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The Effect of Absenteeism and Clinic Protocol on Health Outcomes: The Case of Mother-to-Child Transmission of HIV in Kenya

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Abstract

Absenteeism of health workers in developing countries is widespread with some estimates indicating rates of provider absence of nearly 40% (Chaudhury et. al. 2006). This is the first paper to present evidence of the impact of health provider absence combined with limitations in health clinic protocol on health outcomes. Using longitudinal data from nearly 600 ante-natal care seekers at a rural ante-natal clinic in Western Kenya, we find that nurse absence on a patient's first visit significantly reduces the probability that a woman tests for HIV over her entire pregnancy. Since the benefits of PMTCT services depend on HIV status, we proxy HIV status with self-reported pre-test expectations of being HIV-positive and estimate the heterogeneous impact of absence based on these self-reported expectations. We find that women with a high pre-test expectation of testing HIV-positive and whose first ANC visit coincides with nurse attendance are 25 percentage points more likely to deliver in a hospital or health center, 7.4 percentage points more likely to receive PMTCT medication, 9 percentage points less likely to breastfeed and 10 percentage points more likely to enroll in the free AIDS treatment program at the clinic than similar women whose first visit coincides with nurse absence. The procedural shortcomings in our study setting, shortcomings that do not enable pregnant women to test on a subsequent clinic visit, appear common in other countries in sub-Saharan Africa. They suggest that nurse absence in the context of this medical system translates into sizable reductions in child and maternal health.

1 Introduction

Service provider absence in the health and education sector in developing countries is high and widespread. A recent multi-country survey of education and health providers reported rates of provider absence ranging from 20% for teachers to nearly 40% for health workers (Chaudhury et. al. (2006)). Moreover, the effects of the absence can be compounded by shortcomings in the processes associated with public service delivery. While negative associations between income per capita and absence levels underscore the potential importance of this phenomenon, causal micro-evidence on the impacts of this absence on health and education outcomes is limited. A handful of studies have estimated the impacts of teacher absence on learning (Das et. al 2007; Duflo, Hanna and Ryan 2008; and indirectly, Kremer, Miguel and Thornton 2009). However, similar work has not been done in the area of health.[1] This paper examines the role of absence in the context of maternal and child health services, where adequate service delivery can make the difference between life and death and healthworker absence has the potential to be especially harmful.

In the setting that we study in this paper, healthworker absence in not particularly high relative to rates reported elsewhere. But even low rates of absence can have significant impacts when processes at health facilities do not provide adequate alternatives for clients when healthworkers are absent. We show that the absence of a nurse who provides HIV testing and counseling services, in conjunction with the lack of an effective institutional response that enables pregnant women to test on a subsequent clinic visit, leads to significant health consequences for mothers and their children. By not receiving HIV testing and counseling during pregnancy, some women fail to receive services for the prevention of mother-to-child transmission of HIV (pMTCT). We provide evidence that the problem we describe at the study site is generalizable to the pMTCT outcomes in other countries in sub-Saharan Africa.

Fundamentally, the absence of a service provider represents a shock to the supply of health care. There is a large literature on how individuals and households respond to shocks (see, for example, Besley 1995 and Townsend 1995). These responses can be broadly classified into *ex ante* response (for example, precautionary savings) and *ex post* responses (for example, mutual insurance). In the provider absence context, *ex ante* actions could include hiring additional staff or developing monitoring and incentive mechanisms that reduce unnecessary absence. Since *ex ante* plans are often both costly and imperfect, investments in *ex post* measures, such as the implementation of robust standard operating procedures that specify how clients who missed services can be identified and linked to care, will be necessary as well. While there is a literature on *ex ante* mechanisms to cope with absence and their impacts (see for example a review of a number of studies in Banerjee and Duflo 2006), little is known about the causal impacts of effective *ex post* coping mechanisms.

In the rural antenatal care (ANC) clinic that we study, pregnant women are to be provided with the opportunity to test for HIV/AIDS. If found HIV-positive, they are referred to an HIV clinic within the facility and provided with pMTCT services. Typically, the HIV test is provided on the first antenatal clinic visit on an opt-out basis and, theoretically, if women are not tested on their first visit and do not opt out, they should be offered an HIV test on subsequent ANC clinic visits. We show that despite low levels of provider absence, nurse absence does indeed have significant negative health consequences. Women who fail to test during their first visit when the sole nurse trained in HIV testing for pregnant mothers is absent are more than 50 percentage points less likely to learn their HIV status during their pregnancy.

Of course, it is not nurse absence alone, but also the process of HIV testing in antenatal clinics - specifically the lack of adequate *ex post* coping mechanisms for nurse absence - that account for these negative health consequences. To be fair, the complex nature of medical delivery systems, which involve multiple linkages (i.e., hand offs) between providers with specialized tasks, makes it particularly susceptible to a break down at any point in this process (Wachter 2004). In fact, the mismanagement of patient hand offs between medical units and caregivers has been identified as one of the largest contributors to medical errors, even in sophisticated healthcare systems with state of the art information and

[1]Bjorkman and Svensson (2009) find large health gains associated with a randomized intervention that improves service quality along several dimensions, including provider attendance. The impacts of provider absence alone cannot be separated from other program effects in their empirical framework.

communication technologies (Kohn et al, 1999). The response to these challenges in the health care systems of developed countries has been, in part, to redesign care protocols to include more process redundancies - such as the use of checklists - to ensure that critical care elements do not fall between the cracks (Grout 2003; Kumar and Steinebach 2008). In developing countries, where financial and human capital resources are limited, the significant deployment of redundant processes and personnel are quite 'costly', if achievable at all. While the systematization of care through standard operating procedures (SOP) may be helpful, it is unclear how easily care can be standardized without sacrificing specificity in actionable protocols. Indeed, the relevant existing government SOP for our empirical work — HIV testing in the ANC clinic — is clear in its goals but quite vague in the mechanics of how to achieve them. Since the management of care in a medical clinic is both complex and highly varied over space and time, the 'how to' in any protocol is essential. It is thus not surprising that, as we will show later in the paper, many countries appear to be operating in a manner that fails to significantly compensate for failing to test a pregnant woman for HIV on her first visit to the ANC clinic. Our results underscore that this failure, combined with nurse absence on the first visit, results in real health and human costs.

The bulk of this paper examines the impact of health worker absence on various health outcomes among women attending an ANC clinic in a high HIV prevalence region of Kenya. We exploit across-time variation in the attendance of the sole nurse qualified to provide HIV testing to pregnant women as part of broader prevention-of-mother-to-child-transmission (PMTCT) services - HIV counseling and testing and the provision of medications to women who test HIV-positive - at the ANC clinic. Our empirical strategy is two-fold. We begin by showing that the PMTCT nurse's absence is uncorrelated with a wide range of observable characteristics of the pregnant women as well as visit date information. We then present reduced form estimates of the effects of the nurse's absence on a range of health outcomes. The lone PMTCT nurse at the ANC clinic was absent on approximately 9 percent of clinic days during the study period. First time visitors to the clinic who arrived on a day when the PMTCT nurse was absent were nearly 60 percentage points less likely to receive HIV testing services over the entire course of their pregnancy. This impact of nurse absence is large and robust to controlling for pre-test beliefs about HIV status and date characteristics of the first ANC clinic visit. Women whose first visit coincided with the PMTCT nurse's absence were also 13 percentage points less likely to deliver at a hospital or health center, where deliveries are safest.

