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In A Study Of A Population Cohort In South Africa, HIV Patients On Antiretrovirals Had Nearly Full Recovery Of Employment

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ABSTRACT **Antiretroviral therapy for HIV may have important economic benefits for patients and their households. We quantified the impact of HIV treatment on employment status among HIV patients in rural South Africa who were enrolled in a public-sector HIV treatment program supported by the President's Emergency Plan for AIDS Relief. We linked clinical data from more than 2,000 patients in the treatment program with ten years of longitudinal socioeconomic data from a complete community-based population cohort of more than 30,000 adults residing in the clinical catchment area. We estimated the employment effects of HIV treatment in fixed-effects regressions. Four years after the initiation of antiretroviral therapy, employment among HIV patients had recovered to about 90 percent of baseline rates observed in the same patients three to five years before they started treatment. Many patients initiated treatment early enough that they were able to avoid any loss of employment due to HIV. These results represent the first estimates of employment recovery among HIV patients in a general population, relative to the employment levels that these patients had prior to job-threatening HIV illness and the decision to seek care. There are large economic benefits to HIV treatment. For some patients, further gains could be obtained from initiating antiretroviral therapy earlier, prior to HIV-related job loss.**

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Antiretroviral drug therapies have changed the prognosis for people with HIV/AIDS, enabling many patients to avoid morbidity and premature mortality due to HIV infection. Although clinical recovery on antiretroviral therapy is well documented,[1] far less is understood about the economic benefits of treatment for HIV.[2]

We investigated the extent to which HIV patients receiving antiretroviral therapy were able to maintain employment or return to work after losing a job. We assessed employment recovery in a community in rural South Africa with very high rates of HIV infection—28 percent among adults[3]—and high rates of unemployment and temporary labor migration. We linked ten years of longitudinal socioeconomic data from a large, community-based population surveillance system with clinical records from a government HIV treatment program that serves the community. We provide the first estimates of the extent to which HIV patients on antiretroviral therapy in a general population were able to remain employed or return to work, comparing employment levels among the same patients several years before and after they initiated treatment.

This study provides some of the first rigorous evidence on the economic effects of one of the

world's largest health policy interventions, the expansion of public-sector HIV treatment in southern Africa, the region with the world's highest HIV rates. Past studies of HIV treatment and employment have been either clinical cohorts or firm-based studies. However, these study designs suffer from various limitations.

Studies that recruit participants in clinical settings fail to observe employment of HIV patients prior to their decision to seek care.[4–8] If care seeking is correlated with employment status (for instance, because people who are unemployed have more time to go to the clinic when they are unemployed, relative to other times when they are working), then estimates of employment recovery using a clinical baseline will be biased. Additionally, only one clinical study to date has adjusted for secular economic trends in the larger community.[6]

Some firm-based studies have overcome both limitations in estimating the effects of antiretroviral therapy on labor supply. However, these studies used highly selected samples of formally employed workers at firms in specific industries and with functioning workplace HIV treatment programs.[9,10] Thus, their results may not be generalizable to other workers or work environments, nor to the experiences of many HIV patients in settings of high unemployment.

Furthermore, existing clinical and firm-based studies may suffer from substantial attrition bias because they did not observe patients who changed jobs,[9,10] migrated, or did not return for clinical follow-up for other reasons.[4–8]

In contrast, by observing HIV patients within a complete population cohort, we were able to avoid these limitations. First, we were able to assess employment recovery relative to levels observed three to five years before initiation of antiretroviral therapy, prior to any job-threatening HIV illness and the decision to seek care. This baseline enables us to avoid bias associated with the timing of clinical enrollment and represents a natural yardstick against which to measure employment recovery.

Second, we controlled for changes in local employment opportunities over time, using the employment experiences of community members who had not accessed treatment or other clinical care for HIV. Third, our analysis included people representing the full range of labor market experiences in this community. Finally, we observed employment outcomes regardless of whether HIV patients remained in clinical care, took different jobs in the community, or migrated temporarily to other communities.

To investigate the timing of health recovery, we assessed trends in immunological status, physical functioning, and unemployment due to illness. We also estimated the effect of HIV treatment on migration because of the close link between migration and labor supply in this community. Trends were assessed up to four years after initiation of antiretroviral therapy.

