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# PEPFAR Programs Linked To More Deliveries In Health Facilities By African Women Who Are Not Infected with HIV

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**ABSTRACT HIV programs in lower-income countries have provided lifesaving care and treatment to millions of people, but their expansion has raised concerns that these programs may have diverted health workers, management attention, and infrastructure investments from other health priorities, such as high maternal mortality in sub-Saharan Africa. We assessed the effect of HIV programs supported by the President's Emergency Plan for AIDS Relief (PEPFAR) on maternal health services for women not infected with HIV in 257 health facilities in eight African countries in 2007–11. Controlling for other variables, we found that having more patients on antiretroviral treatment and HIV-related infrastructure investments, such as on-site laboratories at health clinics, were associated with more deliveries at health facilities by women not infected with HIV. This association is consistent with the hypothesis that PEPFAR-funded infrastructure may also support other health services and that the program may have laid the foundation for improving health system performance in maternal health overall. We recommend that lessons learned from the rapid expansion of HIV services in sub-Saharan Africa should be drawn on to increase the provision of maternal and newborn health care and other high-priority health services, such as the treatment of diabetes, hypertension, and other chronic, noncommunicable diseases.**

The global expansion of HIV programs has been remarkably effective, providing access to HIV treatment for 6.6 million people living with HIV in low- and middle-income countries and averting an estimated 2.5 million deaths since 2004.[1] The United States has played a leading role in this effort through the President's Emergency Plan for AIDS Relief (PEPFAR),[2] providing more than $25 billion in assistance to countries with a high burden of HIV since 2004. In addition, the United States is the world's largest donor to the Global Fund to Fight AIDS, Tuberculosis, and Malaria. In partnership with host countries, PEPFAR has supported a wide range of HIV prevention, care, and treatment services and enabled 3.9 million people to initiate lifesaving antiretroviral therapy between 2004 and 2011.[3]

In sub-Saharan Africa, HIV remains a leading cause of death, but it is only one of several critically important health priorities. Countries severely affected by HIV also face high maternal and child mortality and, increasingly, high rates of chronic noncommunicable diseases.[4–6] Maternal health, in particular, is an important challenge in sub-Saharan Africa, where half of the world's maternal deaths occur.

None of the countries in the region expect to reach UN Millennium Development Goal 5, a global agreement to reduce maternal mortality by 75 percent between 1990 and 2015.[4,7] Health budgets in sub-Saharan Africa are exceedingly low, with average annual expenditures of $21 per capita.[8] Weak health systems present a formidable barrier to addressing population health needs.[9,10]

Although PEPFAR brought new funding to the global HIV/AIDS effort, most of its investments are disease-specific rather than intended to support the broader health system.[11] The expansion of HIV programs has raised concern among some observers that HIV services may have weakened health systems by displacing health workers and diverting scarce management attention and infrastructure from other health priorities.[12,13] Others have postulated that HIV investments have strengthened health systems by improving health facilities' infrastructure, supply chains for procurement of medications and supplies, data management, health worker training, and laboratory systems, as well as by establishing models for chronic disease management.[14–17]

There is limited empirical evidence about the interactions between HIV programs and existing health systems in low-income countries.[17] Several observational studies have explored the effects of the initiation of HIV services on the provision of non-HIV health services. Jessica Price and coauthors found significant increases in the provision of reproductive health services after the introduction of HIV care in thirty primary health centers in Rwanda.[18] Similarly, Tetsuya Matsubayashi and coauthors found increases in pediatric immunization in six urban clinics in Uganda after the introduction of HIV programs.[19]

However, these and other studies of interactions between HIV programs and broader health systems were small and lacked comparison groups, making it difficult to attribute the effects they found to the HIV programs. Nor did these studies disaggregate the effects of separate components of HIV service delivery from infrastructure investments, which might have different impacts on other services.[20]

Most studies to date have focused on the introduction of HIV services as a one-time event, rather than on the ongoing interactions between HIV services and other health services over time. Nine years after the establishment of PEPFAR, HIV services are routinely available at thousands of health facilities and have become important components of many countries' health systems. Nonetheless, it is not clear whether the growth and increasing complexity of HIV services at a health facility detract from the facility's ability to care for pregnant women who are not infected with HIV. Nor is it known if HIV-related investments at a health facility benefit patients with other health concerns. Understanding the dynamics between HIV services and non-HIV services is essential to inform health system policy.

