Impact of universal antiretroviral treatment eligibility on rapid treatment initiation among young adolescents with HIV in sub-Saharan Africa.

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SUMMARY (40 words or less): Universal antiretroviral treatment (ART) policies led to increases in rapid ART initiation among young adolescents, ages 10-14 years, after enrollment in HIV care. Immediate increases in rapid ART initiation were observed after policy adoption in some countries.

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ABSTRACT:

Background: Young adolescents with perinatally-acquired HIV are at risk for poor care outcomes. We examined whether universal antiretroviral treatment (ART) eligibility policies (Treat All) improved rapid ART initiation following care enrollment among 10-14-year-olds in seven sub-Saharan African countries.

Methods: Regression discontinuity analysis and data for 6,912 10-14-year-old patients were used to estimate changes in rapid ART initiation (within 30 days of care enrollment) following adoption of Treat All policies in two groups of countries: Uganda and Zambia (policy adopted in 2013) and Burundi, Democratic Republic of the Congo, Kenya, Malawi, and Rwanda (policy adopted in 2016).

Results: There were immediate increases in rapid ART initiation among young adolescents after national adoption of Treat All. Increases were greater in countries adopting the policy in 2016, compared with those adopting it in 2013: 23.4 percentage points (pp) (95%CI: 13.9-32.8) vs. 11.2pp (95%CI: 2.5-19.9). However, the rate of increase in rapid ART initiation among 10-14-year-olds rose appreciably in countries with earlier treatment expansions, from 1.5pp per year before Treat All to 7.7pp afterwards.

Conclusions: Universal ART eligibility has increased rapid treatment initiation among young adolescents enrolling in HIV care. Further research should assess their retention in care and viral suppression under Treat All.

Keywords: adolescents, Treat All, ART eligibility, ART initiation, sub-Saharan Africa, regression discontinuity

INTRODUCTION

In 2018, an estimated 599,000 young adolescents, ages 10 to 14 years, were living with HIV, with close to 90% in sub-Saharan Africa [1, 2]. While data on this age group are limited [3, 4], young adolescents living with HIV are presumed to have acquired HIV perinatally [5, 6]. Studies suggest that adolescents aged 10 to 14 may be less likely than younger children and older age groups to be tested for HIV because of slow-progressing disease, HIV-related stigma, parental concerns about disclosing their own status, and HIV testing strategies, including requirements for caregiver consent, that are not tailored towards adolescents [7-13].

Disproportionately high HIV-related mortality rates have been reported for young adolescents, compared with older adolescents who likely acquire HIV later in life [2]. Young adolescents enrolling in HIV care are often underweight and stunted, and they tend to have lower CD4 counts and more advanced disease than both older adolescents [14, 15] and younger children diagnosed earlier following perinatal infection [16]. Research has shown that adolescents are also at greater risk of failing to initiate antiretroviral treatment (ART), particularly if they are ineligible for treatment at the time they enroll in HIV care [17]. The extent to which treatment eligibility guidelines have constrained ART initiation for adolescents is unknown. Before 2015, the World Health Organization (WHO) provided consolidated guidance on HIV treatment for both adolescents, ages 10 to 19 years, and adults that based ART initiation on CD4 count and clinical eligibility criteria [18-21]. Although a few countries in sub-Saharan Africa extended HIV treatment to all adolescents aged 15 or below in 2013 [22, 23], adolescents only became universally eligible for immediate treatment with the WHO's 2015 recommendation to treat all people living with HIV/AIDS (PLHA), irrespective of immunologic or clinical status [18].

Using longitudinal patient data from seven countries participating in the International epidemiology Databases to Evaluate AIDS (IeDEA) research consortium, we assessed changes in rates of rapid ART initiation among 10-to-14-year-old patients newly enrolling in HIV care following national adoption of Treat All policies for young adolescents or Treat All policies for the general population of PLHA.