Study Data And Methods

DATA Funded by the Wellcome Trust, the Africa Centre for Health and Population Studies is a research center at the University of KwaZulu-Natal, South Africa. Since 2000 the Africa Centre has collected longitudinal sociodemographic data through routine household survey visits on a cohort of more than 100,000 people living in a 167-square-mile area in northern KwaZulu-Natal. In this community-based population surveillance system, demographic data on births, deaths, and migration are collected every six months, with response rates of greater than 99 percent.[11] To capture the complexities of household living arrangements in South Africa, the Africa Centre collects data on people who reside outside the surveillance area but who continue to be members of a household within the area, such as those who migrate temporarily for work.[11] As part of the population surveillance, the Africa Centre conducted seven waves of socioeconomic surveys during the period 2001–10 and four waves of health surveys during the period 2005–08.

Since 2004 the Africa Centre has collaborated with the South African Department of Health to implement the Hlabsia HIV Treatment and Care Programme at government facilities in the Hlabisa subdistrict of Umkhanyakude District, in KwaZulu-Natal. The entire surveillance area is located within the program catchment area (see Appendix Exhibit 1).[12] In the Hlabisa HIV Treatment and Care Programme, free antiretroviral therapy and other clinical services for HIV are provided by nurses at seventeen community-based health clinics and one subdistrict hospital. Since 2005 the program has received US financial support via the President's Emergency Plan for AIDS Relief (PEPFAR).[13–15]

We linked clinical records of patients in the Hlabisa HIV Treatment and Care Programme with longitudinal socioeconomic and health data on these same patients collected in the Africa Centre's population surveillance system. Patients were linked using their unique South African identification number or their first name, surname, age, and sex. Ethics approval for data collection, linkage, and use was obtained from the Biomedical Research and Ethics Committee of the University of KwaZulu-Natal.

STUDY POPULATION AND EXCLUSION CRITERIA The study population included all working-age

people who were members of a household in the Africa Centre's population surveillance area at some point during the ten-year follow-up period, 2001–10, and who themselves resided in the surveillance area from January 1 to June 30, 2004, the six-month period just prior to the establishment of the Hlabisa HIV Treatment and Care Programme.[12] Observations of a given person from each wave of the population-based socioeconomic and health surveys were eligible for inclusion if the person was 18–59 years old on the date of the survey visit. If a person was observed multiple times in a single survey wave, we retained only the first response.

Coverage of the population in the socioeconomic survey was nearly complete. Ninety-five percent of all working-age adults in the surveillance area were observed in at least one survey wave. Response rates in the survey waves for which these working-age adults were age-eligible were also high. A small proportion of survey wave observations were missing for one of the following four mutually exclusive reasons: attrition (3.6 percent), mortality (3.6 percent), late entry into the cohort (1.9 percent), and lack of information on employment status for people under surveillance (11.3 percent) (Appendix Exhibit 2).[12]

People who began antiretroviral therapy in the Hlabisa HIV Treatment and Care Programme by December 31, 2010, were considered to be in what we called the "HIV treatment sample." All working-age adults in the population cohort who had not accessed public-sector HIV care or treatment services in Hlabisa were also included in the analysis, to adjust for secular changes in employment opportunities facing members of the community. People who accessed clinical services for HIV but had not yet initiated antiretroviral therapy by December 31, 2010, were excluded because they were likely to experience declines in health and employment over time—which would lead to upward bias in our estimates of employment recovery for HIV patients who initiated treatment.

DEFINITION OF EXPOSURE The exposure of interest was the length of time from the date a person initiated antiretroviral therapy to the dates of the household survey visits when information on employment and other outcomes was collected. For analytical purposes, time since treatment initiation was divided into six-month intervals. We constructed indicator variables that had the value of 1 if an observation fell into a particular six-month interval, and had the value of 0 otherwise. Observations of people not enrolled in the treatment program had the value of 0.

OUTCOME MEASURES We estimated trends in the following economic outcomes: employment status; unemployment due to illness; and whether a person resided in the surveillance area, an indicator of migration. These variables were observed in up to six socioeconomic survey waves, from 2003 to 2010, with employment additionally observed in 2001. Data were reported for all resident and nonresident household members by a single proxy respondent, typically the household head or another senior member of the household.

To assess the timing of health recovery, we estimated trends in physical functioning and immunological status. Physical functioning was assessed through the four health surveys mentioned above, which were conducted during the period 2005–08 as part of the population surveillance. Respondents were asked to report whether they could "walk 5km (around 45min) without stopping," "carry heavy objects, like a 20 litre water container, for 20 metres without stopping," and "participate in heavy or vigorous activities such as planting, harvesting, or construction work." We constructed a summary indicator for physical functioning that had the value of 1 if the respondent could walk five kilometers, carry heavy objects, and do hard work; otherwise, it had the value of 0. Only resident household members and a 10 percent sample of nonresidents were eligible for the health surveys, which were conducted with each respondent in face-to-face interviews.

