. In particular, we test whether HIV-positive women who enrolled in the AMPATH HIV clinic have different responses than HIV-positive women who did not enroll in the clinic. This amounts to estimating the following equation:

$$(5)\ \Delta y_i = \beta_o + \beta_1 \Delta X_i + \gamma_1 T_i + \gamma_2 T_i * HIV\_POS_i + \gamma_3 T_i * HIV\_POS_i * AMPATH_i + \gamma_3 * \pi_i + \Delta\varepsilon_i$$

Another alternative to specification (3) above, is to split the sample into two groups. Group 1 contains those who test HIV-positive and non-testers and group 2 contains those who test HIV-negative with non-testers. Then using the basic testing specification, we estimate the following equation separately for the two groups:

$$(6)\ \Delta y_i = \beta_o + \beta_1 \Delta X_i + \gamma_1 T_i + \gamma_4 * \pi_i + (\varepsilon_{it+1} - \varepsilon_{it})$$

In this case, we have just one endogenous variable ($T_i$) in the specification and one instrumental variable (presence of the PMTCT nurse). The interpretation of $\widehat{\gamma}_1^+$ would be the effect of testing for women who test HIV-positive and similarly $\widehat{\gamma}_1^-$ would be the effect of testing for women who test HIV-negative, with the comparison group being women who do not test but have similar subjective beliefs in wave 1. In the results below, we focus on an estimation of specification (3) but results of specification (6) are available from the authors.

# 4 Results

This section begins to present the results from examining the effects of HIV testing on a variety of behavioral outcomes. Our analysis is restricted to 591 pregnant women who were enrolled in our study during their first visit to the antenatal clinic *and* were located at home during wave 2 of the survey. Table 1 presents summary statistics of several key variables, for the entire sample of 591 women as well as the sub-samples of women who tested HIV-negative and HIV-positive. As noted earlier, 77 percent of women enrolled in our study and located in wave 2 were tested for HIV during one of their antenatal clinic visits (not necessarily on the first visit, during which they were enrolled in the study). Among those tested, nearly 20 percent obtained an HIV-positive result. For 91 percent of the women, a PMTCT nurse was present on the day of the first ANC visit. Several outcomes pertaining to the pregnancy and delivery are of interest. First, women's self-reported information during wave 2 on whether testing and counselling services were offered at the ANC correspond well to the actual testing rate indicated by the PMTCT logbooks (the self-reported rates are in fact slightly higher). While nearly half the women in our sample report that they delivered their child with the assistance of a traditional birth attendant and at home, 38 percent reported having had the assistance of a doctor or professional professional. Only 18 percent of women reported delivering at the health center where the study enrollment was conducted. Since 39 percent of women indicated that they delivered in a hospital or a health center, roughly 20 percent of the women delivered in some other clinic, hospital, or rural health center near their home.

Table 1 also summarizes the other outcome variables that we examine. Some of these outcome variables are discussed further below. Subjective beliefs about one's chances of having HIV/AIDS were measured in each wave on a scale of 1-4 (with 1 indicating a "great chance" of having HIV and 4 indicating "zero chance"). The mean for this subjective measure of beliefs is 2.76 in wave 1. For women who tested HIV-positive, the mean in wave 1 is clearly lower than the mean for HIV-negative women. Data were also collected on sexual behavior in the past six months. The reported number of sexual partners in the past six months is very close to 1, and reported rates of condom use during the last sexual encounter with the main partner is about 25 percent. The survey also sought to learn about the fertility preferences of women. In wave 1, 71 percent of women reported a desire for more children (in addition to the current pregnancy). One important measure of wealth, the number of cows or calves owned by the woman's household, indicates that the women who tested HIV-positive come from households that are slightly poorer than those of HIV-negative women. Finally, the average number of church attendances in the past 4 weeks was 3.3. It is worth noting that for the entire sample of women (which includes those tested HIV-positive and HIV-negative, as well as non-testers), these outcomes do not change much in wave 2 of the survey. A few of the outcome variables we study were recorded in wave 2 only. The summary statistics for these variables are also reported in Table 1.

The decision to undergo an HIV test is likely to be driven by a number of factors. For example, the sexual behavior of women and their perceptions of their sexual partners' HIV risk will undoubtedly influence the desire to get tested. A number of other factors such as the perceived risk of domestic violence stemming from disclosure of test results and the perceived benefits of PMTCT services will also affect demand for an HIV test. The endogeneity of the testing decision is therefore likely to confound the identification of the impact of testing on a variety of behavioral outcomes. However, the supply of HIV testing and counselling services should also influence the likelihood of getting tested.

In order for testing and counselling to occur, a PMTCT nurse must be present at the clinic. As Table 2a indicates, information on the absence of this nurse provides us with a plausible identification strategy because it helps determine whether women who attend the antenatal clinic actually get tested for HIV. When we examine whether or not women get tested during the course of their pregnancy, the presence of a PMTCT nurse who offers testing and counselling services during the day of the first antenatal visit increases the probability that a woman is tested during her pregnancy by 58 percentage points. Since women who attend the clinic on a day when the PMTCT nurse is absent may not have another opportunity to be tested, the results indicate that absence of the PMTCT nurse during the first visit happens to be critical.

One concern might be that absence of the PMTCT nurse is more common during certain days of the week such as market days, and that women who attend the clinic on these days may be less likely to be tested for reasons other than the nurse being absent. Column 2 of Table 2a indicates that even when we control for the day of the week during which the first ANC visit took place, the large and significant effect of the nurse's absence remains. Similarly, the result is robust to the inclusion of controls for the subjective expectations that women have about their own HIV status before they are tested. In Table 2b, we provide further evidence that the presence of a PMTCT nurse on the day of a woman's first antenatal visit is uncorrelated with characteristics of pregnant women. We report the results from a cross-sectional regression of the indicator of nurse presence on a variety of characteristics about the pregnant woman. By and large, the likelihood that a nurse is absent on the woman's first antenatal visit is uncorrelated with observable characteristics such as the age and education of the women. Higher ownership of livestock (cows and calves) does appear to be associated with higher likelihood of having a nurse present on the day of the first visit, but apart from that no other important variables are significantly associated with nurse presence.[10] Concerning one of the primary goals of this paper – to examine the impact of testing on a variety of socioeconomic outcomes – the results in Tables 2a and 2b suggest that the indicator variable for whether or not a PMTCT nurse is present at the clinic can provide a plausibly exogenous source of variation that is unlikely to be correlated with other variables that might affect testing. Thus, the presence of the PMTCT nurse can serve as an instrumental variable to control for the selection process that may be occurring when women decide whether to get tested.

While PMTCT nurse absence exerts a large effect on testing, it should be emphasized that the nurse's rate of absence at the clinic is considerably lower than levels that have been documented in other developing country settings (see Chaudhury et al., 2005). Average levels of absence for nurses from a multi-country study are more than three times as large. Anecdotal evidence from the study area suggests that the reasons for absence include official reasons such as collection of salaries and attendance at workshops, illness of self/family and funeral attendance.

## 4.1 Subjective beliefs and HIV testing

While Tables 2a and 2b show why the data on the PMTCT nurse's absence can be useful for dealing with the endogeneity of women's testing decisions, robust estimation of the impact of learning HIV status requires identifying an appropriate comparison group for the women who do get tested and learn their status. As noted in Section 3, the sample of women who did not get tested during the course of their pregnancy can serve as a reasonable comparison group provided that these women's subjective beliefs about their HIV status serve as a proxy for actual HIV status (unlike the case of HIV status, data on subjective beliefs before the first antenatal visit are available for all women enrolled in our study). This allows us to pool testers and non-testers in the regressions reported below.