METHODS

Data sources and management

Patient data: The IeDEA consortium (www.iedea.org) assembles sociodemographic and clinical data on adult and pediatric patients receiving HIV care across seven regional cohorts [24]. The data represent diverse clinical sites, the majority of which (87%) are public-sector health facilities, including primary (42%), as well as secondary and tertiary level sites (58%) [25]. In this analysis, we used medical records from 10-to-14-year-old patients newly enrolling in HIV care from 2010 to 2018 in seven sub-Saharan African countries in three IeDEA regions. These countries were selected because patient data were available for analysis following the adoption of universal treatment eligibility policies (Central Africa: Burundi, Democratic Republic of the Congo [DRC], and Rwanda; East Africa: Kenya and Uganda; Southern Africa: Malawi and Zambia). Prior to data analysis, each region's data were standardized by regional data managers in accordance with IeDEA data definitions and formatting standards (iedeades.org).

For each country, we identified the date when ART eligibility was first extended to all patients aged 10 to 14 years, either as part of a pediatric (<15 years) Treat All policy, or a general Treat All policy (covering patients of all ages). If a country first adopted a pediatric Treat All policy and subsequently adopted a general Treat All policy, we recorded both dates. We have previously described our systematic search for current and historical ART eligibility guidelines based on publicly available policy

documents, published literature, and input from in-country experts [26]. If the exact day of expansion was unknown, it was assumed to have occurred on the first day of the month in which the policy was adopted.

Data were de-identified before sharing and approved for use by local research ethics committees in each of the IeDEA regions included in the study.

Inclusion criteria

Patients: Patients had to be between 10 and 14 years of age at the time of enrollment into HIV care, with at least 30 days of possible follow-up between enrollment and database closure. Patients were excluded if they were known to have transferred to an IeDEA site from another clinic or were known to be ART-experienced at enrollment.

Sites: Sites had to have patient data available for the period between care enrollment and ART initiation (i.e., pre-ART data) for both ART initiators and non-initiators (i.e., those dying or dropping out of care prior to starting treatment). Sites with data only from the period following ART initiation were excluded.

Outcome and exposure

The outcome of interest was "rapid" ART initiation, and was defined as initiation of treatment within 30 days of enrollment in HIV care, which is consistent with our prior analyses in adults [27]. This definition differs from the 2017 WHO definition of rapid ART initiation, which is ART-initiation occurring within seven days of HIV diagnosis [28]. The exposure was period of enrollment in HIV care, as defined by the relationship to the calendar date of country-level ART eligibility expansion to Treat All.

Other definitions

ART was defined as treatment with any regimen of at least three antiretroviral drugs, excluding antiretrovirals taken solely for the prevention of mother-to-child transmission. As a measure of HIV disease severity, pre-treatment CD4 count was defined as the CD4 closest to the enrollment date within a 90-day window (before or after), but no later than one week after ART initiation.

Study design

Descriptive analyses

Patient characteristics, including sex, age, availability of pre-treatment CD4 measure, and median CD4, were described for each country where a pediatric or general Treat All policy extended ART eligibility to all children ages 10 to 14 years, and were aggregated by time period of policy change. The proportion of patients initiating ART rapidly in the year before and after Treat All adoption was calculated for each country and for the Central Africa region (i.e., Burundi, DRC, and Rwanda) because of small sample sizes available for the individual countries.

Effect of ART eligibility expansion to Treat All on rapid ART initiation

The effect of enrollment in HIV care under Treat All on the proportion of young adolescents initiating ART rapidly was assessed using a regression discontinuity design. This approach takes advantage of local randomness in a continuous eligibility assignment variable (calendar time of HIV care enrollment), relative to a cut-off threshold (date of country-level adoption of pediatric or general Treat All). In this quasi-experimental condition, as long as there is no evidence that values of the assignment variable are being manipulated, patients enrolling in care directly before and after the cut-off date are considered exchangeable. Accordingly, there should be no systematic differences in measured and unmeasured

characteristics between the groups, other than the higher probability of treatment eligibility among those enrolling after Treat All policy adoption. If these assumptions are met, observed effects can be interpreted causally, as intention-to-treat estimates [29, 30].

