Antiretroviral therapy and demand for HIV testing: Evidence from Zambia☆

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ABSTRACT

This paper examines the effects of antiretroviral therapy (ART) on demand for HIV testing and of ART-induced testing on demand for risky sexual behavior. I provide a model of sexual behavior decision-making under uncertainty and estimate the structural parameters of the model using nationally representative survey data from Zambia on HIV testing decisions before and after the introduction of ART. The empirical results indicate that although the introduction of ART appears to have increased HIV testing rates by upwards of 50 percent, the ART allocation process may have limited the prevention benefit of ART-induced testing. Simulation results show that eliminating this prevention inefficiency while holding the supply of ART constant would increase the prevention impact of ART-induced testing more than four-fold. More generally, the analysis indicates that existing studies which examine "universal" testing or quasi-experimental testing programs understate the efficacy of standard voluntary counseling and testing programs.

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1. Introduction

Policymakers believe that HIV testing is an important intervention in the HIV/AIDS pandemic. Proponents of HIV testing presume that on average individuals who learn whether or not they are infected will respond to this new information by reducing risky behavior. However, HIV testing rates are low in much of the world and the majority of HIV positive individuals may not be aware that they are infected.[1] For example, among the 67 percent of the world population infected with HIV/AIDS that reside in Sub-Saharan Africa only 10 percent know their HIV status (UNAIDS, 2008; WHO, 2006a).

One of the main mechanisms by which policymakers hope to increase demand for HIV testing is increased availability of subsidized antiretroviral therapy (Global HIV Prevention Working Group, 2004). The availability of antiretroviral therapy (ART) gives individuals a direct incentive to take a HIV test: if they take a HIV test and are HIV positive then they may begin therapy, which has been shown to reduce morbidity and prolong life (e.g. Lichtenberg, 2003). However, the incentive effects of ART may be heterogeneous (Druyts et al., 2013) and many individuals may not choose to test in response to the introduction of ART. Moreover, those who test because of

[1] Simultaneously, many other individuals may overestimate the likelihood that they are HIV positive (Anglewicz and Kohler, 2009).

ART may not demonstrate substantial behavior change subsequent to testing.

This paper examines the effect of ART availability on demand for HIV testing and the effect of ART-induced testing on demand for risky behavior. I present a model of demand for HIV testing and for risky behavior. Initially I assume that the conditions under which individuals have an incentive to test and testing reduces risky behavior hold. In particular, I assume that demand for risky behavior is concave in the prior probability of being HIV positive. Under these conditions, I show that in the pre-ART era it is the riskiest individuals (i.e., individuals with the highest prior probabilities of being HIV positive) who have the greatest incentive to test in the setting examined in the current analysis.[2] The riskiest individuals are also those individuals whose testing decisions should be most responsive to the introduction of ART. I show that under these same conditions the expected reduction in risky behavior associated with taking a HIV test in this setting should be increasing in the prior probability an individual is HIV positive. Thus, ART-induced testing has the potential to substantially reduce the spread of HIV/AIDS.

Using newly assembled data from before and after the introduction of ART in Zambia I examine the empirical evidence on these predictions. Testing behavior among women and men prior to the introduction of ART is consistent with the prediction that individuals with the highest prior probabilities of being HIV positive are those who should be most likely to test.[3] The change in testing behavior among women after the introduction of ART is consistent with the prediction that individuals with the highest prior probabilities of being HIV positive are those who should demonstrate the greatest response to the availability of ART. However, the change in testing behavior among men after the introduction of ART is not consistent with this prediction. Specifically, testing decisions among older men appear to be particularly responsive to the introduction of ART despite the fact that older men are one of the lowest HIV prevalence groups in Zambia. In contrast, testing decisions among men in the middle of the age distribution are not particularly responsive to the introduction of ART despite the fact that these men are one of the higher HIV prevalence groups. Although data on the age distribution of ART patients in Zambia are not available, I interpret these results as evidence of a non-random rationing mechanism determining the allocation of ART among HIV positive individuals (in favor of older males) and provide evidence rejecting alternative hypotheses. In any case, from the perspective of maximizing the prevention impact of ART-induced testing, the results indicate an inefficiency in the process determining who seeks and receives ART.

I estimate the structural parameters of the model and show that the conditions for individuals to have an incentive to test and for testing to reduce risky behavior are indeed satisfied in this setting. Moreover, the structural parameter estimates allow me to simulate the effect of ART availability on testing demand and the effects of ART-induced testing on demand for risky behavior and on the spread of HIV/AIDS. As part of the simulations, I examine the effects of eliminating the prevention inefficiency in the process determining the allocation of ART and/or expanding the supply of ART. Simulation results show that under the existing policy ART availability increased testing demand by approximately 3 percentage points and ART-induced testing reduced the incidence of HIV by less than 2 percent. Expanding the supply of antiretroviral drugs without eliminating the prevention inefficiency would only have moderate effects on testing rates and risky behavior. In contrast, eliminating the prevention inefficiency while holding fixed the existing supply of antiretroviral drugs would more than quadruple ART-induced testing and the number of new infections avoided due to ART-induced testing.

This analysis yields four broader insights about the economics of HIV/AIDS and health economics more generally. First, this paper shows that with a small amount of theoretical structure we can estimate the parameters of the risky behavior demand function without actually observing risky sexual behavior. Because self-reported sexual behavior may be subject to substantial reporting bias (Gersovitz et al., 1998) and biomarkers may also measure risky sexual behavior with error (Mauck and van der Straten, 2008; Minnis et al., 2009; Corno and de Paula, 2014), the indirect approach to estimating the risky behavior demand function implemented in the current analysis may be superior to a direct approach.[4]

Second, this paper provides a counterpoint to the argument that treatment for an infectious disease diminishes prevention efforts by reducing the private benefit of preventive behavior and, in the case of HIV/AIDS, by increasing vector activity. In contexts where uncertainty about one's own infection status is an important factor in decision-making about preventive behavior, treatment for an infectious disease may actually increase private prevention efforts.[5]

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[2] In contrast, evidence in Kaler and Watkins (2010) suggests that individuals who are very concerned about testing positive for HIV (e.g. particularly risky individuals) may be very hesitant to test.

[3] Women with the highest prior probabilities of being HIV positive are disproportionately pregnant women. Evidence from elsewhere in sub-Saharan Africa suggests that healthcare providers at antenatal clinics may strongly emphasize HIV testing (Angotti et al., 2011). The results in the current analysis are robust to controlling for pregnancy (see Table 1).

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[4] A related point is that instead of examining the effect of HIV testing on a single or a handful of risky behavior measures, I examine the effect of HIV testing on the cumulative risk of acquiring HIV.

[5] For the particular disease I examine in this analysis, HIV/AIDS, the net effect of treatment (i.e., ART) on preventive behavior is unclear. I show that ART-induced HIV testing increases preventive behavior. In contrast, Lakdawalla et al. (2006) show that the introduction of highly-active antiretroviral therapy (HAART) in the United States increased the number of sex partners of the representative HIV positive individual and suggest that this was due to the improved health and longevity of HIV positive individuals receiving HAART. Although this is an important finding, the model I present here focuses on the effect of ART-induced testing on demand for risky behavior. Because Lakdawalla et al. (2006) do not consider the role of ART-induced testing in behavior change and the current study does not incorporate the Lakdawalla et al. (2006) mechanism, writing a more general model simultaneously allowing for these two effects may be a useful avenue for future research. However, it may be difficult to reliably estimate the structural parameters of an expanded model. Similarly, Friedman (2013) presents evidence indicating that ART may increase risky sexual behavior by reducing the expected cost of acquiring HIV.