Since the benefits of a hospital birth and breast-feeding depends on the HIV status of the pregnant woman, in the second part of our empirical strategy we use an interacted specification to estimate separate effects for women with high and low self-reported pre-test expectations of being HIV-positive. Since we do not know the HIV status for non-testers in our sample, we proxy HIV status with self-reported pre-test expectations of being HIV-positive, a variable that we show is predictive of the actual HIV status of women who were tested at the clinic. We find large and significant effects of PMTCT nurse attendance that are consistent with underlying HIV status. Women with a high pre-test expectation of being HIV-positive who had a nurse present during their first ANC visit were nearly 27 percentage points more likely to give birth in a health center or hospital than similar high risk women whose first visit coincided with nurse absence. More crucially for the long run health of children, high HIV-positive expectations women whose first visit coincided with the nurse attendance are 7.5 percentage points more likely to receive PMTCT medications and 9 percentage points less likely to breast-feed their child than similar high HIV-positive expectations women whose first visit coincided with nurse absence.

Given the efficacy of PMTCT medications and the importance of breast-feeding on the transmission of HIV from mother-to-child, these impacts indicate that health worker absence in our setting has far-reaching implications for the health outcomes of women and their children. Our estimates imply that the absence of the PMTCT nurse in our study translates into 3.7 additional HIV infections per 10,000 live births. Applying our estimates to the average multi-country study absence rate and holding other features of the environment constant implies a four-fold increase in the rate of new infections.

To determine whether the findings in our paper are generalizable to other settings, we also examine Demographic and Health Survey (DHS) data from several countries on women's experiences at antenatal clinics. When comparing the percentage of women who were offered an HIV test during their most recent pregnancy against the number of times that women visited ANC clinics during that pregnancy, we find that the likelihood of being offered an HIV test during pregnancy does not increase with the number of ANC visits at the rate that one would expect if women who did not test during a prior visit were always offered an HIV test during subsequent visits. Thus, it is likely that the process failure that we identify at the clinic studied in this paper is also prevalent at many other ANC clinics. In addition, we cite data on the uptake of PMTCT services as well as official PMTCT guidelines to show that the conclusions from our empirical work in Kenya are consistent with other work on PMTCT services.

The remainder of the paper is organized as follows. Section 2 provides background information on counseling and HIV testing services during antenatal care and describes the data, Section 3 presents the empirical strategy, Section 4 presents reduced form estimates of the effects of health worker absence, as well as the differential impacts by HIV status priors. Section 5 focuses on the generalizability of our results to other settings, and Section 6 concludes.

2 Background and Data

The data used in this study were collected by the authors between July 2005 and February 2007. 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 2007 Kenya AIDS Indicator Survey (KAIS) indicate that 17.2% of adult women in the province are HIV-positive, compared to a national average of 8.4% (National AIDS and STI Control Programme 2009).[2] The health center offers outpatient, inpatient and antenatal care services. It also includes an HIV care and treatment clinic that is managed by the US-Kenya academic medical partnership, USAID-Academic Model Providing Access to Healthcare (AMPATH) Partnership. AMPATH provides PMTCT medication for pregnant women who are HIV-positive as well as highly active anti-retroviral therapy (HAART) for patients who have developed AIDS at no cost to the patient.

Typically, women make three to four visits to the antenatal clinic during their pregnancy. In addition to receiving routine antenatal care, women are generally offered counseling and HIV testing services (CTS) at the first visit. If they decline these services during the first

[2]This is consistent with results from the 2003 Demographic and Health Survey (DHS) that 18.3 percent of adult women in Nyanza province were HIV-positive, compared to a national average of just under 7 percent (Central Bureau of Statistics, Kenya 2004).

visit or if a PMTCT nurse counselor is not present, the women can obtain counseling and HIV testing during subsequent visits. All women are eligible for a pre- and post HIV-test counseling session. As part of the information provided to women in these sessions, women are encouraged to deliver at the health center or with a professional birth attendant. Women who test HIV-positive are counseled on ways to prevent transmission of the virus to their partner and unborn children. For PMTCT, the women are typically referred to 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 (as indicated above 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).

Enrollment into the study was limited to women visiting the ANC clinic for the first time for the observed pregnancy between July 2005 and February 2006. During enrollment we also obtained consent from the study participants to have access to their medical records (including the results of any HIV tests) and in addition a short intake questionnaire was administered prior to engaging with the staff at the ANC clinic (we refer to this as wave 1 of the study). Due to the space and time constraints at the clinic, the wave 1 questionnaire was kept fairly brief. 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.[3] Since patients who did not receive CTS during the first visit could do so on subsequent visits to the ANC clinic, administrative records were used to routinely update the CTS status of enrolled women. During the first wave, we also obtained consent from the women to visit them at their homes after delivery.[4] Only a handful of first wave respondents did not consent to the home visit. 591 women who were interviewed at the clinic during wave 1 were located in wave 2, and sample attrition between waves was under 10 percent.[5] The second wave of the study was part of a large community-based study of maternal health. This wave of the study included a broader survey instrument that included a household roster, questions on education, health, consumption, marriage, sexual behavior, assets, income, and transfers. Interviews were also conducted with the husband or cohabiting partner of 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.

Table 1 presents summary statistics of several key variables, for the entire sample as well as the sub-samples of women who report low and high priors that they are HIV-positive. The average age of the women interviewed in both waves of the survey is 24.7 years, and 59

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[3]The PMTCT nurse was defined as absent if on a given day when the ANC clinic was open there was no entry in the PMTCT logbook. We also kept a direct-observation record of PMTCT nurse absenteeism in order to make sure that days on which all ANC visitors refused the test are not coded as days of PMTCT nurse absence. Such a coincidence did not occur during our sample period, and therefore our two approaches of measuring nurse absence produced identical outcomes

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

[5]In the majority of cases we could not complete the household interview because the respondent could not be located, despite considerable efforts to track down respondents as far as Nairobi. We have included a table in the appendix showing no correlation between the probability of completing the second survey and the nurse absence or the pre-test expectations of testing HIV-positive.

percent of them report having completed primary school. Just over one third of the women report being married, while 40 percent report living with their partner and 24 percent report being unmarried or living separately from their partner. 77 percent of women enrolled in our study and located in wave 2 were tested for HIV during one of their antenatal clinic visits. Among those tested, just over 15 percent were HIV-positive. For 91 percent of the women, a PMTCT nurse was present on the day of their first ANC clinic visit. Several outcomes pertaining to the pregnancy and delivery are of interest.

First, women's self-reports during wave 2 on whether testing and counseling services were offered at the ANC clinic 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, 39 percent reported having delivered in a public or private health facility or hospital.

Table 1 also summarizes the other key variables used in our empirical strategy. Subjective beliefs about one's chances of being HIV-positive were measured in each wave on a scale of 1–4 (with 1 indicating "great chance" and 4 indicating "no chance at all"of being HIV-positive). The mean for this subjective measure of beliefs is 2.76 in wave 1 and the distribution of beliefs is shown in panel B. We define women with low priors as those who in the baseline survey believe that they have little or no chance of being HIV positive and we also define women with high priors as those who believe that they have a moderate or great chance of being HIV positive. In the same table we also present all the summary statistics separately for women with low and high priors. For women who report high priors of being HIV-positive, the mean in wave 1 is clearly lower than the mean for low prior women. On most dimensions of baseline household characteristics, women who report low priors of being HIV-positive are similar to high-prior women. Age is the only covariate that is statistically different between these two groups as women with high priors are slightly older than low prior women.

Our ANC sample is very similar to the population of young or expecting mothers in this part of Kenya. Nearly three quarters of the women in both ours and the DHS Nyanza province sample live in houses with a durable materials roof. 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. Finally, HIV testing rates appear considerably higher in our sample; women enrolled at the ANC clinic are 3 times more likely to have had an HIV test. This difference is likely driven by temporal differences in testing rates possibly related to the recent availability of anti-retroviral medications.[6]

3 Empirical Strategy

The first step of our analysis is to obtain the reduced form effect of nurse absence on a range of health outcomes. We estimate regressions of the form:

$$Y_i = \beta_o + \beta_1 X_i + \beta_2 W_i + \beta_3 P_i + \varepsilon_i \quad (1)$$

[6]There is also 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 recent aggressive marketing and distribution of mosquito nets that has taken place in this area in the period between the surveys.

where *Y* is an outcome variable of interest; *X* is a set of individual characteristics, such as education, age, distance from the clinic and marital status, *W* represents visit date characteristics such as the day of the week or month, and *P* is an indicator for whether the counseling and testing nurse was present on the first visit to the ANC clinic. β_3 represents the reduced form effect of nurse attendance on health outcomes such as learning HIV-status as a result of a test at the clinic, the choice of delivery location, receipt of PMTCT medication and breast-feeding. In all our specifications our standard errors are clustered on the visit date level.