Immunological status was assessed among HIV patients using data on CD4+ lymphocyte counts collected via routine, semiannual clinical monitoring, following treatment initiation. CD4+ lymphocytes are white blood cells involved in the immune system's defense against infections and tumors.[14] Because these cells are targeted and destroyed by HIV, counts of the cells are a commonly used indicator of HIV disease progression and immunological recovery among patients on treatment.

All outcomes other than CD4+ counts were coded as dichotomous indicators—that is, with a value of zero or one. Details on the assessment and construction of the outcome measures are provided in the Appendix.[12]

STATISTICAL METHODS To assess the effect of HIV treatment on physical functioning, employment, unemployment due to illness, and migration, we estimated linear probability regression models with individual fixed effects. The predictors of interest were the six-month intervals of time relative to the date when a person began antiretroviral therapy.

The individual fixed effects controlled for all time-invariant characteristics of study participants. We additionally controlled for the follow-

ing time-varying factors: month of survey visit (to adjust for seasonality); day of survey visit (to adjust for pay-day effects); sex- and education-specific age profiles (to account for the evolution of labor supply over a person's working life, for different demographic groups); and survey wave fixed effects, interacted with sex and education (to account for changes in the employment opportunities for specific demographic groups, such as changes resulting from the opening of a local coal mine in 2009). We accounted for serial correlation in the error terms by clustering standard errors at the individual level.[16]

In all fixed-effects regression models, the period three to five years prior to the initiation of antiretroviral therapy was the reference group, with which we compared all other periods. An indicator for five to eight years before the start of treatment was included to test the hypothesis that the reference group was observed prior to any employment loss due to HIV illness.

As an extension of our main analysis, we assessed employment recovery for men and women separately. Employment opportunities in the community are highly segregated by sex, and these differences may affect the ability of HIV patients to maintain or return to work.

For HIV patients who lost their jobs prior to initiating treatment, a critical question is how they fared in the labor market, relative to other people suffering job loss. HIV patients may face barriers to reemployment, including incomplete health recovery, side effects of treatment, discrimination from employers, time spent seeking care, and difficulties relocating for work. We conducted survival analysis to assess the length of jobless spells for HIV patients who lost work within the three years before they initiated treatment, relative to jobless spells of controls matched according to birth year, sex, education, place of residence prior to job loss, and year of job loss. We estimated hazard regression models and constructed Kaplan-Meier failure curves to assess rates of reemployment. Further details are provided in the online Appendix.[12]

Crude trends in CD4+ counts were estimated for a panel of treatment initiators who were observed continuously for a full four years following initiation of antiretroviral therapy. We used the statistical software Stata, version 11, for all statistical tests.

SENSITIVITY ANALYSES To assess the robustness of our fixed effects regression estimates to modeling assumptions, we estimated conditional logistic (fixed effects) models. To assess the robustness of our main employment results to attrition, mortality, late entry into the cohort, and missing information, we imputed data for all survey waves when a cohort member was age-eligible but the person's employment status was not observed. Details are provided in the Appendix.[12]

Study Results

DESCRIPTIVE STATISTICS The socioeconomic surveys collected 138,666 observations of 32,321 people ages 18–59 between 2001 and 2010, who resided in the Africa Centre surveillance area during the first six months of 2004. Of these 32,321 cohort members, 2,027 initiated antiretroviral therapy in the Hlabisa HIV Treatment and Care Programme by December 31, 2010.

Appendix Exhibit 2[12] presents descriptive statistics for the sample. Relative to the general working-age population, those who initiated HIV treatment were older, more likely to be female, less likely to have completed secondary school, and less likely to reside outside the surveillance area. Unemployment was very high among both the HIV treatment group and other members of the larger population, with 66 percent of working-age adults not employed.

IMMUNE RECOVERY FOR HIV PATIENTS Patients initiated antiretroviral therapy with an average CD4+ count of 122 cells/mm^3—well below the treatment eligibility threshold of 200 cells/mm^3. Immune functioning improved rapidly among most patients (Exhibit 1). Within the first six months, the mean CD4+ count among these patients recovered to 235. Thereafter, CD4+ counts continued to rise, but at a decreasing rate. In clinical studies, patients with CD4+ counts above 200 have dramatically lower risk of adverse health events,[17] compared to those with CD4+ counts below that level, and those with CD4+ counts above 500 have survival rates similar to the general population.[18]

PHYSICAL FUNCTIONING Of 32,321 people in the socioeconomic sample, 22,401 were invited to participate in the 2005–08 health surveys (Appendix Exhibit 3).[12] In contrast to the socioeconomic surveys, which had very high participation levels, participation in the health surveys was low, with 48 percent of eligible respondents refusing to be interviewed for the survey. However, among people who participated in the survey, the response rate for the physical functioning questions was over 99 percent. The analytical sample for the health surveys consisted of 29,551 observations of 16,538 individuals.