[10] Some of the days of the week are significant, but we control for these in all of our regressions.

The assumption can be called into question, however, if subjective beliefs are not good indicators of women's HIV status and if underlying status exerts independent effects on future behavior, independent of beliefs. In Table 3, we examine the relationship between subjective beliefs in wave 1 and actual HIV status using the sample of women who did get tested for HIV during one of their antenatal visits. We find that the subjective beliefs do contain useful information about the women's actual HIV status. Column 1 of Table 3 shows that compared to women who reported "no chance at all" of having HIV/AIDS at the time of enrollment, women who reported a "moderate" chance or a "great" chance were approximately 17 and 27 percentage points more likely to test HIV-positive (these differences are statistically significant). These results persist even when we control for factors such as the day of the week during which the first ANC visit occurred. Adding observable characteristics of women in column 3 (such as age, education, and wealth) reduces the predictive power of beliefs slightly. The results in Table 3 indicate that data on subjective expectations do indeed contain important information about the risk of being HIV-positive, and as such these data can plausibly be used as a reasonable proxy for HIV status of women who did not learn their HIV status during their pregnancy.

A natural question that can be answered using the second wave of survey data is whether women update their subjective beliefs after learning their HIV status. Proper updating would be consistent with the results above, which confirm the predictive power of subjective beliefs in wave 1. This would also provide additional motivation for the possibility that women may change their forward-looking behavior after learning their HIV status.[11] We therefore estimate equation 3 with the dependent variable being the change in subjective beliefs between waves 1 and 2. Since greater subjective risk of having HIV is indicated by smaller numbers in the subjective measure, a negative change over

[11] It could be argued, however, that changes in behavior as a result of learning one's HIV status need not be accompanied by updated subjective beliefs if, for example, women did not understand the question on subjective beliefs about HIV status, or if women who tested HIV-positive deny their HIV status when reporting subjective beliefs in the second round.

time implies that the respondent's subjective belief about her HIV status shifted towards a *higher* probability of having HIV/AIDS in wave 2. In Table 4 we present results from estimating OLS and IV regressions that estimate the effect of learning HIV status on subjective beliefs. As the results in column 1, women who test HIV-positive update their subjective beliefs substantially compared to women who do not test but have similar pre-test subjective beliefs (the sum of the coefficients $\gamma_1$ and $\gamma_2$ in equation 3) and also compared to HIV-negative women (the coefficient $\gamma_2$ in equation 3). On a scale of 1-4 (1 being the highest chance of having HIV/AIDS and 4 being no chance), the IV estimates imply that the average decrease in the subjective belief index is 0.5 index points greater for HIV-positive women than the corresponding decrease for HIV-negative women. HIV-positive women display an even larger decrease in the subjective belief index compared to women who do not get tested but have similar prior beliefs about their HIV status. The results in column 1 are fairly similar under the OLS and the IV specifications, suggesting that in this case the endogeneity of the testing decision does not lead to large bias in the estimated coefficients. The results also indicate that women who test HIV-negative do not significantly change their subjective beliefs.[12] The results in Tables 3 and 4 provide convincing evidence that learning of HIV status can be reliably detected through women's own subjective beliefs about their HIV status.

It should be noted that not all women who test HIV-positive update their subjective beliefs similarly. As noted earlier, we can compare the responses for HIV-positive women who enroll in the HIV care and treatment program (AMPATH) to those who do not enroll in the treatment program. Column 2 in Table 4 presents these results. Both the OLS and IV regressions suggests a greater degree of updating among women who enroll in the AMPATH clinic. These women report significantly larger changes in their chances of

[12] Additional results not reported here show that when we examine the change in a binary indicator of whether the respondent reported that she had a "great" or "moderate" chance of having HIV/AIDS, we find a significant increase in the probability that women who test HIV-positive report having such chances in the second wave than in the first wave.

having HIV/AIDS (in the direction of a higher chance) than women who do not enroll in the clinic. They also report significantly larger changes than women who do not get tested for HIV and have similar subjective beliefs in wave 1 (as indicated by the F-test in column 2)

As further evidence that learning about HIV occurs after the HIV test, column 3 of Table 4 shows that women who test HIV-positive also significantly change their subjective beliefs that *their main partner* is HIV-negative (the belief is measured as a binary indicator variable). In the OLS and IV regressions, compared to women who do not test for HIV but have similar prior beliefs about their HIV status, women who test HIV-negative have no significant decrease in their subjective belief that their partner is HIV-negative. On the other hand, women who obtain an HIV-positive test result report a decrease in their subjective belief that their partner is HIV-negative that is 23 percentage points greater than the change reported by women who obtain an HIV-negative test result. The bottom panel of column 4 shows that the reported updating in beliefs about partner's status occurs predominantly among HIV-positive women who enroll in the AMPATH clinic.

Given the evidence that HIV testing affects the subjective HIV risk assessments of women who get tested, we now examine whether HIV testing leads to modifications in a variety of individual and household decisions.

## 4.2 Effect of HIV testing on likelihood of receiving PMTCT services

The most immediate impact of HIV testing and counselling during antenatal care is that it can increase the likelihood that women take-up important services that can affect child delivery outcomes. The first and foremost reason for offering HIV testing during antenatal care is that it identifies HIV-positive women who can be given medications for the prevention of mother-to-child transmission of HIV. To enhance the chances that PMTCT medications are taken at the time of delivery, it is typically advised that HIV-positive women deliver in a health center or at the very least use a professional birth attendant who can provide the PMTCT medications. More broadly, for all women who take advantage of HIV testing and counselling, it is possible for the PMTCT counsellor to reinforce the general importance of delivering at a health center or using birth attendants. Since pregnant women and their households may weigh the costs of delivery in a formal setting against the perceived benefits, information gained during pre- and post-test counselling sessions may alter the trade-offs towards safer delivery and greater take-up of PMTCT medications.

The impact of HIV testing and counselling on these antenatal, delivery, and postnatal outcomes is reported in Table 5. Panel A shows the results from OLS regressions while panel B shows the results from IV regressions that use the PMTCT nurse's presence at the clinic as an instrument for getting tested. As in the interpretation of the results of Table 4, we are interested in multiple comparisons – i.e. women who test HIV-negative compared to women who do not test but share similar pre-test beliefs about their HIV risk ($\gamma_1$ in equation 3), women who test HIV-positive compared to women who test HIV-negative ($\gamma_2$ in equation 3), women who test HIV-positive compared to women who do not test but share similar pre-test beliefs ($\gamma_1+\gamma_2$ in equation 3), as well as comparisons of HIV-positive women who do and do not enroll in the AMPATH program ($\gamma_3$ in equation 5).

Column 1 of Table 5 examines data from wave 2 on women's self-reports about whether or not they received treatment for PMTCT (the question asked whether the women were given any medication during the time of delivery to prevent HIV/AIDS transmission). For women who tested HIV-negative, both the OLS and IV estimates show no significant impact of learning HIV status on the likelihood of reportedly getting PMTCT medication. This result is consistent with the fact that PMTCT medications are generally given to HIV-infected mothers only. Column 1 shows that women who tested HIV-positive are significantly more likely to report getting PMTCT medications than HIV-negative women (the IV estimates in panel B indicate they are 18 percentage points more likely to get medications). The F-statistic indicates that positive testers are also significantly more likely to report getting PMTCT medications than non-testers with similar subjective beliefs about their HIV status. Column 2 of Table 5 shows that the HIV-positive women who are most likely to have received PMTCT medications are those who enrolled in the AMPATH program.[13] These women are about 37 percentage points more likely to have received medications than other HIV-positive women, who are not significantly different from HIV-negative women.