In this study, we evaluated the effect of HIV care and treatment services on the concurrent provision of maternal health services over time in 257 health facilities in eight countries in sub-Saharan Africa. Specifically, we assessed the effect of the size, intensity, and quality of HIV services on maternal health services for women not infected with HIV, as measured by first antenatal (sometimes called prenatal) care visits and deliveries at the health facilities. Facility deliveries are a proxy for births attended by skilled providers (doctors, nurses, or midwives), a key intervention to reduce maternal mortality and an indicator used to measure progress toward the Millennium Development Goal on maternal mortality.

Study data were provided by ICAP (formerly known as the International Center for AIDS Care and Treatment Programs at Columbia University). ICAP is a large PEPFAR partner that supports ministries of health and local organizations in twenty countries, sixteen of which are in sub-Saharan Africa. ICAP supports more than 2,500 health facilities in their efforts to provide comprehensive HIV/AIDS prevention, care, and treatment services for children and adults. The support includes training, mentoring, and supervision of program managers and clinical, laboratory, and pharmacy personnel. It also includes upgrading infrastructure; equipping laboratories, clinics, and pharmacies; and developing medical records and financial tracking systems.

## Study Data And Methods

**STUDY DESIGN AND DATA SOURCES** We used two types of data from ICAP's programs in this study. One type was aggregate HIV and maternal service delivery data, which each health facility collects from its paper-based registries, electronic databases, or both and reports quarterly to ministries of health and PEPFAR through ICAP's Unified Reporting System. The second type was the results of an annual survey of facilities' characteristics, infrastructure, and local context. These program data undergo regular quality checks, both in country and at ICAP's headquarters, in New York City.

Facilities were included in the study if they met the following four criteria: They provided antiretroviral therapy and services aimed at the prevention of mother-to-child transmission of HIV;

they provided consistent antenatal care and delivery services throughout the study period, defined as a mean of at least thirty prenatal care visits and thirty deliveries per quarter; they reported service delivery data via the Unified Reporting System for at least two quarters and facility characteristic data via the annual survey; and they reported the HIV status of pregnant and delivering women who received maternal health services in the facility.

As outcome variables, we used the number of deliveries by women not infected with HIV in a given quarter and the number of first prenatal care visits to the facility by women not infected with HIV in the quarter. We focused on women not infected with HIV to exclude women participating in the HIV program.

To guide our analysis, we developed a conceptual model that identified the key potential mechanisms for interaction between the use of HIV services and other health services (see the online Appendix).[21] Our model was informed by the prevailing hypotheses in the global health literature.[12–17] The model thus included potential positive effects of HIV services, such as strengthening laboratory infrastructure support for other health services. It also included potential negative effects, such as reducing space or the number of health workers available for other health services. Based on this model, we selected key independent variables, which we categorized into measures of size, intensity, and quality of HIV services in the facilities.

The size of the HIV treatment program was indicated by the number of HIV patients on antiretroviral therapy in the past quarter. The intensity of HIV services was characterized according to the following three variables: the proportion of all patients on antiretroviral therapy who began the therapy in the past quarter, because these patients require more clinician time and resources; the availability of on-site outreach programs to promote patients' adherence to medication regimens and remaining in treatment; and the availability of support groups for HIV-infected patients.

The quality of HIV services was measured by the change in median CD4+ cell count—that is, the number of CD4+ cells (white blood cells involved in the immune system's defense against tumors and infections) in a cubic millimeter of blood, a standard measure of immune response to antiretroviral therapy; and the number of patients lost to follow-up, defined as patients who have not returned to the clinic for at least ninety days for any reason other than known death.