Appendix Exhibit 4[12] shows regression results for physical functioning and its component indicators. From a baseline of 79 percent three to five years before treatment initiation, the proportion of respondents who could walk five kilometers, carry a heavy object, and do hard work declined by 16 percentage points in the year prior

to HIV treatment initiation. That change represented a 76 percent relative increase in the proportion of respondents who had at least one limitation. On average, physical functioning for these respondents recovered to baseline levels within one year after they began treatment, although the effects are imprecisely estimated because these data were collected only through 2008. As a result, the number of observations on physical functioning after treatment initiation was relatively small.

EMPLOYMENT Both crude and regression-adjusted trends in employment for HIV patients receiving antiretroviral therapy (Exhibits 2 and 3) display a consistent pattern: There was a sharp decline in employment in the year before the patient started treatment, followed by a slow but nearly complete recovery. From 37.0 percent at the baseline of three to five years before treatment initiation, employment fell by 14.1 percentage points, a 38 percent relative decline. Four years after treatment began, employment among HIV patients was only 3.8 percentage points lower than in the baseline reference period, a 90 percent relative recovery.

Employment levels five to eight years before treatment initiation were no different from the reference period of three to five years before initiation, suggesting that any loss of employment associated with HIV illness occurred within the three years before initiation (Exhibit 4). Trends in employment were not substantively different in conditional logistic models (Appendix Exhibit 5)[12] or in linear probability models using imputation to account for attrition, mortality, late entry into the cohort, and missing data (Appendix Exhibit 6).[12]

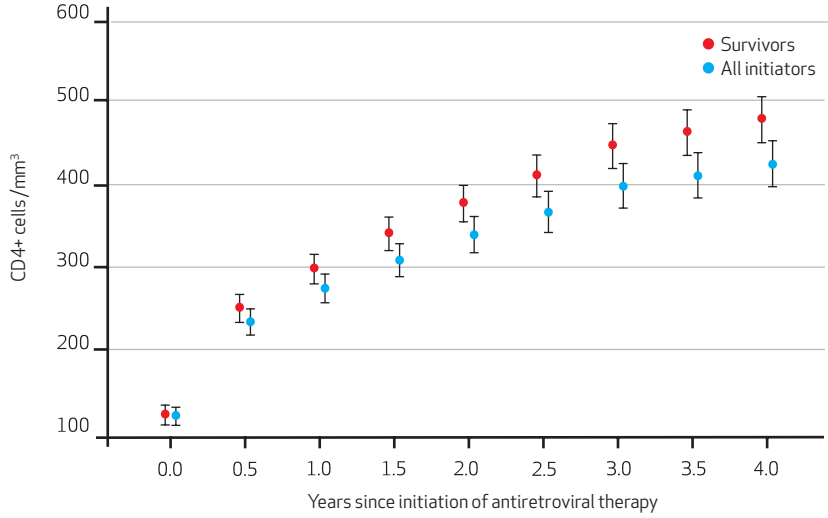
Employment trends were qualitatively similar for men and women (Appendix Exhibits 7 and 8),[12] recovering nearly completely by four years after initiation for both sexes. Compared to women, men had substantially higher baseline employment rates (49 percent versus 32 percent) and experienced both larger absolute declines prior to treatment initiation and larger recoveries.

OTHER ECONOMIC OUTCOMES Unemployment due to illness nearly doubled from 3.5 percent at baseline to 6.6 percent in the six months before treatment initiation—that is, a 3.1-percentage-point increase (Exhibit 4). Just prior to initiation, 10 percent of men and 5 percent of women were reported to be unemployed because of sickness or disability (Appendix Exhibit 8).[12] After one year of antiretroviral therapy, however, HIV patients (or their household proxies) were no more likely to report that illness or disability was a barrier to employment than they were at baseline. These trends are consistent with the rapid health improvements indicated by data on CD4+ counts and physical functioning.