In columns 3-6, we show that HIV testing also has a significant impact on the delivery choices of women. The IV results suggest that compared to women who do not get tested for HIV, women who test are about 20 percentage points more likely to report having the assistance of a professional (nurse or doctor) during delivery and also 20 percentage points more likely to have delivered in a hospital setting. Women who test HIV-positive are not any more likely to have relied on professional assistance or hospitals, which may due to the fact that the pre- and post-test counselling urges all testers (independent of status) to choose these delivery options. These results suggest that HIV testing and counselling during antenatal care has beneficial impacts on the choices made by *both* HIV-positive and HIV-negative women.

We also examine whether HIV testing influences the number of prenatal visits made to the antenatal clinic and the likelihood that women report breastfeeding their newborn children (columns 7-10). In both cases, we find no impact of HIV testing for women who learn they are HIV-negative, whereas we find large and significant impacts for HIV-positive women who enroll in the AMPATH program. Compared to women who test

[13] Since HIV-positive women self-select into the AMPATH program, the AMPATH coefficients throughout the paper need to be interpreted cautiously. They are consistent with an AMPATH program effect but they could also be driven by the fact that women who enroll in AMPATH have different unobservable characteristics compared to women who do not enroll in the program.

HIV-positive but do not enroll in AMPATH, those who do enroll in the program report a significantly higher number of visits to the antenatal clinic. The number of antenatal visits made by the former group in fact is not significantly different than the number of visits made by women who test HIV-negative. Obtaining an HIV-positive result does have a significant effect on the likelihood of breastfeeding, regardless on enrollment in AMPATH. Since breastfeeding newborn children is generally discouraged for HIV-positive mothers (due to likelihood of transmitting HIV), these results suggest an important prevention benefit stemming from HIV testing and counselling. Women who test HIV-positive are about 22 percentage points less likely to report breastfeeding than women who test HIV-negative (column 9). Notably, the impact of learning HIV status on breastfeeding is largest for HIV-positive women who enroll in AMPATH (30 percentage points less likely than HIV-positive women who do not enroll in AMPATH).[14]

## 4.3 Effect of HIV testing on sexual behavior

Our results so far indicate a sizeable impact of testing and counselling on the prevention of new infections around the time of delivery. In this section, we report the main results from examining the additional impact of learning HIV status on new infections through changes in sexual behavior. Our empirical strategy includes the estimation of both OLS and IV regressions that estimate the overall average effect of getting tested for HIV (irrespective of the test result) as well the average effects of learning the actual test result.

In the first three columns of Table 6 we start by exploring how testing affects the probability of disclosing the test result to one's spouse. As column 1 indicates, compared to women who did not get tested during their pregnancy, there is no significant difference in the probability that women who get tested report having disclosed their HIV status

[14]Both groups of HIV-positive women are also signficantly less likely to report breastfeeding than women who do not get tested but share similar pre-test beliefs about their HIV risk, as indicated by the F-statistics in columns 9 and 10.

to their spouse. The comparison group of non-testers in this case is limited to those who report having been tested at some point *prior* to their pregnancy.[15] However, the result in column 1 combines the impact of testing for two samples of women who obtain very different information about their HIV status and may have correspondingly different responses in their behavior. The overall average effect for both groups of women may mask large and opposite changes in behavior that depend on the test result. Results that separate the effects of testing by test result are reported in columns 2 and 3 of Table 6. Women who test HIV-positive are about 17 percentage points less likely to report that they disclosed their status to spouses than women who test negative (in panel B). This finding is consistent with the possibility that HIV-positive women fear the repercussions of disclosing their status. In column 3, we find that among HIV-positive women, the likelihood of disclosure is not significantly different for those who do and do not enroll in the AMPATH program.

Next we examine our main outcomes related to sexual behavior: changes in the number of sexual partners in the past six months and changes in the likelihood of condom use during the most recent sexual encounter with a main partner. Similar to the findings in column 1, we do not find a statistically significant overall impact of testing on the number of sexual partners (column 4) and condom use (column 7). When we estimate separate effects based on HIV status, the results also indicate no significant difference in the number of sexual partners by test result. More interestingly though, columns 8 and 9 of Table 6 indicate that there are significant differences in the likelihood of condom use between women who test HIV-negative and HIV-positive. The IV estimates indicate that compared to women who test HIV-negative, those who test HIV-positive have a significant decline (of nearly 17 percentage points) in their reported use of condoms between waves

[15]While this baseline category is not very well defined, more than 80 percent of the non-testers who had tested either before their first ANC visit took the test within a 7 month window of their first ANC visit.

1 and 2.[16] This decline may in part be explained by changes in beliefs about spouse's status that occur when the women receive a positive test result (see column 3 of Table 4).

Overall, in contrast to the large and sizeable benefit of testing in reducing new infections at the time of delivery, the set of results in Table 6 suggest behavioral responses to HIV testing and counselling that may instead increase new infections. This finding would be consistent with the results in Boozer and Philipson (2000). However, we are cautious to draw implications for HIV testing and counselling more generally (particularly VCT services) since the sample studied here is comprised of pregnant women who are more likely to be in committed relationships and as such are not representative of the sexually active population that could be favorably affected by testing.[17]

## 4.4 Effect of HIV testing on investment behavior

Finally, we analyze the impact of testing on intertemporal investment decisions and coping mechanisms. As previously mentioned, HIV testing provides the pregnant women in our sample with new information about their life expectancy and this could lead to adjustments in consumption and saving behavior. We focus on all the outcomes that were included in *both* rounds of data collection and can plausibly represent such behavior. Most importantly, we analyze changes in child-related investments, both in terms of changes in desired fertility as well as children's schooling. At the same time we try to measure changes in household assets by looking at livestock holdings.[18] We also examine

[16]For women who test HIV-negative, there is no significant change in condom usage over time relative to non-testers. The overall decline in condom usage for HIV-positive women compared to women who do not test but have similar subjective beliefs about their status is also sizable (11 percent) but statistically insignificant. Additionally, we do not find a significant difference between HIV-positive women who do and do not enroll in AMPATH (column 9).

[17]Only 5 percent of women report having at least one other sexual partner other than the spouse.

[18]In addition to the fertility, education and livestock variables, the only other investment variable included in both rounds was a question about landholdings. We have excluded this variable since many

an additional outcome variable (church attendance) to understand some of the coping mechanisms at play.

We first discuss the impact of HIV testing on those who test HIV-negative. In both waves of the study, women were asked whether they desired any additional children beyond the pregnancy during which study enrollment occurred. Changes in these responses due to the learning of HIV status are noteworthy in light of recent debate about the fertility response to HIV/AIDS (Young, 2005). In column 2 of Table 7, the IV estimates are not statistically significant at conventional levels, although the size of the impact (5 percentage points) is large and positive. There is strong evidence that schooling outcomes improve significantly in the households of women who learn they are HIV-negative. For women who test HIV-negative, there is an increase of 21 percentage points in the fraction of their children between 6 and 18 years who are reported to be enrolled in school during the past six months. Turning to another measure of investment – the number of cows and cattle owned by the women's households – we again find strong evidence that investment increases the most in the households of women who learn they are HIV-negative. For these women's households, the number of cows and cattle owned increases by over 2 between the first and second waves of the study (a change that is statistically significant). In sum, our evidence indicates that the households of women who find out that they are HIV-negative increase their investment levels. This finding is consistent with a standard inter-temporal model of saving and investment.