We characterized the investment of HIV programs in facility-level infrastructure by the availability of an on-site laboratory that could perform CD4+ cell count testing and the presence of a database that captured patient information electronically to facilitate HIV patient monitoring and reporting. All continuous independent variables were log transformed to address non-normality and facilitate interpretation of estimates.[22,23]

We also included in the analyses a range of facility and contextual variables not related to HIV that might be associated with the provision of maternal health services. These variables were as follows: facility level (primary, secondary/tertiary); ownership (public, private/missionary); location (rural, semiurban, or urban); and HIV prevalence among women making their first prenatal care visit to the facility. For the maternal delivery analysis, we included the number of first prenatal care visits in the same quarter to control for the size and capacity of the facility and its maternal health program.

We included a dummy variable for season to assess cyclical trends. We used a country-year interaction term to capture policy, economic, and health differences among the countries in the study as well as secular national trends, including changing health policies and financing.

**STATISTICAL ANALYSIS** Statistical analysis was conducted using the statistical software Stata, version 12.0. We calculated descriptive statistics for all variables of interest. We examined the association between HIV program characteristics and the number of deliveries and, separately, first prenatal care visits by women not infected with HIV, using generalized estimating equation negative binomial regression models with robust standard errors. Generalized estimating equations adjust estimates for correlation between repeated quarterly observations for the same facility.

Although in the main analysis we focused solely on women not infected with HIV, to avoid endogeneity between the HIV program and the outcome variable, we performed a sensitivity analysis using a dependent variable that included both women infected and not infected with HIV in the outcome (see the Appendix).[21] We performed further sensitivity analysis without the two countries that had the highest prevalence of HIV—South Africa and Lesotho—in the model to see whether HIV prevalence influenced the association (see the Appendix).[21]

**LIMITATIONS** The health facilities included in the study represent a convenience sample of facilities in specific African countries where ICAP provides program support. Therefore, the sample and study results are not representative of national health systems and should not be used to make inferences at the population level.

The data used for analyses in this study ema-

nated from programs rather than research protocols. Thus, many data were missing—in particular, for variables based on cohort data that require patient follow-up over time. Of the 2,937 quarterly observations that met the study's inclusion criteria, 35 percent were missing one or more variables, primarily change in CD4+ counts and loss to follow-up (see the Appendix for more details).[21] We conducted a reanalysis with imputed values for these frequently missing variables and found no meaningful differences in associations between HIV programs and deliveries (data not shown; available on request). Thus, we chose to retain the variables in the final model to permit us to test our conceptual framework.

Another limitation was the dearth of non-HIV variables for inclusion in the analysis, because these variables were not required by PEPFAR or reported by sites. For example, most of the study countries had a high rate of one prenatal care visit by pregnant women. Using four or more prenatal care visits would have been a more sensitive indicator of provision of comprehensive antenatal care than a single visit, but these data were not reported by the clinics. Similarly, we were unable to assess whether the presence of HIV programs was associated with a shift of health workers from other health services to HIV programs.

Our findings apply only to facilities that are similar in characteristics to those included in this study. The relationship that we found with HIV services might not hold for smaller facilities with fewer deliveries, or for all countries supported by PEPFAR. Finally, our results do not allow for causal inference, which would require prospective research.

## Study Results

The analysis included health facility data from eight countries—Côte d'Ivoire, Ethiopia, Lesotho, Mozambique, Nigeria, Rwanda, South Africa, and Tanzania—collected between January 2007 and March 2011. These countries represented a range of health systems and heterogeneous HIV epidemics in sub-Saharan Africa (Exhibit 1).[24]

Per capita health expenditures were low in most of the countries, ranging from $40 international dollars per year in Ethiopia to $862 in South Africa. (An international dollar is a hypothetical unit of currency that has the same purchasing power as one US dollar has in the United States.) In six of the eight countries, there was a high rate of prenatal care for pregnant women. However, the rate of births attended by skilled personnel was lower in most of the countries. South Africa had substantially better maternal health and education indicators than the other countries. The proportion of people receiving antiretroviral therapy of those eli-