To assess whether there were systematic differences between patients enrolling in HIV care on either side of the threshold, as well as non-random enrollment before or after the Treat All adoption date, we used covariate balance tests and plots of the date of enrollment in HIV care. As complete information about each patient's true ART eligibility status at enrollment prior to Treat All adoption was not known (because of missing information on HIV stage, comorbidities, pregnancy, and/or special population status), the study is an intention-to-treat analysis using a "sharp" regression discontinuity design [29, 30].

We examined the association between calendar time of enrollment in HIV care and rapid ART initiation for two groups of countries: those where a pediatric Treat All policy extended ART eligibility to all children 10 to 14 years old in 2013, and those where a general Treat All policy extended ART eligibility to this age group along with adults in 2016. A discontinuity at the date of each country's Treat All policy adoption allowed for different slopes before and after the cutoff, or threshold, date. Local linear regression models [31] were used to estimate predicted outcomes and risk differences at the Treat All threshold date as follows:

$$E[Y_i|Z_i] = \beta_0 + \beta_1 * Z_i + \beta_2 * 1[Z_i \geq 0] + \beta_3 * Z_i * 1[Z_i \geq 0]$$

where Y_i is the patient-level outcome (rapid ART initiation), Z_i is the number of days between a patient's enrollment date and national Treat All policy adoption date (negative if patient enrolled before the policy was adopted), and $1[Z_i \geq 0)]$ indicates whether a patient enrolled after the policy was adopted or not.

Data-driven Imbens-Kalyanaraman bandwidths [32] were used to define windows of time around the date of Treat All adoption within which predicted outcomes and risk differences at the Treat All threshold date were estimated. All observations within the bandwidth were weighted equally. Sensitivity analyses were completed using three other bandwidth sizes, ranging from 150 to 450 days.

In the countries with a general Treat All expansion to all ages following a pediatric Treat All policy, an additional regression discontinuity analysis for the general Treat All adoption was completed to assess whether further expansions of eligibility criteria to encompass older age groups affected rapid ART initiation among already-eligible 10-to-14-year-olds. Such effects could be positive (increase in rapid ART initiation because of, for example, stigma reduction) or negative (decrease in rapid ART initiation because of, for example, facility capacity constraints).

Trends in rapid ART initiation before and after Treat All adoption

To characterize trends in rapid ART initiation following enrollment into HIV care, slopes from linear regression models for the period before and after the date of Treat All adoption were compared, and expressed as percentage point change in rapid ART initiation per year (i.e., average annual rate of increase).

Analyses were completed in SAS 9.4 and Stata/MP version 15.1.

RESULTS

Sample characteristics

Longitudinal data were available for 7,296 patients ages 10 to 14 years who enrolled in HIV care between 2010 and 2018, including 7,239 (99.2%) with at least 30 days of possible follow-up. Of these patients, 6,912 (95.5%) had no evidence of transfer from another site or ART prior to enrollment.

Among the seven countries in the analysis, five (Burundi, DRC, Kenya, Malawi, Rwanda) adopted general Treat All policies that extended treatment eligibility to young adolescents ages 10 to 14 years in 2016. Two countries (Uganda, Zambia) adopted pediatric Treat All policies in 2013, which extended treatment to all children younger than 15 years, and adopted general Treat All policies in 2016. (Supplementary Table 1)

Among the 6,912 patients who met study inclusion criteria, 3,592 (52.0%) were in countries where pediatric Treat All was adopted in 2013, and 3,320 (48.0%) in countries where general Treat All was adopted in 2016. The median age at enrollment in HIV care was 12 years (interquartile range [IQR]: 11-13), with no significant age differences before and after Treat All adoption (Supplementary Table 2), and 58.3% were female. The availability of pre-treatment CD4 count measures varied across countries and before vs. after Treat All policy adoption. Few patients had pre-treatment CD4 measures following the adoption of Treat All policies, particularly in countries that introduced the policy in 2016 (20.1% overall, and only 3% among patients from Malawi). Among patients with a pre-treatment CD4 count, the median value before Treat All adoption was 315 cells/μl (IQR: 124-551) in countries adopting general Treat All policies in 2016 and 363 cells/μl (IQR: 193-589) in countries that adopted a pediatric Treat All policy in 2013 (Table 1).

Table 1. Characteristics of adolescents 10 to 14 years of age enrolling in HIV care (n=6,912), 2010-2018.