In the years following treatment initiation, patients were more likely to reside in the population surveillance area (Exhibit 4). This indicates lower levels of temporary migration—a

EXHIBIT 1

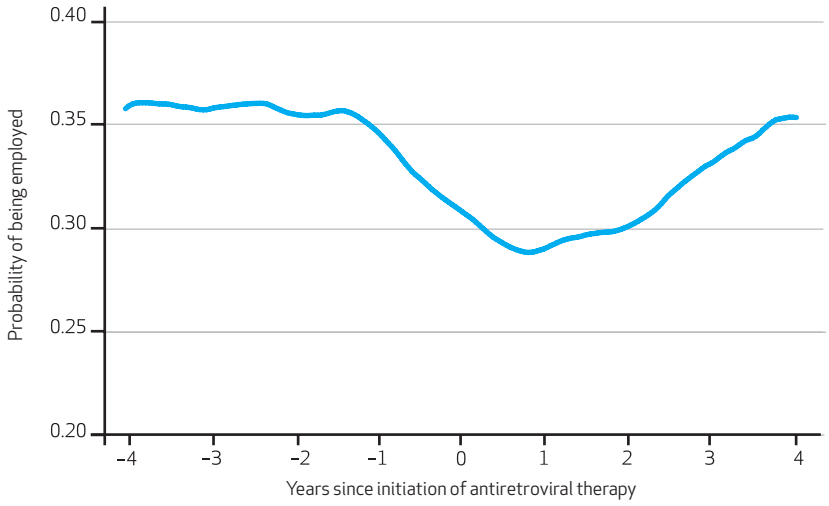
Immunological Recovery Among HIV Patients Receiving Antiretroviral Therapy



SOURCE Authors' analysis of data from the Hlabisa HIV Treatment and Care Programme. **NOTES** CD4+ lymphocyte counts are explained in text. Analysis includes 372 patients in the Hlabisa HIV Treatment and Care Programme who initiated treatment before December 31, 2006, and had a CD4+ lymphocyte count within the six months prior to initiation. CD4+ lymphocyte counts were imputed as zero following date of death and as "last observed" for loss to follow-up other than death. Eighty-five percent of the patients were alive after four years of treatment. Ninety-five percent confidence intervals are reported.

EXHIBIT 2

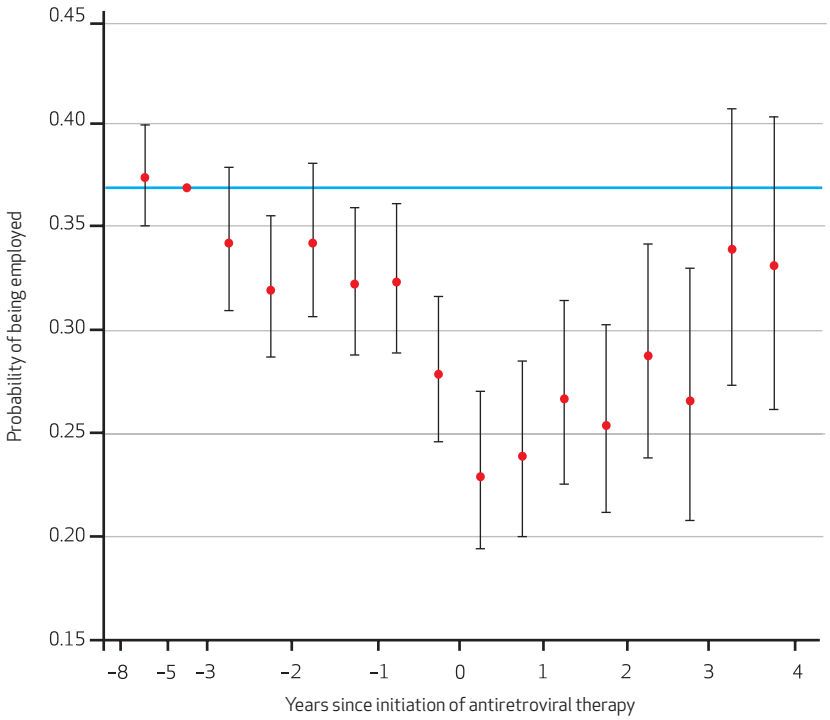
Crude Employment Trend Among HIV Patients Receiving Antiretroviral Therapy



SOURCE Authors' analysis of data from the Hlabisa HIV Treatment and Care Programme and Africa Centre for Health and Population Studies. **NOTE** The crude trend is estimated by local linear regression, with a bandwidth of 200 days.