**EXHIBIT 1**

**Characteristics Of Eight Sub-Saharan African Countries, January 2007–March 2011**

| | Country | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Characteristic | Ethiopia | Rwanda | Côte d'Ivoire | Nigeria | Tanzania | Mozambique | South Africa | Lesotho |
| HIV prevalence among adults[a] (%) | 2.1 | 2.9 | 3.4 | 3.6 | 5.6 | 11.5 | 17.8 | 23.6 |
| Contribution to study sample (percent of observations)[b] | 28.5 | 10.4 | 8.7 | 14.4 | 19.4 | 15.4 | 2.5 | 0.8 |
| Gross national income per capita ($)[c] | 1,000 | 1,200 | 1,800 | 2,200 | 1,400 | 900 | 10,300 | 1,800 |
| Population (thousands) | 83,000 | 10,600 | 19,700 | 158,400 | 44,800 | 23,400 | 50,100 | 2,200 |
| Adult literacy rate (%) | 35.9 | 70.3 | 54.6 | 60.1 | 72.6 | 54.0 | 89.0 | 89.5 |
| Fertility rate[d] | 4.2 | 5.4 | 4.4 | 5.5 | 5.5 | 4.9 | 2.5 | 3.2 |
| Per capita expenditure on health ($)[c] | 40 | 102 | 88 | 136 | 68 | 55 | 862 | 133 |
| Physician density (per 1,000 population) | 0.02 | 0.02 | 0.14 | 0.40 | 0.01 | 0.03 | 0.77 | 0.05 |
| Pregnant women receiving one prenatal visit (%) | 28 | 96 | 85 | 58 | 96 | 92 | 92 | 92 |
| Births attended by skilled health personnel (%)[e] | 6 | 52 | 57 | 39 | 51 | 55 | 91 | 62 |
| Antiretroviral therapy provision (%)[f] | 29 | 88 | 37 | 26 | 42 | 40 | 55 | 57 |

**SOURCE** World Health Organization. Global Health Observatory Data Repository (Note 30 in text). [a]Adults are people ages 15–49. [b]Percentages might not sum to 100 because of rounding. [c]In international dollars, using purchasing power parity exchange rates. International dollars are explained in the text. [d]Fertility rate is the average number of children per woman. [e]Skilled health personnel are doctors, nurses, and midwives. [f]Provision to people with advanced HIV infection according to World Health Organization 2010 guidelines. World Health Organization. Towards universal access: scaling up priority HIV/AIDS interventions in the health sector: progress report 2010 [Internet]. Geneva: WHO; 2010 [cited 2012 May 25]. Available from: http://whqlibdoc.who.int/publications/2010/9789241500395_eng.pdf.

gible for it ranged from 26 percent in Nigeria to 88 percent in Rwanda.

Complete data for the analysis of skilled deliveries in facilities were available for 1,907 quarterly observations from 257 health facilities. Data for 1,833 observations were available from the same health facilities for the prenatal care analysis. The number of observations included in the study ranged from 16 in Lesotho to 543 in Ethiopia.

Per quarter, the health facilities included in this analysis provided antiretroviral therapy to a median of 330 patients, first prenatal care visits to a median of 224 women who were not infected with HIV, and delivery services to a median of 192 uninfected women per quarter (Exhibit 2). The median HIV prevalence, as measured at first prenatal care visit at the 257 facilities, was 3 percent. The median number of patients lost to follow-up from antiretroviral therapy program was one per quarter.

We found a significant association between several HIV program variables and skilled deliveries in facilities by women not infected with HIV (Exhibit 3). When other variables were controlled for, a doubling in the number of anti-