Conversely, the results in Table 7 do not indicate that women who test HIV-positive are changing their investment levels significantly more than non-testers. However, similar to findings in other tables, the effects for women who test HIV-positive differ according to whether or not they enroll in AMPATH. Women who enroll in AMPATH are less likely to disinvest compared to other women who test HIV-positive, although many of the

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women did not report/know the size of their household's landholdings. We have decided not to use any of the investment outcomes included only in the second round in order to avoid selective reporting.

coefficients are not precisely estimated (the exception being livestock holdings, for which the households of HIV-positive women who enroll in AMPATH invest significantly more than households of HIV-positive women who do not enroll in AMPATH).

Finally, in Column 10 of Table 7, we find that the measure of women's participation in their local church – the number of visits made in the past four weeks – also changes significantly following HIV testing. Since religion may play an important role by providing social support to women and serving as a coping mechanism during times of adversity, it is striking that women who get tested increase church attendance in the past month by over 2 visits (based on the IV estimates).

One theory of the relationship between information and behavioral change would suggest that, rather than simply the type of new information provided (i.e. the test result of HIV-positive or -negative), it is the amount of new information that ultimately determines how much behavioral change should occur. The amount of new information, in this case, would be measured by the extent to which the test result differed from women's subjective beliefs about their HIV status in wave 1 (we refer to this as the level of surprise presented by the test result). Alternatively, the amount of new information could be represented by the change in women's subjective beliefs between waves 1 and 2 (we refer to this as the extent of updating about own HIV status that takes place after the test). In the last two tables of the paper, we examine whether the level of surprise and updating for women has an effect on the changes in sexual behavior and investment behavior. In Table 8, we estimate the impact of obtaining an HIV-positive result while controlling for binary measures of whether women were surprised by the test result and whether they updated their HIV status. In Table 9, we estimate the impacts of obtaining an HIV-negative result. Our results indicate that by and large, the extent to which the test result differs from subjective beliefs does not have an effect on behavior. Similarly, whether or not women update subjective beliefs about their own HIV status does not influence behavior. These results suggest that the effect of learning one's HIV status definitively dominates any effects that stem from whether or not women were surprised by the test result or updated their reported subjective beliefs. For further discussion of the psychological underpinnings of this possibility, see Lowenstein et. al (2001).

# 5 Conclusion

In this paper we assess the relationship between health provider absence and HIV testing. We then use this relationship to identify the impact of learning HIV status on a variety of behaviors. The most immediate response to testing is in the medical domain. Pregnant women who test HIV-positive are more likely to receive medications that prevent the transmission of the virus to their child. They are also more likely to deliver their child at a health care facility or in the presence of a trained health professional. Our results point to a diverse array of considerations for policy makers. Taken together these results suggest that HIV testing in the antenatal setting can contribute significantly to reductions in child and maternal mortality and thus may form an important part of the strategy to achieve two of the core Millennium Development Goals. The results also point to other considerations for policy makers.

Our results on sexual behavior suggest that the preventive effects of testing are not entirely straightforward. Women in our sample who test HIV-positive are less likely to disclose their status to their spouse and to use condoms after receiving their test results. Since testing also leads the women to revise their beliefs about their partner's HIV status, they may be reducing their condom use due to these revised beliefs. On the other hand, the results on the reluctance to disclose HIV status are suggestive that other dimensions of intrahousehold dynamics may also be important. While disentangling these effects is beyond the scope of this paper, attending to them is important – any successful intervention will have be appropriately targeted at the root cause of this behavior.

Our analysis of investment responses to learning HIV status provides evidence that is in accordance with models of forward-looking economic behavior. Households of women who test HIV-negative acquire more livestock and are more likely to send their children to school. Given the poverty levels in this part of Kenya, schooling and livestock represent two of the most important investments that households can make to increase their long-term income. These results suggest more generally that information about life expectancy has important effects on investment in human capital and productive assets, with attendant consequences for economic development.

While our results on the impact of HIV testing rely on using health worker absence as an instrumental variable for the likelihood of getting tested, the effects of absence are of great interest in their own right. Given the pervasiveness of health worker absence across the developing world, it is instructive to translate these impacts into an estimate of the number of new HIV cases averted (see Appendix for details on calculations). The lone PMTCT nurse in our setting is absent 9 percent of the time and this absence results in a 58 percentage point reduction in the likelihood that patients test at any point during their pregnancy. Combining this with data on patient flow at the antenatal clinic and the effectiveness of medications in reducing mother-to-child transmission among other things yields the result that PMTCT nurse absence contributes to an additional .37 infections per 1,000 live births. If we apply these estimates to the 35 percent absence rate documented in some other developing country settings (Chaudhury et al., 2005), then nurse absence contributes to about 1.46 infections per 1,000 live births. This number appears staggeringly large when compared to the rather small expenditure that would be required to provide substitute nurse coverage in the clinic.

The ability to obtain an HIV test depends critically on the functioning of health systems in developing countries. Moreover, the results of these tests have real effects on health outcomes, sexual behavior, and investment decisions. National and global policymakers need to take the costs and benefits associated with these effects into account when deciding on priority investments for health.

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Table 1: Summary Statistics

| | All women enrolled | | | HIV- women | | | HIV+ women | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | N | Mean | SD | N | Mean | SD | N |
| *Variables* | | | | | | | | | |
| School years completed | 7.07 | 1.83 | 587 | 7.08 | 1.83 | 363 | 6.94 | 1.83 | 90 |
| Tested for HIV | 0.77 | 0.42 | 591 | | | | | | |
| Tested HIV-positive | 0.20 | 0.40 | 456 | 0 | | | 1 | | |
| Nurse present at first ANC visit | 0.91 | 0.29 | 591 | 0.97 | 0.17 | 366 | 0.98 | 0.15 | 90 |
| Received counselling/testing - self-report | 0.88 | 0.32 | 590 | 0.92 | 0.27 | 365 | 0.88 | 0.33 | 90 |
| Had assistance of professional at delivery | 0.38 | 0.49 | 591 | 0.40 | 0.49 | 366 | 0.38 | 0.49 | 90 |
| Delivered at the health center | 0.18 | 0.39 | 591 | 0.20 | 0.40 | 366 | 0.18 | 0.38 | 90 |
| Delivered in the health center or hospital | 0.39 | 0.49 | 591 | 0.40 | 0.49 | 366 | 0.41 | 0.49 | 90 |
| *Data from Waves 1 and 2* | | | | | | | | | |
| Subjective belief about HIV status (Scale 1-4 decreasing in risk) | | | | | | | | | |
| Wave 1 | 2.76 | 0.88 | 587 | 2.86 | 1.02 | 359 | 2.23 | 1.12 | 86 |
| Wave 2 | 2.78 | 1.06 | 576 | 2.79 | 0.86 | 363 | 2.41 | 0.92 | 90 |
| Number of partners in past 6 months | | | | | | | | | |
| Wave 1 | 1.02 | 0.31 | 591 | 1.02 | 0.33 | 366 | 1.01 | 0.18 | 90 |
| Wave 2 | 0.83 | 0.41 | 591 | 0.82 | 0.43 | 366 | 0.84 | 0.39 | 90 |
| Used condom in last sexual encounter with main partner | | | | | | | | | |
| Wave 1 | 0.25 | 0.43 | 591 | 0.24 | 0.43 | 366 | 0.34 | 0.48 | 90 |
| Wave 2 | 0.21 | 0.41 | 591 | 0.21 | 0.41 | 366 | 0.18 | 0.38 | 90 |
| Wants more children | | | | | | | | | |
| Wave 1 | 0.71 | 0.46 | 591 | 0.71 | 0.46 | 366 | 0.64 | 0.48 | 90 |
| Wave 2 | 0.67 | 0.47 | 590 | 0.68 | 0.47 | 365 | 0.58 | 0.50 | 90 |
| Number of cows owned | | | | | | | | | |
| Wave 1 | 2.10 | 3.48 | 589 | 2.31 | 3.93 | 364 | 1.74 | 2.75 | 90 |
| Wave 2 | 1.43 | 4.33 | 591 | 1.67 | 5.28 | 366 | 0.77 | 1.71 | 90 |
| # of church attendances in past 4 weeks | | | | | | | | | |
| Wave 1 | 3.33 | 2.53 | 591 | 3.58 | 2.64 | 366 | 3.63 | 3.05 | 89 |
| Wave 2 | 3.47 | 2.70 | 589 | 3.26 | 2.48 | 366 | 3.72 | 2.70 | 90 |
| *Data from Wave 2 only* | | | | | | | | | |
| Disclosed test result to spouse | 0.82 | 0.39 | 482 | 0.86 | 0.35 | 335 | 0.71 | 0.46 | 62 |
| Breastfeed newborn child | 0.95 | 0.22 | 591 | 0.99 | 0.10 | 366 | 0.76 | 0.43 | 90 |