Our estimation strategy will not reproduce the reduced form effect of nurse absence on outcomes (β_3) if nurse absence is correlated with unobserved patient characteristics that affect outcomes ($Cov(P_i, \varepsilon_i) \neq 0$). The identifying assumption underlying our analysis is that after controlling for observable household and ANC user characteristics, visit date characteristics and priors about HIV-status, the demand for the information and services provided by the PMTCT nurse for women who visit the clinic on days when the nurse is present is the same as on days when she is absent. Our empirical strategy would be invalid if for example a selected subsample of women with particular unobservable characteristics who want to avoid CTS come to the clinic for antenatal care on days when the PMTCT nurse is absent or more likely to be absent.

In order to address this concern, we first start by showing that the presence or absence of a PMTCT nurse on the day of a woman's first antenatal visit is uncorrelated with observable characteristics of pregnant women, their beliefs about their perceived probability of having HIV/AIDS and visit date characteristics. In Table 2, we report the results from a cross-sectional regression of an indicator of nurse presence on ANC user and first visit date characteristics. In column (1) we include a range of socioeconomic characteristics of the woman and her household. The results in column (1) suggest that the likelihood that a nurse is absent on the woman's first antenatal visit is uncorrelated with observable characteristics such as the age, education, marital status and other measures of household well-being.[7] To address additional sources of bias we include in column (2) the quarter in which the baby was conceived.[8] The results suggest the lack of a systematic association between nurse attendance patterns and the timing of conception. In column (3) we include self-reported beliefs that the woman is HIV-positive to control for a wide variety of observable and unobservable determinants of the demand for counseling and testing. Holding observable characteristics constant, we find no systematic association between reported beliefs and the nurse's likelihood to be absent. Finally it is possible that women can use information about patterns of absence unknown to the researcher to select visit dates where the nurse is more or less likely to be absent. We examine this possibility by including controls for visit date characteristics in column (4). In particular we include indicator variables for each day of the week and a quadratic in the day of the month. Compared to our base variable (Monday), most of our day of the week indicators are small and statistically insignificant. However, there is evidence that Fridays are associated with a 18 percentage points greater absence rate compared to Mondays. Of note is the fact that we find no evidence of a systematic relationship between absence patterns and the day of the month. In sum our evidence suggests that the composition of women whose first visit coincides with the nurse's presence is not measurably different from those who visit when she is absent.

[7]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/members of the family and funeral attendance. It is unlikely that information about these 'shocks' to attendance would be available to any of the ANC users.

[8]We use the quarter rather than the month of conception to deal with measurement error associated with premature birth as well as to conserve degrees of freedom. However, our results are robust to controlling for month of conception.

A number of institutional details and additional robustness checks may help assuage any remaining doubts about this identification strategy. Firstly, for selection bias to be present, potential ANC visitors need to be able to observe and predict patterns of nurse absence. Based on our two year long experience working with the clinic this is unlikely to be the case since absences of the medical staff are rarely pre-announced or advertised (consistent with the results in Banerjee, Deaton and Duflo 2004). Moreover since the majority of women travel significant distances to the clinic it is unlikely that they could have access to such information at home, even if it were available. Secondly, the average rate of nurse absence (9 percent of days) and the variation by day of week, which ranges from 3.4 percent on Mondays to just under 22 percent on Fridays, is small enough that strategically choosing to visit on a day when the nurse is absent seems unlikely.[9] This possibility is made all the more implausible by the fact that women can always opt out of CTS (20 percent of women who visit on a day when the nurse is present do indeed decline to be tested). Third, we have performed a number of additional robustness checks (not reported) and found no consistent relationship between the characteristics of women and the day of the week when they visit the ANC clinic. For example, there is no significant relationship between the distribution of pre-test beliefs that women have about their HIV status and the day of the week of their first visit. In addition, there is no relationship between the distribution of pre-test beliefs about HIV status and the presence of the PMTCT nurse.

Next we extend our main framework to capture the heterogenous treatment effects of absence by HIV status. Understanding these heterogenous responses are of particular interest in this setting, because the benefits from contact with the PMTCT nurse are expected to be larger for women who are HIV-positive as well as their infants. It is worth noting that since we do not observe in our data the HIV status of women who do not get testing and counseling services, we are unable to use actual HIV status as the variable that is interacted with nurse attendance. Instead, our specifications use the self-reported belief from the baseline survey as a proxy for actual HIV status. We thus estimate the following regression model:

$$Y_i=\beta_o+\beta_1 X_i+\beta_2 W_i+\beta_3 P_i+\beta_4 low_i+\beta_5 P*low_i+\varepsilon_i \quad (2)$$

Most variables are defined in equation 1. low_i is a dummy taking value 0 for women who in the baseline survey believe that they have a moderate or great chance of being HIV-positive and value 1 for women who believe that they have little or no chance of being HIV-positive. The main coefficient of interest are β_3 and β_5, as they indicate the impact of nurse attendance for women with high priors (β_3) and the impact for women with low priors (β_3 + β_5) of having HIV.

Before proceeding, we discuss two identification challenges for our analysis of heterogenous treatment effects by HIV status. The first identification issue is that our measure of self-reported beliefs of HIV status may be correlated with a number of observable and unobservable characteristics of the women. For example, one might worry that if age and self-reported beliefs about HIV are correlated, our coefficient of interest (β_5) might also pick up the differential effect of nurse absence by age. As a robustness check we will show specifications where we also add as a control the interaction of nurse absence with an index of socioeconomic status that includes age (quadratic), marital status, education, distance from the clinic, housing characteristics and livestock holdings. This principal components

[9]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. Average levels of absence for nurses from a multi-country study are more than three times as large (see Chaudhury et al., 2006).

index captures potential earnings and/or wealth during the life cycle and conserves degrees of freedom..

The second issue is whether self-reported beliefs of HIV status is a good proxy for underlying HIV status. A priori, bias in self-reported beliefs about HIV status might arise from stigma-related concerns that prevent women from revealing their true beliefs to an enumerator or from poor survey comprehension. As mentioned earlier, not all women tested for HIV at the ANC clinic, but for the 77% who do get tested we can confirm that the reported beliefs are good predictors of actual HIV status.[10] Column (1) of Appendix Table A.1 shows that compared to women who reported “no chance at all” of being HIV-positive at the time of enrollment, women who reported a “moderate” or a “great” chance were approximately 17 and 27 percentage points more likely, respectively, to test HIV-positive (these differences are statistically significant). These results persist when we control for visit date characteristics as well as the timing of conception in column (2). Adding observable characteristics of women in column (3) (such as age, education, and wealth) reduces the predictive power of beliefs slightly, as indicated by the change in the p-value of the Chi-squared test of no predictive power of self-reported beliefs. Even then, we reject the null of no-information in self-reported beliefs at the 5% level. It is noteworthy that conditional on HIV status priors, only age significantly predicts HIV status. In column (4) we show that sample selection driven by non-response on some control variables does not drive the results. In columns (5)–(8), we show that an indicator of whether the woman reports a moderate/great chance of HIV increases the likelihood that she tests positive by 12 percentage points. Overall, these results provide support for the strategy we implement to uncover heterogenous reduced form effects of absence.