**EXHIBIT 2**

**Characteristics Of 257 Health Facilities In Sub-Saharan Africa, January 2007–March 2011**

| Characteristic | Number | Frequency (%) | Median[a] | Interquartile range |
|---|---|---|---|---|
| Secondary or tertiary level[b] | 1,201 | 63.0 | —[c] | —[c] |
| Public ownership[d] | 1,701 | 89.2 | —[c] | —[c] |
| **LOCATION** | | | | |
| Urban[e] | 562 | 29.5 | —[c] | —[c] |
| Semiurban[f] | 828 | 43.4 | | |
| Rural | 517 | 27.1 | —[c] | —[c] |
| **COUNTRY** | | | | |
| Côte d'Ivoire | 165 | 8.7 | —[c] | —[c] |
| Ethiopia | 543 | 28.5 | —[c] | —[c] |
| Lesotho | 16 | 0.8 | —[c] | —[c] |
| Mozambique | 293 | 15.4 | —[c] | —[c] |
| Nigeria | 274 | 14.4 | —[c] | —[c] |
| Rwanda | 199 | 10.4 | —[c] | —[c] |
| South Africa | 47 | 2.5 | —[c] | —[c] |
| Tanzania | 370 | 19.4 | —[c] | —[c] |
| **HEALTH NEED** | | | | |
| Percent of women testing positive for HIV at first prenatal care visit | —[c] | —[c] | 3 | 2, 7 |
| Non-HIV programs | | | | |
| Facility deliveries, uninfected women | —[c] | —[c] | 192 | 91, 375 |
| First prenatal care visits, uninfected women | —[c] | —[c] | 224 | 129, 411 |
| HIV program | | | | |
| Number of patients in antiretroviral therapy[g] | —[c] | —[c] | 330 | 121, 784 |
| Percent of patients in antiretroviral therapy who are newly enrolled[h] | —[c] | —[c] | 12 | 8, 18 |
| Availability of outreach program[i] | 1,531 | 80.3 | —[c] | —[c] |
| Availability of HIV support groups | 1,326 | 69.5 | —[c] | —[c] |
| Change in median CD4+ count[j] | —[c] | —[c] | 139 | 97, 195 |
| Patients lost to follow-up[k] | —[c] | —[c] | 1 | 0, 11 |
| On-site CD4+ testing[l] | 1,011 | 53.0 | —[c] | —[c] |
| Electronic database available[m] | 1,168 | 61.3 | —[c] | —[c] |

**SOURCE** Authors' analysis of data from ICAP. [a]Median values are per quarter. [b]District, provincial, teaching, and national referral hospitals. Reference group is health centers and dispensaries. [c]Not applicable. [d]Reference group is private and mission facilities. [e]Officially designated as city by the country's central statistics office; with city administration and political bodies. [f]Big and small towns, periurban areas, and mining communities. [g]Adult and pediatric patients on antiretroviral therapy at end of quarter who are not known to have discontinued, or transferred out of, treatment. [h]New patients enrolled in antiretroviral therapy in a given quarter, as a proportion of all patients in antiretroviral therapy in that quarter. We counted each person as new to the program only once. [i]Activities through which the HIV care and treatment clinic initiates contact with patients who missed clinic visits for follow-up care or to pick up medication. [j]Number of CD4+ cells in a cubic milliliter of blood. CD4+ count is explained in text. Calculated using median CD4+ count at six months minus median CD4+ count at baseline, measured among the same cohort. [k]Patients are considered lost to follow-up if they have not been to the clinic or picked up drugs for at least ninety days. [l]Blood collection and testing of CD4+ counts done within the facility. [m]Electronic database used to document delivery of HIV services.

retroviral therapy patients at a given facility was associated with 13 percent more deliveries at the facility by women not infected with HIV in a quarter. In addition, deliveries in facilities were nearly 13 percent higher in facilities with on-site laboratories that provided CD4+ count testing and nearly 10 percent higher in facilities using electronic HIV databases, compared to facilities without these features—elements that indicated investments in HIV programs at the facilities. Finally, facilities that offered support groups for HIV patients had 6 percent more deliveries per quarter for women not infected with HIV than facilities without support groups.