	General Treat All adopted in 2016						Pediatric Treat All adopted in 2013		
	Burundi	DRC	Kenya	Malawi	Rwanda	**Overall**	Uganda	Zambia	**Overall**
Treat All adoption date	Sep 2016	Sep 2016	Jul 2016	May 2016	Jul 2016	2016	Dec 2013	Dec 2013	2013
Total enrollments (%)	178 (2.6%)	123 (1.8%)	1,752 (25.3%)	1,168 (16.9%)	99 (1.4%)	3,320 (48.0%)	461 (6.7%)	3,131 (45.3%)	3,592 (52.0%)
Period of enrollment									
Before Treat All adoption	154 (86.5%)	110 (89.4%)	1548 (88.4%)	1067 (91.4%)	82 (82.8%)	2,961 (89.2%)	257 (55.7%)	1635 (52.2%)	1,892 (52.7%)
After Treat All adoption	24 (13.5%)	13 (10.6%)	204 (11.6%)	101 (8.6%)	17 (17.2%)	359 (10.8%)	204 (44.3%)	1496 (47.8%)	1,700 (47.3%)
Sex									
Male	73 (41.0%)	67 (54.5%)	702 (40.1%)	511 (43.8%)	50 (50.5%)	1,403 (42.3%)	186 (40.3%)	1294 (41.3%)	1,480 (41.2%)
Female	105 (59.0%)	56 (45.5%)	1050 (59.9%)	657 (56.3%)	49 (49.5%)	1,917 (57.7%)	275 (59.7%)	1837 (58.7%)	2,112 (58.8%)
Age (years)									
Median (IQR)	12 (11-13)	12 (11-13)	12 (11-13)	12 (11-13)	12 (11-13)	12 (11-13)	12 (11-13)	12 (11-13)	12 (11-13)
Pre-treatment CD4 measure before Treat All adoption									
CD4 measure available	42 (27.3%)	79 (71.8%)	1,073 (69.3%)	235 (22.0%)	66 (80.5%)	1,495 (50.5%)	167 (65.0%)	1,090 (66.7%)	1,257 (66.4%)
Median CD4 count (cells/µl) (IQR)	417 (220-762)	297 (93-499)	315 (120-574)	308 (145-456)	400 (176-675)	315 (124-551)	377 (197-671)	359 (193-579)	363 (193-589)
Pre-treatment CD4 measure after Treat All adoption									
CD4 measure available	5 (20.8%)	1 (7.7%)	53 (26.0%)	3 (3.0%)	10 (58.8%)	72 (20.1%)	106 (52.0%)	704 (47.1%)	1,700 (47.7%)
Median CD4 count (cells/µl) (IQR)	N/A	N/A	397 (233-558)	N/A	N/A	N/A	408 (194-579)	343 (173-545)	347 (173-554)

IQR = interquartile range; DRC = Democratic Republic of the Congo

Distributions of baseline characteristics among newly enrolling patients were similar just before and just after Treat All adoption (Supplementary Table 2). No major discontinuity in the number of new enrollments around the date of Treat All adoption was observed (Supplementary Figure 1).

Figure 1. Proportions of adolescents 10 to 14 years old initiating ART rapidly (within 30 days of enrollment in HIV care) in the years before and after Treat All adoption, by country or region.

Rapid ART initiation before and after Treat All adoption (descriptive analysis)

There were appreciable increases in rapid ART initiation among young adolescents in the year following Treat All adoption in all seven countries. Increases ranged from 16.3 percentage points (pp) in Zambia (from 37.4% in the year before to 53.7% in the year after) to 33.7pp in Uganda (from 41.3% to 75.0%, respectively). The proportion of young adolescents rapidly initiating ART in the year after Treat All adoption was highest in Malawi and Kenya (88.1% and 86.5%, respectively), both of which adopted a general Treat All policy in 2016. (Figure 1).