4 Results

4.1 Impact of nurse presence on uptake of HIV testing

In Panel A of Table 3 we begin with the impact of the PMTCT nurse presence on the likelihood that women learn their HIV status during the observed pregnancy. The dependent variable for the regressions is an indicator for whether or not a woman learns her HIV status during the course of this pregnancy. In column (1), we present the unconditional estimate and add visit date, self-reported beliefs and ANC user and household characteristics in columns (2), (3) and (4) respectively. In column (5), we show that sample selection due to non-response does not drive our results. Across all specifications we find a very large and statistically significant effect of nurse presence during the first ANC visit on the likelihood that women learn their HIV status. The point estimates from our different specifications range between 55 and 59 percentage points. The robustness of these results to the inclusion of different controls also alleviate the earlier concerns that the absence of the PMTCT nurse might be correlated with types of women who attend the clinic on such days. Despite the fact that women whose first visit coincides the PMTCT nurse’s absence make additional visits to the clinic, only one out of four women learns their HIV-status during other ANC visits. In comparison, a woman whose first visit coincides with the nurse’s attendance is three times more likely to learn her HIV status. The very large effect of absence on the uptake of HIV-testing suggests that the referral system at this health center is broken. While women whose first visit coincides with nurse’s absence should in principle have about three more opportunities to learn their HIV-status, poor records management implies that three out of four such women are not identified as needing HIV counseling and testing. Overall, the

[10]The regressions in Appendix Table A.1 suffer from potential sample selection bias given that the choice to test is endogenous. A Heckman selection model (not reported) using the nurse absence as an instrument for selection into HIV testing corroborates the findings here that self-reported beliefs predict HIV status.

estimates in Panel A of Table 3 suggest that the presence of the PMTCT nurse is critical to important health outcomes.

4.2 Impact of Nurse Presence on Delivery and PMTCT Outcomes

The immediate impact of the absence of a PMTCT nurse is that it can affect the likelihood that women take-up important services that influence child delivery outcomes. The principal reason for offering HIV testing and counseling 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 administer the PMTCT medications. More broadly, for all women who take advantage of HIV testing and counseling, the PMTCT nurse reinforces the importance of delivering at a health center or using sufficiently trained birth attendants.[11] Since pregnant women and their households may weigh the costs of delivery in a formal setting against the perceived benefits, information gained during preand post-test counseling sessions may alter the trade-offs towards safer delivery and greater take-up of PMTCT medications.

The reduced form impact of nurse presence on antenatal, delivery, and postnatal outcomes is reported in Table 4. In columns (1)–(3) of Table 4 we examine the impact of nurse presence on the likelihood that the women deliver in an environment where they can obtain relatively high quality obstetric care. Columns (4)–(6) examine how nurse presence affects the number of subsequent ANC visits while columns (7)–(9) focus on the self-reported uptake of medication to prevent the vertical transmission of HIV. Columns (10)–(12) looks at the effects on whether mothers breast-feed, while columns (13)–(15) examine the effect on enrollment into the AIDS treatment program. We include controls for visit date characteristics and HIV-status priors in all specifications, and in specifications (2), (5), (8), (11) and (14) we also add socioeconomic characteristics of the ANC user. Specifications (3), (6), (9), (12) and (15) are similar to those in columns (1), (4), (7), (10) and (13) but the sample is restricted to women with complete data on all controls. Our preferred estimates are drawn from specifications (2), (5), (8), (11) and (14) which have the full set of controls. We find a large and significant effect of nurse attendance on the choice to deliver in a hospital or health center. The estimate suggests that women whose first ANC visit coincides with the nurse's attendance are 13 percentage points more likely to deliver in a hospital or health center than women whose first visit coincides with the nurse's absence. This represents a large — nearly 50% — increase in the likelihood of delivering in a considerably safer environment. In columns (4)–(6) of the same table we find that nurse absence during the initial ANC visit does not appear to affect the number of subsequent ANC visits. We will discuss the interpretation of this result in the concluding section, but note that this result is suggestive with absence not having an impact on the future demand for health services caused by a loss of confidence in the medical system. We find no effects of nurse presence on the likelihood of reporting the use of medication to prevent the vertical transmission of HIV. While the point estimates on PMTCT uptake are economically large they are imprecisely estimated. This finding could also be explained by the fact that in our reduced form regressions the sample includes a large fraction of HIV-negative women for whom the use of PMTCT medications is generally not recommended. In columns (10)–(12) we find no effect of nurse absence on breast-feeding patterns and enrollment into the AIDS treatment program. These results are not surprising since during prenatal counseling, HIV-positive and HIV-negative women receive opposite advice regarding breast-feeding and AIDS treatment programs are only appropriate for those testing positive.

[11] This evidence is based on an interview at the clinic with the PMTCT nurse.

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4.3 Do impacts of health worker presence differ by HIV status?

Table 5 explores the differential impact of PMTCT nurse presence by HIV status for the same outcome variables used in Table 4. We estimate equations in which the variable for nurse absence on the day of the first PMTCT visit is interacted with an indicator of whether at baseline the pregnant woman believes she has a low probability of being HIV-positive. As discussed above, we use the self-reported beliefs instead of the actual results from the HIV test since about 23 percent of women in our sample do not get tested at the clinic during their pregnancy. Nevertheless, since our data from the sample of testers indicates that baseline self-reported beliefs are good predictors for underlying status, it suggests that pre-test beliefs can be used to understand the heterogenous reduced form impacts of nurse absence.

The two key estimates are drawn from the main and interacted effects of nurse presence. The main effect measures the impact of nurse attendance for women who report a high likelihood of being HIV-positive, while the sum of the main and interacted effects measure the impact of nurse presence on low-prior women. As in Table 4, we control for visit date and ANC user characteristics and our preferred estimates are drawn from columns (2), (6), (10), (14) and (20) which also include a set of background controls.

We find considerable heterogeneity in the impact of health worker attendance on child delivery outcomes. High prior women whose first visit coincides with the nurse's attendance are 25 percentage points more likely to deliver in a health center or hospital than high prior women whose first visit coincides with nurse absence. This effect is large and statistically significant at the 5% level. For low prior women, the effect size indicated by the sum of the main and interacted terms is considerably smaller relative to the impact on high prior women. Low prior women whose visit coincides with the nurse's attendance are only 10 percentage points more likely to deliver in a health center or hospital than low prior women who arrive when the nurse is absent. The low prior effect is also imprecisely estimated with p-values ranging between 0.15 and 0.32 across the different specifications.

In columns (5)–(8) we do not find heterogeneity in health worker presence on number of ANC visits. In columns (9)–(12) we document the heterogenous impact of health worker presence on the likelihood of receiving medication to prevent vertical transmission of HIV. High prior women whose first visit is on a day when the PMTCT nurse is present are 7.4 percentage points more likely to report receiving PMTCT medication than high prior women whose visit coincides with the nurse's absence. As we would expect for this outcome, health worker absence has no statistically significant effect on low prior women. Similarly in columns (13)–(16), we estimate the differential effect of health worker presence on breastfeeding behavior for high and low prior ANC users. The impact of health worker presence on high prior women is to reduce the likelihood that they breast-feed by nearly 9 percentage points. For low prior women, we estimate a very small and statistically insignificant impact of attendance on the likelihood of breast-feeding. The uptake of PMTCT medication and abstaining from breast-feeding are both strategies to reduce vertical transmission of HIV to children. Any impact of the health worker's presence should only matter for those women most likely to be HIV-positive. In particular, it suggests that information delivered in the pre- and particularly the post-HIV test counseling sessions has large impacts on child health outcomes.