In addition, the number of deliveries was higher in hospitals than clinics, in urban com-

**EXHIBIT 3**

**Associations Between HIV Program Characteristics And Care For Women Not Infected With HIV, January 2007–March 2011**

| | Incidence rate ratio[a] | |
|---|---|---|
| **Association** | **Deliveries by uninfected women** | **First prenatal care visits by uninfected women** |
| Size of HIV program (number of patients in antiretroviral therapy) | 1.134**** | 1.005 |
| **INTENSITY OF HIV PROGRAM** | | |
| Percent of patients in antiretroviral therapy who are newly enrolled[b] | 1.002 | 0.999 |
| Availability of outreach program[c] | 0.975 | 1.010 |
| Availability of HIV support groups | 1.060** | 0.989 |
| **QUALITY OF HIV PROGRAM** | | |
| Change in median CD4+ count[d] | 1.001 | 0.991 |
| Patients lost to follow-up[e] | 1.001 | 1.001 |
| **HIV INFRASTRUCTURE INVESTMENTS** | | |
| On-site CD4+ testing[f] | 1.126*** | 1.039 |
| Electronic database available[g] | 1.096** | 1.034 |
| **FACILITY CHARACTERISTICS AND CONTEXT** | | |
| Public ownership[h] | 0.994 | 1.388 |
| Secondary or tertiary level[i] | 1.773**** | 1.255* |
| Number of first prenatal care visits | 1.371**** | —[j] |
| Percent of women testing positive for HIV at first prenatal care visit | 1.000 | 1.006* |
| Location | | |
| Semiurban[k] | 1.165** | 0.950 |
| Urban[l] | 1.725**** | 1.217*** |
| Season[m] | | |
| April–June | 1.049*** | 0.975 |
| July–September | 1.058** | 0.954** |
| October–December | 0.990 | 0.973 |

**SOURCE** Authors' analysis of data from ICAP. **NOTES** Results controlled for country, year, and country-year interaction term. Fewer quarterly observations (1,883) about first prenatal care visits by uninfected women were available from the 257 facilities than about deliveries by uninfected women (1,907). [a]The incidence rate ratio provides a relative measure of the effect of the HIV program and facility/context characteristics on use of delivery and first prenatal care services within the same facility. The ratio is interpreted similarly to an odds ratio. The null hypothesis specifies no difference in delivery of non-HIV services (that is, the ratio equals 1.0). The ratio represents the change in the dependent variable associated with a one-unit change in the independent variable; the percentage change can be calculated using the following formula: (ratio minus 1) multiplied by 100 percent. In the case of log-transformed continuous variables, we interpret the ratio as a percentage change in the dependent variable for a percentage change of the independent variable. [b]New patients enrolled in antiretroviral therapy in a given quarter, as a proportion of all patients in antiretroviral therapy in that quarter. We counted each person as new to the program only once. [c]Activities through which the HIV care and treatment clinic initiates contact with patients who missed clinic visits for follow-up care or to pick up medication. [d]Number of CD4+ cells in a cubic milliliter of blood. CD4+ count is explained in text. Calculated using median CD4+ count at six months minus median CD4+ count at baseline, measured among the same cohort. Median change in CD4+ counts incorporates a six-month lead. Lead variables are introduced to account for time required to achieve a clinical effect. That is, we assigned a future CD4+ count value to a current quarterly observation. [e]Patients are considered lost to follow-up if they have not been to the clinic or picked up drugs for at least ninety days. "Patients lost to follow-up" incorporates a three-month lead. That is, we assigned a future value for number of patients lost to follow-up to a current quarterly observation. [f]Blood collection and testing of CD4+ counts done within the facility. [g]Electronic database used to document delivery of HIV services. [h]Reference group is private and mission facilities. [i]District, provincial, teaching, and national referral hospitals. Reference group is health centers and dispensaries. [j]This variable was omitted from the prenatal care visits model. [k]Big and small towns, periurban areas, and mining communities. [l]Officially designated as a city by the country's central statistics office, with city administration and political bodies. [m]Reference group is January–March. *$p < 0.10$ **$p < 0.05$ ***$p < 0.01$ ****$p < 0.001$

pared to rural facilities, and in facilities with larger prenatal care programs. Sensitivity analyses—those including deliveries by HIV-infected women or excluding countries with a high prevalence of HIV—yielded similar results to the main analysis (data not shown).

None of the variables associated with HIV program size, intensity, quality, or infrastructure was associated with the number of first prenatal care visits by women not infected with HIV.