Notes: SD is the standard deviation and N is the sample size. Source: Sample of women enrolled during first ANC clinic visit.

Table 2a: Effect of nurse absenteeism on testing

| | Tested for HIV (1) | Tested for HIV (2) | Tested for HIV (3) |
|---|---|---|---|
| PMTCT Nurse Present | 0.584 | 0.577 | 0.568 |
| | (0.061)** | (0.063)** | (0.063)** |
| Day of week = Tuesday | | 0.052 | 0.056 |
| | | (0.050) | (0.050) |
| Day of week = Wednesday | | 0.102 | 0.105 |
| | | (0.048)* | (0.048)* |
| Day of week = Thursday | | 0.079 | 0.086 |
| | | (0.047)+ | (0.047)+ |
| Day of week = Friday | | -0.027 | -0.026 |
| | | (0.056) | (0.056) |
| *HIV subjective beliefs* | | | |
| Moderate chance | | | 0.022 |
| | | | (0.053) |
| Small chance | | | -0.038 |
| | | | (0.046) |
| No chance at all | | | -0.073 |
| | | | (0.057) |
| Constant | 0.241 | 0.209 | 0.243 |
| | (0.058)** | (0.071)** | (0.079)** |
| Sample Size | 591 | 588 | 584 |
| R-squared | 0.16 | 0.18 | 0.18 |
| F-statistic | 93.09 | 84.71 | 81.07 |

Notes: The dependent variables are defined in Table 1. "Tested for HIV" takes value 1 if a pregnant woman was given an HIV test during any visit at the ANC clinic during pregnancy, 0 otherwise. PMTCT Nurse Present takes value 1 if the PMTCT nurse was present at the ANC clinic on the day of the first visit during a particular pregnancy, 0 otherwise. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Table 2b: Predictors of PMTCT nurse presence

| | Nurse present at time of woman's first visit | |
|---|---|---|
| | (1) | (2) |
| Age in years | 0.001 | 0.001 |
| | (0.002) | (0.002) |
| Completed primary school | -0.020 | -0.017 |
| | (0.026) | (0.026) |
| Married | 0.021 | 0.027 |
| | (0.039) | (0.038) |
| # of church attendances (past 4 wks) | 0.011 | 0.012 |
| | (0.004)* | (0.004)** |
| Number of sexual partners (past 6 mths) | 0.007 | 0.010 |
| | (0.035) | (0.034) |
| Boils drinking water | 0.035 | 0.038 |
| | (0.026) | (0.025) |
| *HIV subjective beliefs* | | |
| Moderate chance | 0.012 | 0.010 |
| | (0.039) | (0.040) |
| Small chance | -0.029 | -0.032 |
| | (0.037) | (0.038) |
| No chance at all | -0.071 | -0.078 |
| | (0.049) | (0.049) |
| Livestock ownership | 0.003 | 0.003 |
| | (0.002) | (0.002)* |
| House has non-grass roof | -0.033 | -0.032 |
| | (0.028) | (0.028) |
| Household resides in clinic catchment | -0.001 | -0.001 |
| | (0.028) | (0.028) |
| Day of week = Tuesday | | -0.013 |
| | | (0.029) |
| Day of week = Wednesday | | -0.028 |
| | | (0.030) |
| Day of week = Thursday | | -0.085 |
| | | (0.033)** |
| Day of week = Friday | | -0.193 |
| | | (0.046)** |
| Constant | 0.865 | 0.909 |
| | (0.081)** | (0.080)** |
| Observations | 577 | 574 |
| R-squared | 0.03 | 0.08 |

Notes: The variables are defined in Table 1. "Nurse present at time of woman's first visit" takes value 1 if the PMTCT nurse was present at the ANC clinic on the day of the first visit during a particular pregnancy, 0 otherwise. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Table 3: Subjective beliefs before HIV test and actual test results

| | Tested positive (1) | Tested positive (2) | Tested positive (3) |
|---|---|---|---|
| Chance of having HIV- great | 0.272 | 0.267 | 0.226 |
| | (0.097)** | (0.098)** | (0.098)* |
| Chance of having HIV- moderate | 0.171 | 0.168 | 0.126 |
| | (0.081)* | (0.082)* | (0.080) |
| Chance of having HIV- small | 0.077 | 0.079 | 0.055 |
| | (0.059) | (0.059) | (0.059) |
| Day of week controls? | N | Y | Y |
| Other controls | N | N | Y |
| Mean of dep. variable | 0.197 | 0.197 | 0.197 |
| Sample Size | 453 | 452 | 452 |
| F-statistic | 12.55 | 11.75 | 8.81 |

Notes: The results are based on probit regressions; marginal effects are reported. The variable "tested positive" takes value 1 if a pregnant woman was tested HIV positive during any visit at the ANC clinic during pregnancy, 0 otherwise. The omitted category among the subjective belief responses is "Chance of having HIV - no chance at all." Other controls include age, education, marital status and wealth. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Table 4: Effect of testing on HIV-related knowledge

| | Change in subjective beliefs about HIV own status | | Change in self-reported beliefs that partner is HIV - | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Panel A:OLS | | | | |
| Tested for HIV | -0.075 | -0.076 | 0.074 | 0.074 |
| | (0.109) | (0.110) | (0.065) | (0.065) |
| Tested positive | -0.577 | -0.409 | -0.291 | -0.207 |
| | (0.135)** | (0.149)** | (0.076)** | (0.088)* |
| AMPATH | | -0.531 | | -0.280 |
| | | (0.265)* | | (0.135)* |
| Constant | 1.683 | 1.714 | 0.117 | 0.133 |
| | (0.186)** | (0.187)** | (0.104) | (0.105) |
| F-test: Tested+Positive=0 | 17.68 | | 5.91 | |
| F-test: Tested+Positive+AMPATH=0 | | 16.85 | | 11.20 |
| prob>F | 0.00 | 0.00 | 0.02 | 0.00 |
| Panel B: IV | | | | |
| Tested for HIV | -0.369 | -0.378 | -0.127 | -0.129 |
| | (0.303) | (0.310) | (0.165) | (0.164) |
| Tested positive | -0.507 | -0.307 | -0.233 | -0.155 |
| | (0.150)** | (0.165)+ | (0.087)** | (0.099) |
| AMPATH | | -0.637 | | -0.258 |
| | | (0.259)* | | (0.138)+ |
| Constant | 1.900 | 1.944 | 0.264 | 0.281 |
| | (0.285)** | (0.291)** | (0.155)+ | (0.155)+ |
| F-test: Tested+Positive=0 | 10.71 | | 6.21 | |
| F-test: Tested+Positive+AMPATH=0 | | 15.73 | | 10.33 |
| prob>F | 0.00 | 0.00 | 0.01 | 0.00 |
| Controls included? | Y | Y | Y | Y |
| Sample Size | 569 | 569 | 584 | 584 |