Finally in columns (17)–(20) we examine the impact of nurse presence on enrollment in the free AIDS treatment program at the health center. Only 5% of our sample enrolls in this treatment program. Our preferred results in column (18) suggest that for women most likely to test HIV-positive, arriving on a day when the nurse is present increases the likelihood that you enroll in the treatment program by 10 percentage points relative to when the nurse is absent. This point estimate suggests that nurse attendance has a three fold effect on the likelihood of enrolling in a treatment program. Given recent evidence that AIDS treatment outcomes are considerably better when treatment starts earlier (Thompson et al. (2010)), these results imply large long-term benefits to women likely to test positive and arriving on a day when the nurse is present. As with the breast-feeding and PMTCT result, the effect of nurse attendance on low prior women is small and statistically insignificant.[12]

The results above are robust to including interactions between nurse presence and an index that summarizes age, education, marital status, distance and wealth holdings of ANC users. In columns (3), (7), (11), (15) and (19), including an interaction of absence and this principal components index of social economic status does not change the magnitude or significance of the coefficients reported above. The results suggest that over and above visiting an antenatal clinic, the PMTCT nurse's presence has large effects on the behavior of pregnant women that translate into large gains in child and maternal health. In addition to the public resources leakage associated with health provider absence, these results suggest considerable adverse effects on the health of the intended beneficiaries of HIV testing and their newborn children.

5 Generalizability of results

One important issue that our analysis has not addressed so far is related to the external validity of our findings — our analysis is based on data from one clinic in rural Kenya. In this section we provide two types of evidence that suggest our results appear applicable to a wider range of settings. First we cite existing studies indicating that failure to offer HIV testing is one important factor that has constrained the rapid scaling up of PMTCT interventions. Secondly, we use data from a number of DHS surveys implemented recently in African countries to show that in many countries providers of ANC care do not seem to offer enough additional HIV testing opportunities to pregnant mothers who fail to get tested on their first visit to the health facility.

Following the discovery of several antiretroviral interventions that were proven to reduce the risk of mother-to-child HIV transmission and the subsequent development of clear guidelines to implement and use such medications during antenatal care and pregnancy, many policymakers believed that PMTCT would be a relatively simple matter of incorporating antenatal HIV testing and maternal-infant antiretroviral prophylaxis into routine pregnancy and newborn care. Intrapartum and neonatal single-dose nevirapine was considered to be a very simple intervention (Guay 1999). However, in practice it has been extremely challenging to bring this and other PMTCT interventions to scale (WHO 2010).

Relatively few studies have rigorously identified the reasons for the failure of near-universal pMTCT coverage. Many programs, for example, do not identify the major programmatic bottlenecks to testing all women and providing prophylaxis to those who need it. Hence, it has been unclear whether low PMTCT coverage is the result of a failure to offer HIV testing as part of antenatal care, a failure of women prescribed single-dose nevi-rapine to self-administer the medication at labor onset, or various other factors. However, a landmark study conducted in 4 African countries (the PEARL study) sought to estimate the coverage of existing pMTCT services (Stringer et. al 2010) by measuring the population nevirapine coverage, defined as the proportion of HIV-exposed infants in the sample with both maternal nevirapine ingestion and infant nevirapine ingestion. The study, conducted in 43 randomly selected facilities providing delivery services in Cameroon, Côte d'Ivoire, South Africa, and Zambia, established a path (or cascade) of events that needed to take place in

[12] In Panel B of Table 3 we do not find evidence of a heterogenous impact for HIV testing for high and low prior women.

order to successfully prevent HIV transmission from mother to infant. Only 51% of HIV-exposed infants were determined to have received the minimal regimen of single-dose nevirapine. Failure to offer HIV testing was one of several important reasons for infants not receiving pMTCT medications. Importantly the study found that the problematic step in delivering PMTCT services varied across clinics: in some clinics the problem was that few women were offered HIV testing, whereas in others it was non-delivery of maternal or infant nevirapine and non-adherence to medication. Each clinic faced its own mix of challenges in maximizing service coverage - a finding that is relevant to our study as it suggests that clinic-specific factors are important in explaining low pMTCT coverage.

In addition to the PEARL study, a number of features in various countries' pMCTCT guidelines reveal why the process by which HIV testing is offered during antenatal care may be responsible for pregnant women never being tested for HIV. In several countries, there is a disproportionate focus on offering HIV testing to new (i.e. first-time) ANC visitors. This makes sense as it is the first opportunity to offer HIV testing to pregnant women, but is problematic if women are not being screened for HIV testing during subsequent visits to the antenatal clinic. In fact, there is evidence from one program in South Africa that first-time visitors are actually segregated and told about mother-to-child transmission of HIV and offered an HIV test (DFID/SA checklist). In other countries such as Zimbabwe, there is an emphasis on group education about HIV and pMTCT for all women presenting for antenatal care, which is easier to deliver to first-time visitors who can be easily identified on each clinic day (Chandisarewa 2007).

One way to determine the extent of gaps in exposure to HIV testing during pregnancy is to look at the relationship between the probability of being offered an HIV test during pregnancy and the number of antenatal visits made by women. We use DHS data from four African countries: Kenya 2008, Uganda 2006, Zambia 2007, and Ghana 2008. These data provide comprehensive socio-economic and demographic information and also indicate the number of ANC visits during the most recent pregnancy as well as whether or not a woman was offered an HIV test during any of her ANC visits.[13] In our analysis we are particularly interested in determining whether the probability of being offered an HIV test seems to differ for women who had only one ANC visit compared to those who had two, three, and four ANC visits. We present our results in graphical form in Figures 1a to 1d. Each of the four country graphs presents the results separately for urban and rural settings. We plot how the *conditional* probability of being offered an HIV test during any visit varies with the number of self-reported ANC clinic visits. These results are based on a linear probability regression that includes a series of indicator variables for the number of ANC visits as well as a set of observable characteristics such as education, age, marital status and wealth indicators. The height of the bars represent the cumulative probability of being offered an HIV-test for women during the most recent pregnancy. These actual frequencies are contrasted with results from a simulation that applies the probability of being offered an HIV test among one time ANC visitors to all the subsequent visits and calculates the projected cumulated probability of being offered an HIV test by the number of ANC visits. The graphical results provide evidence that is consistent with the fact that women are much more likely to be offered an HIV test on the first visit compared to subsequent visits. As an example for rural Kenya (Figure 1a), the actual probability of being offered a test increases from 64% for one time visitors to 80% for two time visitors and 83% for three times visitors. The simulated probabilities for one, two and three time visitors are 64%, 87% and 95% respectively. The results for rural Uganda (Figure 1d) are even more striking: for women who visit the ANC clinic three times during a recent pregnancy (the median number of visits

[13]Unfortunately, the survey did not ask during which specific visits the HIV test was offered.

in the sample) the difference between the actual probability of being offered a test (31%) and the projected probability (60%) is even larger. The results for the remaining two countries presented in Figures 1b and 1c as well as for all urban regions are also broadly consistent. These patterns are also consistent with similar graphs presented in Figure 1e using data from our own survey based on information on actual testing information and the number of ANC visits during the latest pregnancy.

The results presented above should be treated with care in light of the fact that, apart from using observable characteristics as controls, we cannot rule out potential selection effects that drive both the reporting of being offered a test and the number of ANC visits. Nevertheless, we believe that our results using the DHS data combined with the existing evidence on PMTCT coverage are indicative that the findings in our paper apply more generally. They suggest that health facilities do not seem to provide adequate testing opportunities to pregnant women beyond the first ANC clinic visit.

5.1 Discussion and conclusion

Using a panel dataset of pregnant women who sought antenatal care in a high HIV prevalence region of Kenya, we assess the impact of healthcare provider absence on a number of health outcomes. Our results show that in the study area, health worker absence is one of the important determinants of uptake of HIV testing and counseling services and that it also influences the probability that pregnant women give birth in a hospital or health center. We test for differential impacts of nurse attendance using pre-test beliefs which predict HIV-status for those who test. For those women who are more likely to be HIV-positive, we find that the presence of the PMTCT nurse increases the probability of receiving PMTCT medications at the time of delivery, decreases the probability of breast-feeding and increases the probability of enrollment in an HIV treatment program.