## Discussion

In this study, we explored the associations between HIV and maternal health services located at the same health facilities in eight sub-Saharan African countries between 2007 and 2011. We found no evidence that HIV programs had a negative impact on maternal health services for women not infected with HIV.

Indeed, several HIV program characteristics were positively associated with significantly higher numbers of deliveries in facilities by women not infected with HIV. Specifically, we found that the number of patients receiving antiretroviral therapy and the availability of support groups for HIV-infected patients were both associated with higher volumes of deliveries by women not infected with HIV. We also found that health facilities with more advanced HIV infrastructure, as measured by the availability of onsite laboratories providing CD4+ count testing and electronic HIV service databases, were associated with higher volumes of deliveries in health facilities by women not infected with HIV. HIV program characteristics were not significantly associated, either positively or negatively, with first prenatal care visits.

There are several possible explanations for the association between HIV programs and volume of deliveries in health facilities. For example, as HIV treatment programs expand, a larger number of community members may be exposed to the health facility. And HIV-infected patients enrolled in HIV programs who have favorable experiences with the facility may encourage family members and others within their social networks to use the facility for obstetric care.

Another possibility is that growth of HIV services and the focus of such services on quality and continuity of care may lead to facilitywide improvements in the quality of patient care, including a greater focus on encouraging all pregnant women in prenatal care to return for delivery at the facility. Services to prevent mother-to-child transmission of HIV in the prenatal care setting include counseling HIV-infected pregnant women on the importance of delivery at the facility. These counseling services may have a spillover effect on women not infected with HIV at study sites, also motivating them to deliver at the facility.

The association between HIV-related infrastructure and deliveries in health facilities by women not infected with HIV is consistent with the hypothesis that PEPFAR-funded infrastructure may also support other health services.[11,17,18] Investments in laboratory services, including rebuilding and equipping laboratories and training laboratory staff, may have cross-service benefits.[25,26] Our previous research suggests that patients are strongly influenced by the perceived quality of facility equipment.[27,28] Visible upgrades—evident to all patients, not just those with HIV—may influence the decision to give birth in a health facility.

The availability of electronic data systems to document the delivery of HIV services may be a proxy for broader improvements in the health information system in the clinic, which may permit more efficient patient care and better follow-up of pregnant women, irrespective of their HIV status.

With the hope of making childbirth safer and achieving Millennium Development Goal 5, national governments and their development partners have made substantial efforts to increase the rate of deliveries in health facilities.[29] Thus, our finding that HIV programs may expand the provision of this essential maternal health service is encouraging. Evidence of positive interactions between HIV and obstetric services is particularly heartening in sub-Saharan Africa, a region where rates of both HIV and maternal mortality are high and where HIV is responsible for a substantial proportion of maternal deaths.[4]

It is important to note that the magnitude of the associations we found between HIV programs and childbirth in a facility is modest. This is not surprising, given the many factors that are more directly associated with use of obstetric services, such as a woman's age and number of previous pregnancies, distance to a health facility, and the quality of available obstetric care.[27]

Our analyses did not find an association between HIV services and the number of first prenatal care visits by women not infected with HIV. This is probably due to the relatively high utilization rates of prenatal care in the countries included in this analysis (Exhibit 1), which limits the potential for observing an increase. For example, in six out of eight countries included in this analysis—Côte d'Ivoire, Lesotho, Mozambique, Rwanda, South Africa, and Tanzania—85 percent or more of women reported at least one prenatal care visit.[30] Prenatal care is also a much lower-intensity service than delivery at a health facility—that is, prenatal care does not

require highly trained providers or specialized medicines and equipment. Use of prenatal care may therefore be less sensitive to the quality of care than delivery services are.[31]

This study has several strengths. It included a large number of health facilities from several countries in sub-Saharan Africa with variable HIV prevalence and diverse health system characteristics. It is one of the few studies to have used longitudinal health system data to describe the association between HIV services and use of maternal health services. In addition, the HIV program data were sufficiently detailed to permit a thorough exploration of the role of multiple dimensions of HIV investments—such as the volume, quality, and intensity of HIV services—and to analyze service use by women not infected with HIV rather than by all women.