EXHIBIT 3

Regression-Adjusted Employment Trend Among HIV Patients Receiving Antiretroviral Therapy



SOURCE Authors' analysis of data from the Hlabisa HIV Treatment and Care Programme and Africa Centre for Health and Population Studies. **NOTES** Data are coefficients from a fixed-effects linear probability model described in the text and shown in Exhibit 4. Ninety-five percent confidence intervals are adjusted for clustering at the individual level.

possible obstacle to reemployment.

SURVIVAL ANALYSIS OF JOBLESS SPELLS How did HIV patients fare in the event of job loss, relative to the general population? Following job loss, the median time out of work was 3.3 years for matched controls and 3.7 years for patients receiving HIV treatment (Exhibit 5). HIV patients found work at a slightly lower rate than controls (hazard ratio = 0.88), but this difference was not significant (Appendix Exhibit 9).[12]

Discussion

This study is the first to evaluate the economic impact of antiretroviral therapy for HIV in a complete population cohort in sub-Saharan Africa. We assessed employment recovery among patients who were receiving HIV treatment relative to employment levels observed in the same patients, years before any job-threatening HIV illness and the decision to seek care. Four years after initiating treatment, patients were 90 percent as likely to be employed as they were at baseline, three to five years before initiating antiretroviral therapy. Both men and women undergoing HIV treatment experienced nearly complete recovery of employment.

Many patients initiated treatment early enough that they were able to avoid any loss of employment due to HIV illness. Given that these patients would have experienced rapid declines in health and economic productivity in the absence of treatment,[9,10,19] this is an important finding. The majority of patients who lost work prior to initiating treatment had regained employment four years later.

Although employment recovered nearly to baseline levels, the recovery lagged well behind observed health gains. This finding contrasts with results of previous studies, which found rapid gains in labor supply following the initiation of antiretroviral therapy.[6,7,9,10] However, those studies were conducted among employees of firms with workplace HIV treatment programs[9,10] or in clinical cohorts in settings with lower unemployment rates than the community where our study took place.[6,7]

To understand to what extent the lag in employment recovery for HIV patients on antiretroviral therapy was the result of general labor market conditions in this community, we compared the length of jobless spells among HIV patients with those of matched controls. HIV patients who lost their job prior to treatment initiation faced long periods without work. However, for the average patient, almost 90 percent of the time out of work could be explained by factors faced by the general population.

NOVEL ASPECTS OF THE STUDY We advance the literature on the economic impacts of HIV treatment and avoid several critical limitations of previous studies. First, because the decision to seek care may be correlated with changes in employment status (unrelated to HIV illness), studies that recruited patients in clinical settings[4–7] cannot disentangle the effects of treatment from the normal churning of the work force. For example, it is plausible that HIV-infected people are more likely to access antiretroviral therapy when they have lost employment, even for reasons unrelated to their health—for example, because they no longer face employment-related time constraints in accessing health care. The employment gains observed in clinical studies could thus be completely unrelated to the effect of antiretroviral therapy and simply reflect normal patterns of reemployment after job loss.

Second, even if the gains in employment in clinical studies were the result of antiretroviral therapy alone, it would be unclear how to interpret these observed employment gains. This is because baseline employment status measured in clinical studies depends on when, in the course of HIV disease, patients seek care. As ac-

EXHIBIT 4

Changes In Employment And Place Of Residence Among HIV Patients Receiving Antiretroviral Therapy

	Employed		Unemployed because of illness		Resides in surveillance area	
Baseline values[a]	**37.0**		**3.5**		**91.7**	
Percentage-point change in outcome, relative to baseline	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
YEARS BEFORE INITIATION						
8.0 – >5.0	0.5	1.3	-0.0	0.7	-2.6	0.9
5.0 – >3.0	—[b]	—[b]	—[b]	—[b]	—[b]	—[b]
3.0 – >2.5	-2.7	1.8	-0.3	0.9	1.5	1.2
2.5 – >2.0	-5.0	1.8	0.9	1.0	4.1	1.2
2.0 – >1.5	-2.7	1.9	2.1	1.0	2.0	1.3
1.5 – >1.0	-4.7	1.9	-1.3	1.0	4.4	1.2
1.0 – >0.5	-4.6	1.9	1.0	1.0	4.2	1.3
0.5 – >0.0	-9.1	1.8	3.1	1.1	7.2	1.3
YEARS AFTER INITIATION						
0.0 – <0.5	-14.1	2.0	3.3	1.3	10.1	1.3
0.5 – <1.0	-13.1	2.2	3.8	1.3	9.9	1.5
1.0 – <1.5	-10.3	2.3	0.4	1.3	10.3	1.5
1.5 – <2.0	-11.6	2.4	-1.6	1.2	10.4	1.7
2.0 – <2.5	-8.2	2.7	2.3	1.8	10.0	1.8
2.5 – <3.0	-10.4	3.2	0.2	1.6	9.6	2.0
3.0 – <3.5	-3.0	3.5	-3.3	1.7	7.1	2.6
3.5 – <4.0	-3.8	3.7	-1.8	2.1	6.5	2.9
SAMPLE						
Persons	32,316		31,701		32,316	
Observations	138,020		122,505		138,020	