Notes: The dependent variables are defined in Table 1. Tested for HIV takes value 1 if a pregnant woman was given an HIV test during any visit at the ANC clinic during pregnancy, 0 otherwise. The variable "Tested positive" takes value 1 if the HIV test was positive, 0 otherwise. AMPATH is an indicator that takes the value of 1 if the woman is enrolled in the HIV care program at the clinic and 0 otherwise. Controls include pre-test priors and day of the week. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Table 5: Effect of Testing on PMTCT Outcomes by HIV status and AMPATH enrollment

| | Given any medication to prevent MTCT | | Delivered at hospital | | Had assistance of professional at delivery | | Number of ANC visits | | Breastfed baby | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Panel A:OLS | | | | | | | | | | |
| Tested for HIV | 0.005 | 0.005 | 0.092 | 0.092 | 0.103 | 0.103 | -0.357 | -0.357 | 0.012 | 0.012 |
| | (0.020) | (0.020) | (0.049)+ | (0.049)+ | (0.048)* | (0.048)* | (0.222) | (0.222) | (0.015) | (0.015) |
| Tested positive | 0.183 | 0.072 | -0.001 | 0.002 | -0.034 | -0.046 | 0.232 | -0.051 | -0.214 | -0.125 |
| | (0.044)** | (0.040)+ | (0.060) | (0.070) | (0.059) | (0.069) | (0.225) | (0.263) | (0.044)** | (0.043)** |
| AMPATH | | 0.357 | | -0.010 | | 0.041 | | 0.918 | | -0.287 |
| | | (0.103)** | | (0.115) | | (0.115) | | (0.425)* | | (0.104)** |
| Constant | 0.071 | 0.050 | 0.411 | 0.412 | 0.416 | 0.414 | 4.244 | 4.190 | 0.925 | 0.942 |
| | (0.035)* | (0.034) | (0.079)** | (0.080)** | (0.079)** | (0.079)** | (0.344)** | (0.343)** | (0.029)** | (0.026)** |
| F-test: Tested+Positive=0 | 16.06 | | 1.83 | | 1.07 | | 0.19 | | 19.49 | |
| F-test: Tested+Positive+AMPATH=0 | | 20.15 | | 0.65 | | 0.88 | | 1.63 | | 17.91 |
| prob>F | 0.00 | 0.00 | 0.18 | 0.42 | 0.30 | 0.35 | 0.66 | 0.20 | 0.00 | 0.00 |
| Panel B: IV | | | | | | | | | | |
| Tested for HIV | 0.028 | 0.036 | 0.212 | 0.212 | 0.225 | 0.225 | 0.024 | 0.032 | 0.029 | 0.027 |
| | (0.059) | (0.061) | (0.124)+ | (0.124)+ | (0.121)+ | (0.121)+ | (0.573) | (0.573) | (0.056) | (0.057) |
| Tested positive | 0.181 | 0.065 | -0.033 | -0.022 | -0.068 | -0.073 | 0.110 | -0.169 | -0.225 | -0.133 |
| | (0.047)** | (0.042) | (0.067) | (0.076) | (0.066) | (0.075) | (0.261) | (0.295) | (0.046)** | (0.045)** |
| AMPATH | | 0.375 | | -0.037 | | 0.016 | | 0.915 | | -0.301 |
| | | (0.105)** | | (0.117) | | (0.116) | | (0.436)* | | (0.106)** |
| Constant | 0.052 | 0.025 | 0.322 | 0.324 | 0.325 | 0.324 | 3.966 | 3.905 | 0.914 | 0.934 |
| | (0.055) | (0.057) | (0.115)** | (0.116)** | (0.114)** | (0.114)** | (0.527)** | (0.526)** | (0.048)** | (0.049)** |
| F-test: Tested+Positive=0 | 10.92 | | 2.67 | | 2.14 | | 0.07 | | 9.48 | |
| F-test: Tested+Positive+AMPATH=0 | | 18.84 | | 1.25 | | 1.56 | | 1.80 | | 14.24 |
| prob>F | 0.00 | 0.00 | 0.10 | 0.26 | 0.14 | 0.21 | 0.79 | 0.18 | 0.00 | 0.00 |
| Controls included? | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Sample Size | 571 | 571 | 576 | 576 | 576 | 576 | 570 | 570 | 576 | 576 |

Notes: The dependent variables are defined in Table 1. Tested for HIV takes value 1 if a pregnant woman was given an HIV test during any visit at the ANC clinic during pregnancy, 0 otherwise. The variable "Tested positive" takes value 1 if the HIV test was positive, 0 otherwise. AMPATH is an indicator that takes the value of 1 if the woman is enrolled in the HIV care program at the clinic and 0 otherwise. Controls include pre-test priors and day of the week. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Table 6: Effect of Testing on Sexual Behavior

| | Informed spouse/main partner about test result | | | Change in number of sexual partners in past 6 months | | | Change in condom use | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Panel A:OLS | | | | | | | | | |
| Tested for HIV | 0.065 | 0.088 | 0.088 | -0.023 | -0.029 | -0.029 | -0.076 | -0.049 | -0.049 |
| | (0.050) | (0.050)+ | (0.050)+ | (0.049) | (0.051) | (0.052) | (0.055) | (0.057) | -0.057 |
| Tested positive | | -0.144 | -0.139 | | 0.030 | 0.020 | | -0.137 | -0.168 |
| | | (0.061)* | (0.074)+ | | (0.053) | (0.058) | | (0.067)* | (0.078)* |
| AMPATH | | | -0.014 | | | 0.032 | | | 0.1 |
| | | | (0.121) | | | (0.098) | | | -0.131 |
| Constant | 0.686 | 0.704 | 0.705 | -0.141 | -0.144 | -0.146 | 0.021 | 0.036 | 0.03 |
| | (0.074)** | (0.074)** | (0.075)** | (0.076)+ | (0.076)+ | (0.076)+ | (0.089) | (0.089) | -0.089 |
| F-test: Tested+Pos=0 | | 0.58 | | | 0 | | | 5.8 | |
| F-test: Tested+Pos+AMPATH=0 | | | 0.36 | | | 0.06 | | | 0.93 |
| prob>F | | 0.45 | 0.55 | | 0.99 | 0.81 | | 0.02 | 0.33 |
| Panel B: IV | | | | | | | | | |
| Tested for HIV | 0.249 | 0.286 | 0.287 | 0.083 | 0.077 | 0.078 | 0.018 | 0.055 | 0.056 |
| | (0.156) | (0.160)+ | (0.160)+ | (0.127) | (0.135) | (0.135) | (0.137) | (0.15) | (0.146) |
| Tested positive | | -0.172 | -0.177 | | 0.026 | 0.010 | | -0.169 | -0.199 |
| | | (0.067)* | (0.079)* | | (0.061) | (0.066) | | (0.077)* | (0.086)* |
| AMPATH | | | 0.014 | | | 0.053 | | | 0.103 |
| | | | (0.121) | | | (0.094) | | | (0.135) |
| Constant | 0.529 | 0.542 | 0.541 | -0.226 | -0.228 | -0.232 | -0.055 | -0.040 | -0.047 |
| | (0.145)** | (0.141)** | (0.142)** | (0.122)+ | (0.121)+ | (0.121)+ | (0.140) | (0.138) | (0.138) |
| F-test: Tested+Positive=0 | | 0.63 | | | 0.86 | | | 0.78 | |
| F-test: Tested+Positive+AMPATH=0 | | | 0.54 | | | 1.11 | | | 0.06 |
| prob>F | | 0.43 | 0.46 | | 0.35 | 0.29 | | 0.38 | 0.8 |
| Controls included? | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Sample Size | 477 | 477 | 477 | 584 | 584 | 584 | 584 | 584 | 584 |