## Conclusions

Our study findings suggest that PEPFAR-supported programs in this sample of African clinics have not had a detrimental effect on maternal health services for women not infected with HIV. Rather, the programs may have laid the foundation for improving health system performance in maternal health overall.

Additional studies are needed to confirm our findings in other epidemiologic and health system settings. Our data did not permit inference at the country level, which would have required representative sampling and a larger number of facilities in each country. Future research should employ qualitative and mixed-methods approaches to explore mechanisms of interaction between HIV and other health services. In the short term, expanding routine monitoring of PEPFAR-supported programs to include a wider range of other health process and outcome indicators—such as the number of prenatal care visits, provision of postnatal care, provision of integrated management of childhood illness, and mortality rates for mothers and infants in facilities—is essential to allow further analysis of the relationship between HIV programs and health systems.

Given the massive burden that HIV continues to impose on many African countries and the moral imperative to continue the provision of care and treatment to people infected with HIV, the challenge facing policy makers going forward is how best to implement HIV services while supporting the provision of other essential health care. This study, together with other work, suggests that the experience gained in providing HIV care can and should inform efforts to strengthen national health systems as well as global health assistance strategies of the United States and other funders.[13–16,18,19] To this end, we suggest several policy directions.

First, the lessons learned from the rapid expansion of HIV services in sub-Saharan Africa should be drawn on to increase the provision of other priority health services. For example, models used in HIV to reach out to local communities and inform them of availability of HIV-related testing, treatment, and other services could be adapted to encourage the use of other lifesaving services, such as delivery and newborn care in health facilities. Such approaches might also improve the detection of other conditions with few early symptoms, such as diabetes and hypertension—two of the newly looming public health threats in the region.[32]

Second, PEPFAR's attention to effective, continuous, and patient-centered care offers tangible and local examples of how to tackle quality improvement in weak health systems. These lessons are particularly relevant given the growing body of evidence pointing to challenges in the provision of high-quality, essential health care in low-income regions. Those challenges range from inadequate supplies of electricity and water to poor provider performance and unreliable health data.[33–36]

For example, clinical care models that promote quality and continuity of care for patients with HIV—a chronic communicable disease—should be adapted for the management of other chronic conditions that require ongoing contact with the health system.[37] Similarly, best practices in the development of data systems and monitoring for HIV programs should be identified and applied to strengthening health information systems more broadly.[38–40]

Third, as noted above, research must become a more integral component of the global health response to optimize the impact of global health investments in Africa and other resource-constrained settings. Efforts to strengthen health systems should be rigorously evaluated using robust experimental or quasi-experimental designs and implementation science methods to establish their effectiveness, feasibility, and sustainability.[41,42]

In sum, the encouraging findings from our study should inspire a deliberate and systematic effort to invest in health systems and thus bring measurable benefits to both people infected with HIV and the general population. ■

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## NOTES


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In this month's *Health Affairs*, Margaret Kruk and colleagues address the question of whether HIV programs in lower-income countries have diverted investments from other health priorities, such as combating high maternal mortality in sub-Saharan Africa. They assessed the effect of HIV programs in eight countries supported by the President's Emergency Plan for AIDS Relief (PEPFAR) and found that among other factors, having more patients on antiretroviral treatment was associated with more deliveries at health facilities by women not infected with HIV. The finding suggests that PEPFAR may have laid the foundation for improving health system performance in maternal health overall, the authors write.

"Our finding of some modest positive associations—and, perhaps more importantly, no negative associations—is reassuring, given the large scope of PEPFAR-supported programs in high-burden countries," Kruk says. "From here, we would like to turn to prospective research that explores how HIV programs can be actively leveraged to improve health systems, and in turn the health of the general population."

Kruk is an assistant professor of health policy and management at the Columbia University Mailman School of Public Health. Her research in health systems science focuses on determinants of health care use, population preferences for health care, and novel approaches for evaluating the success of complex health system interventions in sub-Saharan Africa and other low-income regions. Kruk holds a medical degree from McMaster University and a master's degree in public health, with a concentration in health policy and management, from Harvard University.

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