SOURCE Authors' analysis of data from the Hlabisa HIV Treatment and Care Programme and Africa Centre for Health and Population Studies. **NOTES** Results are based on fixed-effects regressions. Each column is a linear probability model of the dependent variable on time since initiation indicators, individual fixed effects, and the following controls: survey wave, interacted with sex and education level (less than 12 years, 12 years or more); age group (18–20, 21–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59), interacted with sex and education level; month of survey visit; and day of survey visit. Coefficients and standard errors (SE) are reported in percentage points (multiplied by 100). These coefficients can be interpreted as absolute changes in the probability of the outcome, relative to the probability of the outcome in the reference period (5.0 – >3.0 years before treatment initiation). Predictions of linear probability models are not constrained to the [0, 1] interval. Conditional logistic models are presented in the online Appendix (see Note 12 in text). Omitted from the analysis are 646 observations occurring more than eight years before HIV treatment initiation or more than four years after initiation. [a]Probability of the outcome in the reference period, 5.0 – >3.0 years before initiation, reported as percentage. [b]Not applicable, reference period.

cess to HIV treatment improves, people with HIV will on average seek care earlier in their disease course and will thus be less likely to have lost work due to HIV-related disease. In clinical studies, the "treatment effect" during times of good access would thus be attenuated in comparison to the effect observed during times of bad access, even if the true effect of antiretroviral therapy on employment does not change.

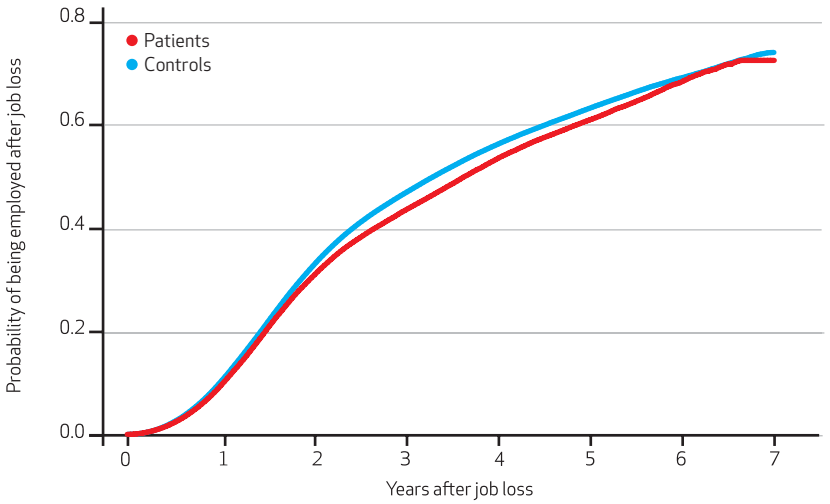
We were able to avoid both of these problems by using, as a baseline, employment status observed several years before treatment initiation. This reference period was observed prior to job-threatening HIV illness and the decision to seek care. Therefore, neither factor could bias our treatment effect estimates. Our early baseline is thus a natural yardstick against which to measure the effect of antiretroviral therapy on employment, enabling us to express employment recovery as a percent of the employment levels that patients had many years earlier and probably would have had in the absence of HIV.

A third strength of our study is that it assesses, for the first time, the effect of HIV treatment on employment in southern Africa, while controlling for secular employment trends in the general population. Because local employment rates fluctuate with agricultural cycles and the opening (or closing) of large firms, estimates that do not control for secular trends may be biased.

A fourth strength is that in contrast to clinical and firm-based studies, we observed people even after clinical attrition, job changes, or migration. A fifth strength is that we assessed long-term employment recovery, up to four years after the initiation of antiretroviral therapy. As our results show, long-term follow-up is necessary to observe the effects of treatment on employment in settings where jobs are scarce and recovery of employment may be slow.