Effect of Treat All adoption on rapid ART initiation (regression discontinuity analysis)

Statistically significant increases in rapid ART initiation among young adolescents were observed immediately after national Treat All policies expanded treatment eligibility for this age group. A larger absolute effect was observed in the group of countries that adopted a general Treat All policy in 2016 (Burundi, DRC, Kenya, Malawi, Rwanda): 23.4pp (95% CI: 13.9, 32.8), compared with the countries with a 2013 pediatric Treat All policy (Uganda, Zambia), where there was an 11.2pp increase in rapid ART

initiation (95% CI: 2.5, 19.9). In the 2016 Treat All group, 85.4% of young adolescents enrolling immediately after Treat All adoption initiated ART rapidly (up from 62.0% immediately before), while in the 2013 group, 50.2% of young adolescents initiated rapidly after the expansion (up from 39.0% immediately before; Table 2, Figure 2).

Table 2. Effect of ART eligibility expansion to treat all adolescents 10 to 14 years old and trends in rapid ART initiation before and after Treat All adoption.

Expansion date	2016	2013	2016
Expansion type	General Treat All	Pediatric Treat All	General Treat All
Countries	Burundi, DRC, Kenya, Malawi, Rwanda	Uganda, Zambia	Uganda, Zambia
Risk difference at the Treat All adoption threshold*	23.4	11.2	-1.1
95% CI	13.9 - 32.8	2.5 - 19.9	-13.9 - 11.7
p-value	<0.001	0.012	0.862
Imbens-Kalyanaraman bandwidth, days	681	780	252
N within bandwidth	970	1,937	665
Predicted outcomes at the Treat All threshold*			
Enrollment just before Treat All adoption	62.0%	39.0%	77.7%
Enrollment just after Treat All adoption	85.4%	50.2%	76.6%
Relative change after Treat All adoption	37.7%	28.7%	-1.4%
Slopes before and after Treat All adoption**			
Percentage point change in rapid ART initiation per year before Treat All adoption	4.1	1.5	5.8

Percentage point change in rapid ART initiation per year after Treat All adoption	2.0	7.7	4.4
P-value for difference of slopes	0.693	<0.001	0.928

ART = antiretroviral treatment; DRC = Democratic Republic of the Congo

*Risk difference and predicted outcomes at the Treat All threshold are from regression discontinuity analyses. Effects are calculated at the guideline expansion threshold of one day before versus one day after Treat All adoption.

**Slope comparison is from separate linear regression models comparing the periods before Treat All adoption and after Treat All adoption.

Figure 2. Trends in rapid ART initiation before and after Treat All adoption among adolescents 10 to 14 years old, by year of Treat All adoption.

There was no statistically significant change in rapid ART initiation among young adolescents immediately after general Treat All policies were adopted in Uganda and Zambia in 2016 (Table 2). Pediatric Treat All policies were already in place in these two countries, and the proportion of young adolescents initiating ART rapidly was 77.7% immediately before the general Treat All policy, versus 76.6% immediately after.

Results of sensitivity analyses using other bandwidths were consistent with the findings based on the data-driven Imbens-Kalyanaraman bandwidth (Supplementary Table 3).

Trends in rapid ART initiation before and after Treat All adoption (slope comparison)

The average annual rate of increase in rapid ART initiation among young adolescents rose in countries where a pediatric Treat All policy was adopted in 2013, from 1.5pp per year before Treat All adoption to

7.7pp afterwards (Table 2). However, no statistically significant change in the annual rate of increase in rapid ART initiation was observed in countries that adopted a general Treat All policy in 2016. In addition, no rate change was observed in Uganda and Zambia following the expansion of pediatric Treat All policies to include all PLHA in 2016.

DISCUSSION

Whether part of a pediatric Treat All policy or a general Treat All policy, expansions of HIV treatment eligibility to those under age 15 were followed by significant and substantial increases in ART initiation among 10- to 14-year-olds within 30 days of enrollment in HIV care. Increases in rapid ART initiation were particularly large following national adoptions of a general Treat All policy (i.e., for all ages) in 2016 in Burundi, DRC, Kenya, Malawi, and Rwanda. Observed increases in the proportion of young adolescents rapidly initiating ART following national adoption of Treat All policies may have substantial clinical importance, given evidence indicating that young adolescents with perinatally-acquired HIV often enroll in care late and do not initiate ART until they are at advanced stages of disease [14, 15, 33-35].