Notes: The dependent variables are defined in Table 1. "Tested for HIV" takes value 1 if a pregnant woman was given an HIV test during any visit at the ANC clinic during pregnancy, 0 otherwise. The variable "Tested positive" takes value 1 if the HIV test was positive, 0 otherwise. AMPATH is an indicator that takes the value of 1 if the woman is enrolled in the HIV care program at the clinic and 0 otherwise. Controls include pre-test priors and day of the week. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Table 7: Effect of Testing on Socio-Economic Behavior

| | Change in desire for more children | | | Change in avg. school enrollment of children (6-18 years) in household | | | Change in livestock | | | Change in church attendance | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Panel A:OLS | | | | | | | | | | | | |
| Tested for HIV | 0.001 | 0.009 | 0.009 | 0.026 | 0.030 | 0.030 | -0.077 | 0.005 | 0.006 | 0.549 | 0.650 | 0.651 |
| | (0.050) | (0.051) | (0.051) | (0.036) | (0.037) | (0.037) | (0.415) | (0.477) | (0.477) | (0.321)+ | (0.330)* | (0.331)* |
| Tested positive | | -0.044 | -0.076 | | -0.018 | -0.024 | | -0.421 | -0.767 | | -0.523 | -0.630 |
| | | (0.055) | (0.064) | | (0.038) | (0.048) | | (0.459) | (0.493) | | (0.350) | (0.407) |
| AMPATH | | | 0.108 | | | 0.018 | | | 1.145 | | | 0.365 |
| | | | (0.104) | | | (0.061) | | | (0.483)* | | | (0.632) |
| Constant | -0.004 | 0.001 | -0.006 | -0.071 | -0.071 | -0.072 | -1.412 | -1.366 | -1.432 | -0.085 | -0.026 | -0.048 |
| | (0.081) | (0.082) | (0.082) | (0.054) | (0.054) | (0.054) | (1.040) | (1.049) | (1.057) | (0.450) | (0.450) | (0.453) |
| F-test: Tested+Pos=0 | | 0.26 | | | | | | 1.48 | | | 0.09 | |
| F-test: Tested+Pos+AMPATH=0 | | | 0.17 | | | | | | 0.92 | | | 0.42 |
| prob>F | | 0.61 | 0.68 | | | | | 0.22 | 0.34 | | 0.76 | 0.52 |
| Panel B: IV | | | | | | | | | | | | |
| Tested for HIV | 0.037 | 0.050 | 0.051 | 0.201 | 0.212 | 0.213 | 1.946 | 2.168 | 2.181 | 2.019 | 2.194 | 2.198 |
| | (0.112) | (0.119) | (0.119) | (0.115)+ | (0.120)+ | (0.120)+ | (1.190) | (1.290)+ | (1.294)+ | (0.850)* | (0.894)* | (0.895)* |
| Tested positive | | -0.057 | -0.091 | | -0.053 | -0.055 | | -0.993 | -1.354 | | -0.800 | -0.907 |
| | | (0.063) | (0.071) | | (0.045) | (0.056) | | (0.570)+ | (0.597)* | | (0.406)* | (0.453)* |
| AMPATH | | | 0.112 | | | 0.004 | | | 1.206 | | | 0.370 |
| | | | (0.108) | | | (0.071) | | | (0.498)* | | | (0.638) |
| Constant | -0.033 | -0.028 | -0.036 | -0.215 | -0.215 | -0.215 | -3.060 | -2.976 | -3.055 | -1.282 | -1.208 | -1.234 |
| | (0.114) | (0.113) | (0.113) | (0.109)* | (0.109)* | (0.108)* | (1.456)* | (1.449)* | (1.458)* | (0.777)+ | (0.761) | (0.764) |
| F-test: Tested+Pos=0 | | 0 | | | 2.56 | | | 1.56 | | | 3.46 | |
| F-test: Tested+Pos+AMPATH=0 | | | 0.3 | | | 2.95 | | | 4.42 | | | 3.57 |
| prob>F | | 0.94 | 0.59 | | 0.11 | 0.09 | | 0.21 | 0.04 | | 0.06 | 0.06 |
| Controls included? | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Sample Size | 583 | 583 | 583 | 370 | 370 | 370 | 579 | 579 | 579 | 582 | 582 | 582 |

Notes: The dependent variables are defined in Table 1. "Tested for HIV" takes value 1 if a pregnant woman was given an HIV test during any visit at the ANC clinic during pregnancy, 0 otherwise. The variable "Tested positive" takes value 1 if the HIV test was positive, 0 otherwise. AMPATH is an indicator that takes the value of 1 if the woman is enrolled in the HIV care program at the clinic and 0 otherwise. Controls include pre-test priors and day of the week. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Table 8: Effect of Testing on Behavioral Outcomes for HIV+ women, by surprises and updates

| | Informed spouse/main partner about result | Change in # of partners in past 6 mths | Change in condom use | Change in desire for more children | Change in livestock | Change in church attendance |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A:OLS | | | | | | |
| Tested for HIV | 0.042 | 0.111 | -0.229 | 0.032 | -0.418 | 0.071 |
| | (0.094) | (0.074) | (0.106)* | (0.084) | (0.459) | (0.456) |
| Surprised | -0.122 | -0.062 | 0.065 | 0.028 | -0.211 | 0.933 |
| | (0.159) | (0.104) | (0.167) | (0.107) | (0.567) | (0.835) |
| Updated | -0.070 | -0.175 | -0.033 | -0.120 | -0.187 | -1.921 |
| | (0.183) | (0.131) | (0.162) | (0.133) | (0.743) | (0.943)* |
| Constant | 0.652 | -0.152 | -0.026 | 0.052 | -0.221 | -0.353 |
| | (0.093)** | (0.065)* | (0.092) | (0.066) | (0.449) | (0.454) |
| Panel B: IV | | | | | | |
| Tested for HIV | 0.567 | 0.616 | -0.017 | 0.156 | 1.538 | 3.121 |
| | (0.373) | (0.320)+ | (0.304) | (0.288) | (1.30) | (1.880)+ |
| Surprised | -0.454 | -0.389 | -0.113 | -0.061 | -1.723 | -1.195 |
| | (0.308) | (0.263) | (0.281) | (0.241) | (1.10) | (1.624) |
| Updated | -0.129 | -0.200 | -0.026 | -0.134 | -0.264 | -1.834 |
| | (0.187) | (0.123) | (0.170) | (0.139) | (0.79) | (0.936)+ |
| Constant | 0.470 | -0.270 | -0.070 | 0.025 | -0.655 | -1.060 |
| | (0.159)** | (0.104)* | (0.110) | (0.085) | (0.507) | (0.597)+ |
| Controls included? | Y | Y | Y | Y | Y | Y |
| Sample Size | 138 | 210 | 210 | 210 | 208 | 208 |