EXHIBIT 5

Probability Of Finding Work After Job Loss For HIV Patients Receiving Antiretroviral Therapy And Matched Controls



SOURCE Authors' analysis of data from the Hlabisa HIV Treatment and Care Programme and Africa Centre for Health and Population Studies. **NOTES** Curves are Kaplan-Meier failure curves for jobless spells (*failure* is defined as regaining employment). Jobless spells for patients were included if they began within three years of the initiation of antiretroviral therapy. Controls were exactly matched to patients by year of birth, sex, education, year of job loss, and place of residence when last employed. The sample included the jobless spells of 213 HIV patients and 805 matched controls. See the online Appendix for further details on sample construction and survival analysis methods (see Note 12 in text).

Sixth, to assess whether patients receiving HIV treatment are disadvantaged in finding reemployment opportunities, we provide the first survival analysis of jobless spells for HIV patients undergoing treatment, relative to matched controls. We find that HIV patients who lose work face jobless spells that are similar in length to those of the general working-age population. However, we caution that in contrast to the fixed-effects models of employment recovery, in this survival analysis we were unable to control for all unobserved time-invariant factors.

Finally, our findings were observed in a community with high levels of unemployment and temporary labor migration and a generalized HIV epidemic with very high infection rates. Such conditions characterize many areas in southern Africa. However, the generalizability of our results may be limited in settings where migration and unemployment are rare, or where HIV prevalence is low and concentrated among particular high-risk groups (see the online Appendix for a discussion of study limitations).[12]

POLICY IMPLICATIONS Our findings have a number of important policy implications. First, in the context of uncertain future funding for HIV treatment,[20] the results support the notion that the economic benefits of treatment are large. These benefits should be considered along with the direct health benefits in cost-benefit calculations and political decisions regarding funding.[21,22]

Furthermore, in a region where nearly half of the population lives with someone who has accessed HIV care or treatment, the benefits of employment recovery for HIV patients are likely to be widely enjoyed.[23] In ongoing analyses of this population cohort, we are investigating the economic spillover effects of HIV treatment on the labor supply of other household members and school enrollment of children in affected households. It is important to note that although the private economic benefits of treatment are large, it is unlikely that many patients would be able to privately finance their own antiretroviral therapy, as a result of the lag in employment recovery and the large number of people who initiate treatment but remain unemployed. Public subsidies and, in some situations, donor assistance, will be required to sustain and expand access to HIV treatment.

Second, information on the economic benefits of treatment could be used to recruit patients into HIV care and treatment before they get sick. Early treatment uptake has positive spillover effects through reduction of HIV transmission.[24] Providing information on the economic benefits of treatment could help increase HIV testing and achieve high levels of treatment coverage. The appeal to economic benefits may be particularly salient for working-age men who have little contact with health systems and lower HIV treatment uptake than women.[25]

Third, people who lose their job before initiating HIV treatment experience lengthy jobless spells in this setting of high unemployment. Our results suggest that further gains in economic well-being for HIV patients could be achieved through recruitment into care and treatment prior to job loss. Many patients seek care only after they have become quite sick; interventions to improve take-up of HIV testing, care, and treatment are thus needed.[26]

Relaxing the clinical eligibility requirements for treatment initiation would also be likely to facilitate earlier recruitment into care and treatment.[27] In 2011 South Africa raised the CD4+ count eligibility threshold to 350 cells/mm^3 for all patients. Future analysis of this cohort will assess the impact of this policy change on employment loss and recovery.

Fourth, when it comes to improving the economic welfare of HIV patients, antiretroviral therapy is a complement to, rather than a substitute for, sound macroeconomic and fiscal policies that emphasize job creation. In rural South Africa, employment of HIV patients receiving treatment recovered nearly to baseline levels. But with baseline employment at only 37 percent,

it is clear that job creation for all South Africans must be emphasized in conjunction with the expansion of treatment access.

Antiretroviral therapy does not only postpone mortality. It also enables HIV patients to lead economically productive lives, benefiting patients' households and communities as well as the patients themselves. For some patients, further economic benefits could be attained by initiating treatment earlier, prior to job-threatening illness and disability. Most important, however, the full economic benefits of HIV treatment will be realized only with a long-term commitment to universal treatment access. ■

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NOTES

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In this month's *Health Affairs*, Jacob Bor and coauthors report on their study examining employment effects of treating HIV-infected patients with antiretroviral therapy. Focusing on HIV patients in rural South Africa, the authors found that four years after patients began treatment, the patients' employment rate was about 90 percent of the rate they had before they became sick. The authors say the results are a further reflection of large economic benefits to HIV treatment and argue for initiating treatment earlier for some patients, before the illness produces disability and subsequent job loss.

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