Pre-treatment CD4 measures were not available for a large proportion of patients, making it difficult to ascertain clinical eligibility for treatment among those enrolling before Treat All policies were adopted. However, among the 56.7% of young adolescents with pre-treatment CD4 data available prior to Treat All adoption, median CD4 counts for each country in our study were well below 500 cells/ul, the previous immunologic threshold for treatment eligibility. This suggests that there were gaps in rapid ART initiation for young adolescents when CD4-based eligibility criteria were in effect. These findings are in accordance with previous research that has highlighted a range of social and structural barriers to HIV

care and treatment for adolescents, whose needs may not be adequately met by service delivery strategies designed for younger children or adult HIV patients. [6, 7, 36, 37].

The absolute effect of treatment eligibility expansions for young adolescents was greater under general Treat All policies than under earlier pediatric Treat All policies. This was noteworthy, given that large numbers of adult patients, newly-eligible under Treat All, could potentially strain HIV service provision, leading to the crowding out of vulnerable groups, such as young adolescents, for whom tailored interventions and services are recommended [11, 15, 38-40]. These results lend support for the supposition that general Treat All policies, with harmonized treatment recommendations for different population groups, are easier to implement in real-world treatment settings than prior policies targeting specific groups. Age-agnostic guidelines may help simplify the provision of HIV treatment in low-resourced health systems in ways that lead to efficiency gains in service delivery [41, 42].

Given the three-year interval between the pediatric Treat All expansions of 2013 and the general Treat All expansions of 2016, findings may also reflect temporal trends in provider preparedness, health system capacities to rapidly implement expanded treatment guidelines, and improved strategies for initiating patients on ART, despite decreases in donor funding for HIV during the period [43, 44]. While immediate increases in rapid ART initiation among 10- to 14-year-olds were smaller following national adoptions of pediatric Treat All policies, the average annual rate of change in rapid ART initiation increased significantly following the adoption of these policies in 2013. Consistent with the smaller immediate effect observed at the Treat All adoption threshold, this may reflect a gradual roll-out or delayed implementation of the policy. In contrast, the lack of a statistically significant change in annual rates of rapid ART initiation following general Treat All policy adoptions in 2016 may be due to the high rates of rapid ART initiation achieved immediately after the policy (85.4%), with limited space for further increases above this level, as well as regression to the mean.

A concerning finding was the large decrease in pre-treatment CD4 measurement, as reflected by an increased proportion of young adolescents with no CD4 measures prior to treatment initiation. This finding is not unique to our study population [26, 45, 46], and reflects a larger trend of abandoning the use of CD4 monitoring altogether in sub-Saharan Africa, driven by combinations of cost and laboratory supply chain issues, as well as prioritization of viral load over CD4 testing [47-49]. Treat All policies have negated the need for CD4 to assess eligibility for treatment, and routine CD4 monitoring after ART initiation is generally not necessary in virally suppressed patients in settings with routine viral load testing [50, 51]. However, assessing *pre-treatment* CD4 remains important for identifying severely immunodeficient individuals who need enhanced clinical services, such as treatment of opportunistic infections [52-54] and for monitoring progress towards achieving the public health goals of HIV care and treatment scale-up [51].

A strength of this analysis is the use of a regression discontinuity design with real-world service delivery data from diverse settings in seven sub-Saharan African countries that adopted Treat All policies at two points in time. This quasi-experimental design provides support for the causal interpretation of the association between expanded ART eligibility under Treat All and increases in rapid ART uptake among young adolescents newly enrolling into HIV care. The use of a data-driven Imbens-Kalyanaraman bandwidth [32] and sensitivity analyses with three other bandwidths enabled us to generate robust effect estimates with minimal risk of researcher bias.