Notes: The dependent variables are defined in Table 1. "Tested for HIV" takes value 1 if a pregnant woman was given an HIV test during any visit at the ANC clinic during pregnancy, 0 otherwise. "Surprised" takes value 1 if the woman's subjective belief about her status prior to the HIV test was "small risk" or "no risk at all." "Updated" takes value 1 if the woman's subjective belief about being HIV-positive was higher after the test than before the test. Controls include pre-test priors and day of the week. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Table 9: Effect of Testing on Behavioral Outcomes for HIV- women, by surprises and updates

| | Informed spouse/main partner about result | Change in # of partners in past 6 mths | Change in condom use | Change in desire for more children | Change in livestock | Change in church attendance |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A:OLS | | | | | | |
| Tested for HIV | 0.090 | -0.020 | -0.058 | 0.031 | 0.172 | 0.539 |
| | (0.054)+ | (0.056) | (0.060) | (0.052) | (0.565) | (0.344) |
| Surprised | 0.041 | -0.061 | -0.050 | -0.018 | -0.414 | 0.182 |
| | (0.055) | (0.080) | (0.087) | (0.084) | (0.518) | (0.443) |
| Updated | -0.015 | 0.071 | 0.020 | 0.004 | -0.259 | 0.065 |
| | (0.068) | (0.103) | (0.108) | (0.098) | (1.011) | (0.547) |
| Constant | 0.763 | -0.123 | 0.110 | -0.036 | -0.895 | -0.022 |
| | (0.060)** | (0.060)* | (0.070) | (0.056) | (0.528)+ | (0.365) |
| Panel B: IV | | | | | | |
| Tested for HIV | 0.281 | 0.038 | 0.013 | 0.085 | 2.736 | 2.170 |
| | (0.172) | (0.144) | (0.158) | (0.132) | (1.564)+ | (0.983)* |
| Surprised | -0.009 | -0.082 | -0.071 | -0.036 | -1.264 | -0.347 |
| | (0.068) | (0.093) | (0.099) | (0.095) | (0.739)+ | (0.542) |
| Updated | -0.020 | 0.059 | 0.037 | 0.002 | -0.249 | 0.149 |
| | (0.069) | (0.106) | (0.109) | (0.100) | (1.063) | (0.559) |
| Constant | 0.618 | -0.158 | 0.062 | -0.070 | -2.570 | -1.083 |
| | (0.138)** | (0.105) | (0.119) | (0.094) | (1.108)* | (0.690) |
| Controls included? | Y | Y | Y | Y | Y | Y |
| Sample Size | 402 | 478 | 478 | 477 | 473 | 477 |

Notes: The dependent variables are defined in Table 1. "Tested for HIV" takes value 1 if a pregnant woman was given an HIV test during any visit at the ANC clinic during pregnancy, 0 otherwise. "Surprised" takes value 1 if the woman's subjective belief about her status prior to the HIV test was "high risk" or "moderate risk." "Updated" takes value 1 if the woman's subjective belief about being HIV-positive was lower after the test than before the test. Controls include pre-test priors and day of the week. Robust standard errors in brackets. **, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Appendix A:

Below we provide a more detailed explanation for the imputation of the number of HIV infections that could be averted by the elimination of nurse absences. First we provide an estimate of the prevalence rate of eventual non-testers whose first ANC visit happened on a day when the nurse is absent. Second we combine these estimates with information from the medical literature on the relationship between PMTCT medication and reductions in HIV transmission at birth. Third we calculate the impact of absence on the number of transmissions in a given year for the absence level at our clinic, as well as for typical absence rates in the health sector in developing countries more generally.

Based on a number of plausible assumptions, we generate five distinct estimates of the prevalence rate of pregnant women who did not test due to nurse absence on the first ANC visit:

1.) We assume that the prevalence rate of non-testers is equal to the prevalence rate of testers (19.7%)
2.) We assume that the prevalence rate of non-testers is equal to the adult prevalence rate in the 2003 Kenyan DHS for the Nyanza region (18.3%).
3.) We assume that the prevalence rate of women who turn up for their first ANC visit on days when the nurse is absent (group 1) is the same as on days when she is present (group 2). Among eventual testers for these two groups, the prevalence rate is 19.9% (group 2) and 15.4% (group 1). The testing rates for these groups are 82.5% (group 2) and 24.1% (group 1). The resulting prevalence rate for non-testers who would have tested if the nurse was present is 21.8%.
4.) We use the background characteristics of the women who test to predict in a regression framework the prevalence of all non-testers (20.7%).
5.) We use the background characteristics of the women who test to predict the prevalence of all non-testers whose first visit is on a day when the nurse is absent (19.1%).

Across each of the five different assumptions, the calculated prevalence rate for the group of interest is roughly 20% and varies between 18.3% and 21.8%.

Using the estimates reported in UNAIDS (2005), rates of mother-to-child transmission and the impact of different PMTCT regimens are as follows:

1. Default mother to child transmission rate without any intervention: 32%
2. No intervention, long breastfeeding (18-24 months): 35%
3. No intervention, short breastfeeding (6 months): 30%
4. No intervention, replacement feeding: 20%
5. Single-dose NVP (mothers & infants), combined with short (6 months) breastfeeding (6 months): 16%
6. Single-dose NVP (mothers & infants), combined with replacement feeding: 11%
7. AZT long (from 28 weeks) and single-dose NVP (mothers & infants), combined with short breastfeeding (6 months): 10%
8. AZT long (from 28 weeks) and single-dose NVP (mothers & infants), combined with replacement feeding: 2%

According to the treatment regimen in place at the time of the survey, the most common treatment was AZT long with single-dose NVP combined with short breastfeeding, which has an estimated transmission rate of 10%. Therefore the treatment with PMTCT in our setting reduces the transmission rate at birth among HIV positive women by approximately 22 percentage points (32% to 10%).

On a typical day, a PMTCT nurse conducts testing and counseling to an average of 4.1 pregnant women. When she is absent, about 58% of first time ANC visitors do not test during the pregnancy. Since the prevalence rate is estimated to be around 20% for this group and testing increases the chance of receiving medication to prevent MTCT for those who are positive by 18 percentage points, this means that a one day absence results in roughly .09 (=4.1*.58*.2*.18) positive women do not receive PMTCT. This translates into an *increase* in the HIV transmission from the mother to the child of .019 (.09*.22) cases. If we apply this estimate to the typical absence rate in our clinic (9%), then nurse absence contributes to an additional .42 infections per year (assuming 250 working days in a year). If we apply these estimates to the much larger absence rates found in the literature (35%), then nurse absence contributes to about 1.65 infections per year per nurse.

Taking into account the fraction of women that visit ANC clinics (88%) and neonatal mortality (33 per 1000 live births), these numbers translate into 0.37 infections per 1000 live births (9% absence) and 1.46 infections per 1000 live births (35% absence rates).