While our analysis has focused on the reduced form impacts of PMTCT nurse presence on health outcomes, at least two plausible and possibly overlapping mechanisms could underpin this relationship and merit a brief discussion. First, the presence of the PMTCT nurse is required for being tested for HIV and for the provision of HIV and pregnancy counseling. Learning one’s HIV status and receiving counseling are the main channels for helping women learn about the risks and benefits of breast feeding for HIV-positive mothers and the benefits of delivery in a safe setting. Nonetheless, an alternative mechanism may also be at play here. If women who arrive at the clinic on a day that the nurse is absent lose confidence in the medical system, then they may similarly be less likely to demand downstream health services, independent of their knowledge regarding the potential benefits of those services. While the absence in our setting does not preclude patients from accessing all forms of antenatal care apart from PMTCT counseling and testing during that visit, we nonetheless cannot rule out this discouragement explanation as at least a partial driver of our results. That nurse absence during the initial ANC visit does not appear to affect the number of subsequent ANC visits (columns 4–6 of Table 4), provides at least suggestive evidence that this is not the primary mechanism through which these absence effects operate.

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 A.2 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 yields the result that PMTCT nurse absence contributes to an additional 3.7 mother-to-child infections per 10,000 live births. If we apply these estimates to the 35 percent absence rate documented in some other developing country settings

(Chaudhury et al., 2006) and assume a similar population and quality of health facility, then nurse absence contributes to about 14.6 additional infections per 10,000 live births. This number appears staggeringly large when compared to the seemingly small expenditure that would be required to provide substitute nurse coverage in the clinic. In addition, improvements in the referral system such as the deployment of well designed electronic medical records systems could mitigate the effects of absence in this setting (Siika et. al. 2005). Of course, implementing effective and long lasting reductions in absence or interventions meant to reduce the effects of absence may be hard when the system is not conducive to change (Banerjee, Duflo, and Glennerster 2008). National and global policy makers need to take the costs and benefits associated with these effects into account when deciding on priority investments for health.

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Appendix

Appendix Table A1: Subjective beliefs before HIV test and actual test results

	Dependent variable: Indicator tested positive							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Chance of having HIV-great	0.272	0.247	0.208	0.263				
	(0.097) **	(0.098) *	(0.099) *	(0.097) **				
Chance of having HIV-moderate	0.171	0.156	0.111	0.166				
	(0.081) *	(0.082) +	(0.079)	(0.082) *				
Chance of having HIV-small	0.077	0.060	0.021	0.069				
	(0.059)	(0.060)	(0.061)	(0.060)				
Chance of having HIV - great or moderate					0.126	0.125	0.120	0.129
					(0.043) **	(0.043) **	(0.043) **	(0.043) **
Day of week = Tuesday		0.004	−0.001			0.004	−0.000	
		(0.057)	(0.056)			(0.057)	(0.056)	
Day of week = Wednesday		−0.005	0.004			−0.002	0.005	
		(0.058)	(0.059)			(0.058)	(0.059)	
Day of week = Thursday		−0.019	−0.041			−0.011	−0.038	
		(0.052)	(0.050)			(0.053)	(0.050)	
Day of week = Friday		0.083	0.073			0.089	0.077	
		(0.072)	(0.071)			(0.072)	(0.072)	

	Dependent variable: Indicator tested positive							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Day of the month		0.006	0.001			0.005	0.001	
		(0.009)	(0.009)			(0.009)	(0.009)	
Day of the month squared		−0.000	−0.000			−0.000	−0.000	
		(0.000)	(0.000)			(0.000)	(0.000)	
Quarter of conception ==2		0.006	0.018			0.004	0.017	
		(0.047)	(0.048)			(0.047)	(0.048)	
Quarter of conception ==3		0.069	0.089			0.073	0.092	
		(0.057)	(0.060)			(0.057)	(0.060)	
Quarter of conception ==4		−0.120	−0.115			−0.126	−0.118	
		(0.054) *	(0.054) *			(0.052) *	(0.052) *	
Age in years			0.087				0.087	
			(0.027) **				(0.026) **	
Age in years, squared			−0.001				−0.001	
			(0.000) **				(0.000) **	
Completed primary school			−0.049				−0.045	
			(0.041)				(0.041)	
Married			−0.073				−0.079	
			(0.061)				(0.061)	
Frequency of church attendance in past four weeks			0.007				0.007	
			(0.008)				(0.008)	
Boils drinking water			0.007				0.005	
			(0.045)				(0.046)	
# of livestock held at enrollment			−0.005				−0.005	
			(0.005)				(0.006)	
Lives in a non-thatched house			−0.007				−0.009	
			(0.043)				(0.043)	
Lives in Maseno division			0.009				0.009	
			(0.044)				(0.044)	
Log distance from clinic			−0.011				−0.011	
			(0.031)				(0.031)	
Observations	453	452	446	446	453	452	446	446
F-Stat:Test No Effect of Priors on Actual Status	12.55	11.41	9.98	12.29				
prob>Chi2	0.01	0.01	0.02	0.01				

Notes: The variables are defined in Table 1. Table reports marginal probit estimates. Tested positive takes value 1 if the subject was tested positive during the pregnancy and 0 if HIV-negative. Standard errors in brackets clustered at the visit date level.

**, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

Appendix Table A.2:

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 population of interest is roughly 20% and varies between 18.3% and 21.8%.

Next we turn to estimates of the efficacy of PMTCT interventions. 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 NVP1 (mothers & infants), combined with short (6 months) breastfeeding (6 months): 16%
6. Single-dose NVP (mothers & infants), combined with replacement feeding: 11%
7. AZT2 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 PMTCT intervention 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 population 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).

[1]NVP – nevirapine.