A limitation of our study is lack of complete data on treatment eligibility criteria for patients enrolling prior to national Treat All policy adoption (e.g., pre-treatment CD4 counts, WHO staging, and coinfection with TB). Such data would have allowed for the use of a "fuzzy" regression discontinuity design [29] to better reflect the probabilistic distribution of ART eligibility in the pre-Treat All sample. In addition, the

limited availability of data on patient characteristics beyond age, sex, and pre-treatment CD4 count restricted our ability to assess whether patients on each side of the regression discontinuity threshold were similar with respect to other pre-treatment covariates. We also lacked data on service delivery strategies, including tailored services for adolescents, and supply side constraints, such as drug stockouts, that may influence rapid ART initiation among young adolescents enrolling into care. Moreover, while we know the dates when Treat All policies were adopted in each country, lags in site-level implementation likely varied across sites and countries included in this analysis [55]. Finally, the use of a 30-day rapid ART initiation window, intended to enable comparisons with this group's prior work [27], limits the comparability of findings to WHO's rapid ART initiation estimates defined by a 7-day window after confirming HIV diagnosis.

These limitations notwithstanding, our results suggest that expanded treatment eligibility under Treat All has benefited 10-to-14-year-olds by getting them onto treatment more rapidly following enrollment in care. As there are few age-disaggregated data related to the HIV care continuum for this age group, this study fills an important gap, indicating that an increasing share of young adolescents may be initiating ART rapidly under Treat All policies. While these results are encouraging, further research is needed on effective strategies for enrolling children with perinatally-acquired HIV in HIV care earlier and improving care retention and ART adherence among adolescent patients to support sustained viral suppression among this vulnerable population.

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Figure 1

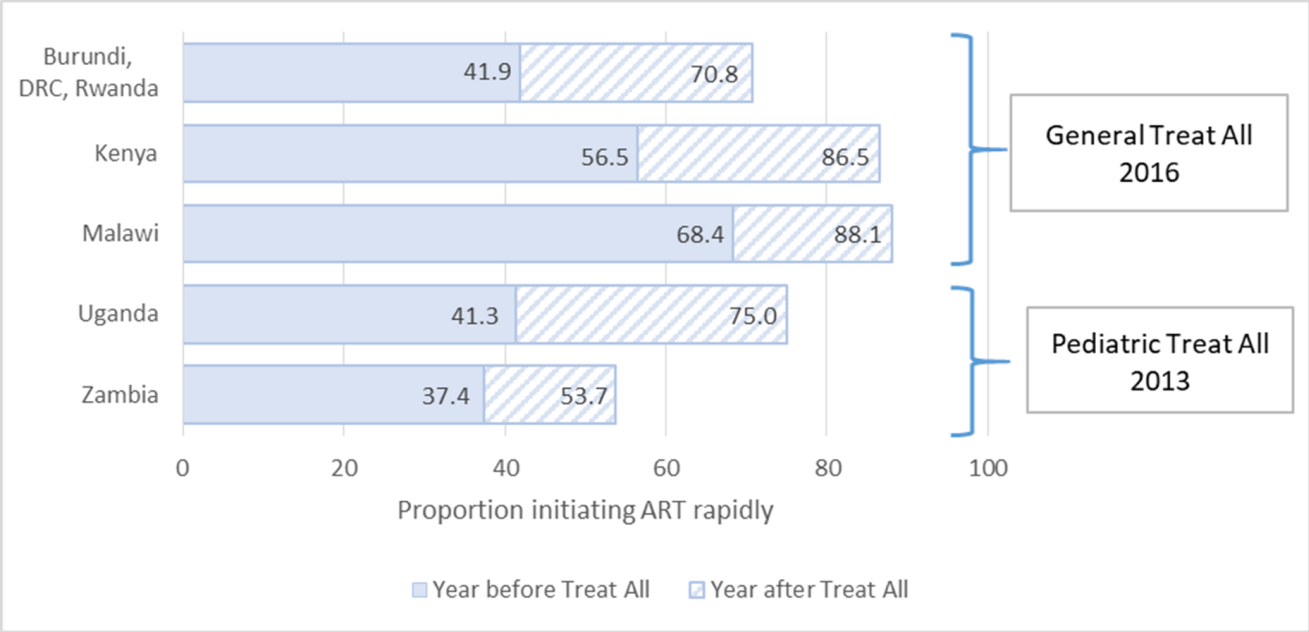

Figure 2