[2]AZT – azidothymidine

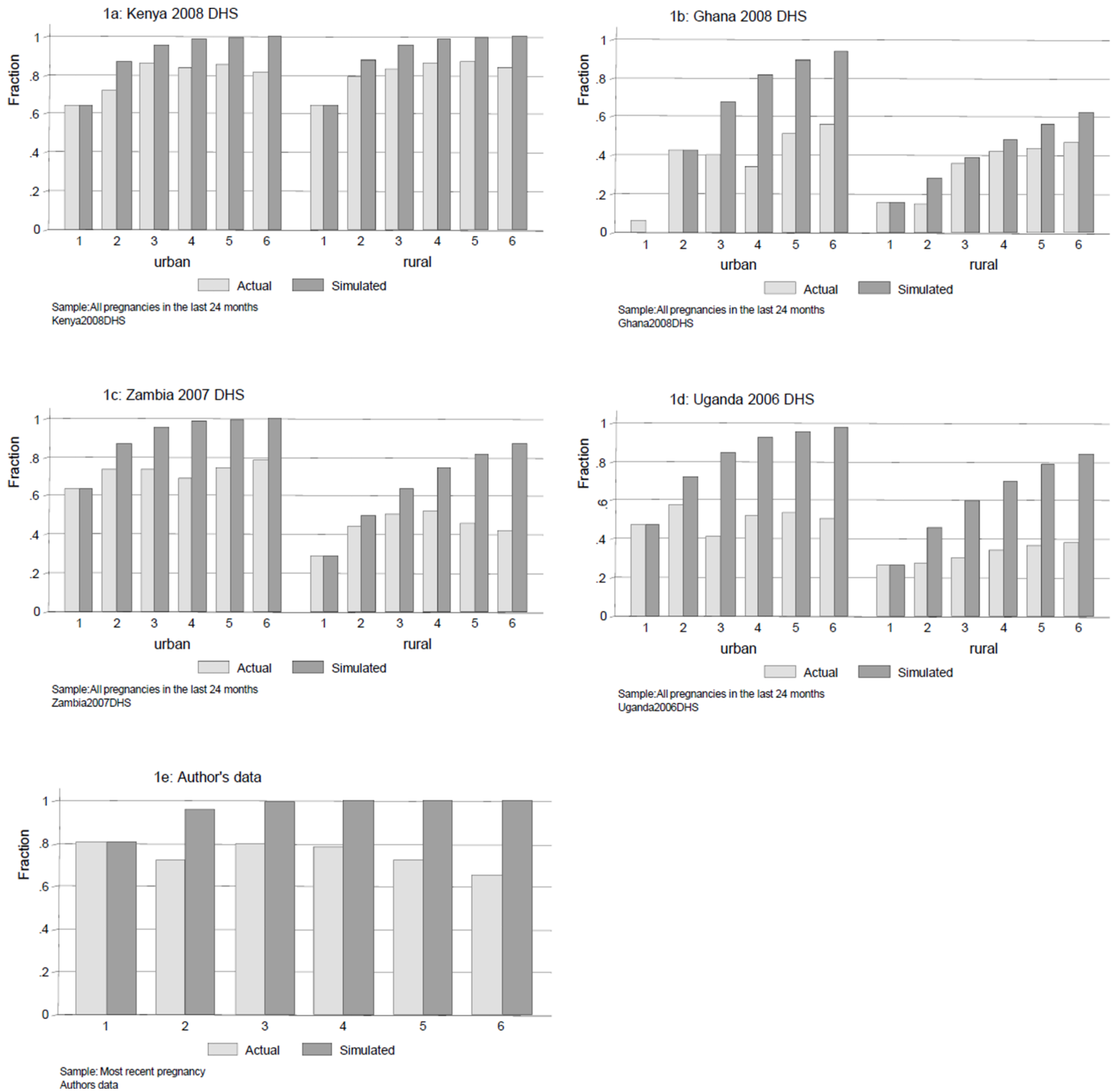

Figure 1.

Fraction of Women Offered HIV Test vs. Number of ANC Visits

Notes: Figures 1a–1d presents the results separately for urban and rural settings based on DHS data from Kenya, Uganda, Zambia and Ghana. The graphs plot the conditional probability of being offered an HIV test during any pregnancy versus the number of self-reported ANC clinic visits. These results are based on a linear probability regression that includes a series of indicator variables for the number of ANC visits as well as a set of observable characteristics such as education, age, marital status and wealth indicators. The height of the bars represent the cumulative probability of being offered an HIV-test for women during the most recent pregnancy. These actual frequencies are constrasted with

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results from a simulation that applies the probability of being offered an HIV test among one time ANC visitors to all the subsequent visits and calculates the projected cumulated probability of being offered an HIV test by the number of ANC visits. Figure 1e present similar data from our own survey sample.

Table 1

Summary Statistics

Panel A	All women enrolled			Low prob HIV+ women			High prob HIV+ women			Diffference: Low vs High
	Mean	SD	N	Mean	SD	N	Mean	SD	N	p-value
Variables										
Age in years	24.69	6.36	587	24.33	6.25	409	25.51	6.53	178	0.04
Fraction completed primary school	0.59	0.49	583	0.60	0.49	406	0.58	0.50	177	0.58
Fraction married	0.76	0.42	587	0.77	0.42	409	0.76	0.43	178	0.97
Freq. church attendance, past 4 weeks	3.34	2.53	587	3.43	2.57	409	3.13	2.44	178	0.20
Number of sexual partners	1.02	0.31	587	1.02	0.33	409	1.01	0.27	178	0.50
Fraction boils water	0.77	0.42	586	0.77	0.42	408	0.78	0.41	178	0.81
Number of livestock	2.09	3.48	585	2.07	2.93	407	2.14	4.52	178	0.83
Fraction iron roof	0.73	0.44	587	0.73	0.44	409	0.73	0.45	178	0.99
Fraction located with Maseno Division	0.74	0.44	587	0.75	0.43	409	0.74	0.44	178	0.75
Tested for HIV	0.77	0.42	587	0.75	0.44	409	0.83	0.38	178	0.02
Tested HIV-positive	0.15	0.36	587	0.12	0.32	409	0.24	0.43	178	<.001
Nurse present at first ANC visit	0.91	0.29	587	0.89	0.31	409	0.94	0.24	178	0.10
Received counselling/testing - self-report	0.88	0.32	586	0.88	0.33	408	0.90	0.30	178	0.40
Delivered in the health center or hospital	0.39	0.49	587	0.41	0.49	409	0.34	0.48	178	0.15
Data from Waves 1 and 2										
Subjective belief about HIV status (Scale 1–4 decreasing in risk)										
Wave 1	2.76	0.88	587	3.25	0.44	409	1.61	0.49	178	<.001
Wave 2	2.78	1.06	572	2.87	1.03	399	2.58	1.11	173	<.001
Data from Wave 2 only										
Received PMTCT medication at birth	0.06	0.24	582	0.06	0.24	406	0.07	0.25	176	0.76
Mother reports breastfeeding newborn child	0.95	0.22	587	0.96	0.19	409	0.92	0.27	178	0.05

Panel B: Distribution of Subjective Beliefs about HIV-status	Wave1		Wave 2	
Chances of Being HIV-positive	N	%	N	%

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Panel B: Distribution of Subjective

Beliefs about HIV-status		Wave1		Wave 2
Great	69	11.8	74	12.9
Moderate	109	18.6	177	30.9
Small	305	52.0	121	21.2
None	104	17.7	200	35.0
Total	587	100	572	100

Notes: SD is the standard deviation and N is the sample size. Source: Sample of women enrolled during first ANC clinic visit (wave 1) and interviewed at home after delivery (wave 2).

Table 2

Correlates of Nurse attendance

	Nurse present at time of woman's first visit			
	(1)	(2)	(3)	(4)
Age in years	−0.013	−0.013	−0.015	−0.012
	(0.012)	(0.013)	(0.013)	(0.013)
Age in years, squared	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Completed primary school	−0.012	−0.011	−0.012	−0.010
	(0.022)	(0.022)	(0.022)	(0.024)
Married	0.037	0.036	0.041	0.042
	(0.027)	(0.027)	(0.028)	(0.030)
Frequency of church attendance in past four weeks	−0.002	−0.002	−0.001	−0.000
	(0.004)	(0.004)	(0.004)	(0.004)
Boils drinking water	−0.026	−0.021	−0.018	−0.018
	(0.027)	(0.023)	(0.024)	(0.025)
# of livestock held at enrollment	−0.000	−0.000	−0.000	−0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Lives in a non-thatched house	−0.009	−0.007	−0.006	−0.005
	(0.031)	(0.030)	(0.028)	(0.029)
Lives in Maseno division	−0.005	−0.005	−0.006	−0.006
	(0.026)	(0.027)	(0.026)	(0.026)
Log distance from clinic	−0.004	−0.005	−0.005	−0.003
	(0.021)	(0.021)	(0.020)	(0.019)
Quarter of conception ==2		0.017	0.017	0.013
		(0.038)	(0.038)	(0.034)
Quarter of conception ==3		−0.030	−0.035	−0.039
		(0.057)	(0.058)	(0.054)
Quarter of conception ==4		−0.045	−0.047	−0.066
		(0.050)	(0.052)	(0.052)
Moderate chance HIV +ve			0.017	0.012
			(0.039)	(0.040)
Small chance HIV +ve			−0.027	−0.029
			(0.036)	(0.037)
No chance at all HIV +ve			−0.069	−0.075
			(0.054)	(0.054)
Day of week = Tuesday				−0.028
				(0.048)
Day of week = Wednesday				−0.045
				(0.043)
Day of week = Thursday				−0.098
				(0.068)

	Nurse present at time of woman's first visit			
	(1)	**(2)**	**(3)**	**(4)**
Day of week = Friday				−0.188
				(0.093) *
Day of the month				0.004
				(0.011)
Day of the month squared				−0.000
				(0.000)
Constant	1.086	1.086	1.140	1.151
	(0.217) **	(0.231) **	(0.252) **	(0.242) **
Observations	581	581	577	577
R-squared	0.01	0.01	0.02	0.07

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 this pregnancy, 0 otherwise. Standard errors in brackets clustered at the visit date level.

**, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively.

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Table 3

Effect of nurse absenteeism on testing

	Independent Variable: Indicator for Tested for HIV during pregnancy				
	(1)	(2)	(3)	(4)	(5)
Panel A					
PMTCT Nurse Present	0.587	0.568	0.558	0.557	0.587
	(0.067)**	(0.066)**	(0.065)**	(0.065)**	(0.067)**
Constant	0.241	0.200	0.252	0.469	0.241
	(0.065)**	(0.099)*	(0.101)*	(0.279)+	(0.065)**
Visit Date Controls		X	X	X	
HIV Priors			X	X	
Controls				X	
Observations	588	588	584	577	577
R-squared	0.16	0.19	0.19	0.22	0.17
Panel B					
PMTCT Nurse Present	0.596	0.575	0.586	0.585	0.575
	(0.138)**	(0.138)**	(0.138)**	(0.145)**	(0.138)**
Low prior HIV +ve	−0.040	−0.045	−0.035	−0.036	−0.045
	(0.155)	(0.157)	(0.158)	(0.164)	(0.157)
PMTCT Nurse Present * Low prior HIV +ve	−0.018	−0.018	−0.034	−0.033	−0.018
	(0.159)	(0.160)	(0.162)	(0.168)	(0.160)
Constant	0.273	0.251	0.455	0.452	0.247
	(0.135)*	(0.152)	(0.294)	(0.300)	(0.151)
Visit Date Controls		X	X	X	X
Controls			X	X	
SES Index*Present interaction				X	
Observations	584	584	577	577	577
R-squared	0.17	0.19	0.21	0.21	0.19
Test: Presence no effect on low prior subjects	55.66	52.67	51.74	51.70	52.90
prob>F	0.00	0.00	0.00	0.00	0.00

Notes: Standard errors in brackets clustered at the visit date level.

**, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively. 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. Visit date controls include the day of the week, day of the month and day of the month squared. Controls include age, age squared, an indicator for primary school completion, married, church attendance, reports boiling water, has permanent roof, location in the district, number of initial livestock holdings, quarter of conception and log distance to the clinic.

Table 4

Effect of nurse absenteeism on Health Outcomes

	Delivered at hospital or health center			Number of times visited clinic for this pregnancy			Given any medication to prevent Mother to child HIV transmission			Breastfed baby			Enrolled in Ampath Treatment Program		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
PMTCT Nurse Present	0.115	0.132	0.115	0.056	−0.031	0.047	0.045	0.037	0.045	−0.012	−0.008	−0.011	0.035	0.037	0.034
	(0.058)$^{+}$	(0.054)*	(0.058)*	(0.288)	(0.276)	(0.288)	(0.035)	(0.033)	(0.035)	(0.039)	(0.039)	(0.039)	(0.021)	(0.023)	(0.021)
Constant	0.281	0.304	0.287	3.339	1.658	3.277	0.025	−0.246	0.011	0.995	1.330	1.010	−0.013	−0.372	−0.027
	(0.098)**	(0.321)	(0.100)**	(0.434)**	(1.461)	(0.438)**	(0.064)	(0.129)$^{+}$	(0.063)	(0.042)**	(0.119)**	(0.040)**	(0.043)	(0.144)*	(0.043)
Visit Date Controls	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HIV Priors	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Controls		X			X			X			X			X	
Observations	576	564	564	570	558	558	571	559	559	576	564	564	576	564	564
R-squared	0.03	0.12	0.03	0.03	0.08	0.03	0.02	0.06	0.02	0.03	0.06	0.03	0.05	0.07	0.05
Mean of dependent variable|nurse absent	0.28			3.74			0.04			0.94			0.05		

Notes: Standard errors in brackets clustered at the visit date level.

**, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively. The dependent variables are defined in Table 1. All specifications include controls for day of the week, date and HIV status priors. 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. Visit date controls include the day of the week, day of the month and day of the month squared. Controls include age, age squared, an indicator for primary school completion, married, church attendance, reports boiling water, has permanent roof, location in the district, number of initial livestock holdings, quarter of conception and log distance to the clinic.

Table 5

Effect of nurse absenteeism on Health Outcomes: interactions with beliefs about HIV Status

	Delivered at hospital or health center				Number of times visited clinic for this pregnancy				Given any medication to prevent Mother to child HIV transmission				Breastfed baby				Enrolled in Ampath Treatment Program			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
PMTCT Nurse Present	0.266	0.246	0.234	0.257	0.026	−0.150	−0.158	0.025	0.086	0.074	0.076	0.081	−0.090	−0.089	−0.102	−0.085	0.111	0.098	0.111	0.107
	(0.099)**	(0.117)*	(0.122)$^{+}$	(0.100)*	(0.735)	(0.710)	(0.755)	(0.736)	(0.026)**	(0.028)**	(0.031)*	(0.026)**	(0.025)**	(0.024)**	(0.027)**	(0.025)**	(0.029)**	(0.030)**	(0.033)**	(0.029)**
Low prior HIV +ve	0.246	0.216	0.204	0.248	−0.151	−0.282	−0.289	−0.154	0.045	0.051	0.052	0.045	−0.050	−0.062	−0.074	−0.050	0.020	0.011	0.023	0.019
	(0.122)*	(0.136)	(0.138)	(0.123)*	(0.777)	(0.761)	(0.792)	(0.780)	(0.036)	(0.038)	(0.032)	(0.036)	(0.045)	(0.049)	(0.054)	(0.045)	(0.021)	(0.029)	(0.033)	(0.021)
PMTCT Nurse Present * Low prior HIV +ve	−0.193	−0.148	−0.138	−0.182	0.029	0.149	0.155	0.018	−0.053	−0.049	−0.051	−0.047	0.099	0.103	0.115	0.094	−0.097	−0.076	−0.088	−0.092
	(0.130)	(0.142)	(0.144)	(0.131)	(0.799)	(0.788)	(0.817)	(0.803)	(0.044)	(0.046)	(0.041)	(0.044)	(0.050)*	(0.053)$^{+}$	(0.057)*	(0.050)$^{+}$	(0.036)**	(0.042)$^{+}$	(0.044)*	(0.036)*
Constant	0.097	0.127	0.081	0.086	3.432	1.879	1.849	3.382	−0.009	−0.292	−0.286	−0.024	1.011	1.355	1.303	1.028	0.009	−0.348	−0.297	−0.006
	(0.125)	(0.334)	(0.339)	(0.128)	(0.809)**	(1.518)	(1.499)	(0.812)**	(0.051)	(0.127)*	(0.125)*	(0.051)	(0.042)**	(0.123)**	(0.117)**	(0.040)**	(0.039)	(0.135)*	(0.151)$^{+}$	(0.037)
Visit Date Controls	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Controls		X	X			X	X			X	X			X	X			X	X	
SES Index*Present interaction			X				X				X				X				X	
Observations	576	564	564	564	570	558	558	558	571	559	559	559	576	564	564	564	576	564	564	564
R-squared	0.02	0.12	0.12	0.03	0.03	0.08	0.08	0.03	0.02	0.06	0.06	0.02	0.03	0.06	0.06	0.02	0.04	0.06	0.06	0.04
Test: Presence no effect on low prior subjects	0.98	2.08	1.98	1.03	0.03	0.00	0.00	0.02	0.61	0.36	0.35	0.64	0.04	0.09	0.07	0.04	0.30	0.51	0.72	0.32
prob>F	0.32	0.15	0.16	0.31	0.86	1.00	0.99	0.89	0.44	0.55	0.56	0.43	0.84	0.76	0.78	0.85	0.59	0.47	0.40	0.57

Notes: Standard errors in brackets clustered at the visit date level.

**, * and + indicate statistical significance at the 1, 5 and 10 percent level respectively. The dependent variables are defined in Table 1. All specifications include controls for day of the week and date. 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. Visit date controls include the day of the week, day of the month and day of the month squared. Controls include age, age squared, an indicator for primary school completion, married, church attendance, reports boiling water, has permanent roof, location in the district, number of initial livestock holdings, quarter of conception and log distance to the clinic.