HHS Public Access

Author manuscript

J Adolesc Health. Author manuscript; available in PMC 2017 September 01.

Published in final edited form as:

J Adolesc Health. 2016 September ; 59(3): 298–304. doi:10.1016/j.jadohealth.2016.05.002.

Age Matters: Increased Risk of Inconsistent HIV Care and Viremia Among Adolescents and Young Adults on Antiretroviral Therapy in Nigeria

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Conflicts of Interest: All named authors declare that they do not have any conflict of interest either real or perceived.

Abstract Presentations: These data were presented in part at the 10th International Conference on HIV Treatment and Prevention Adherence (IAPAC) June, 2015, Miami, FL, USA.

Abstract

Purpose—Interruptions in HIV care are a major cause of morbidity and mortality, particularly in resource-limited settings. We compared engagement in care and virologic outcomes between HIV-infected adolescents and young adults (AYA) and older adults (OA) one year after starting antiretroviral therapy (ART) in Nigeria.

Methods—We conducted a retrospective cohort study of AYA (15–24 years) and OA (>24 years) who initiated ART from 2009–2011. We used negative binomial regression to model the risk of inconsistent care and viremia (HIV RNA >1,000 copies/mL) among AYA and OA in the first year on ART. Regular care included monthly ART pick-up and 3-monthly clinical visits. Patients with ≤3 months between consecutive visits were considered *in care*. Those with *inconsistent care* had >3 months between consecutive visits.

Results—The cohort included 354 AYA and 2,140 OA. More AYA than OA were female (89% vs. 65%, p<0.001). Median baseline CD4 was 252/μL in AYA and 204/μL in OA (p=0.002). More AYA had inconsistent care than OA (55% vs. 47%, p=0.001). Adjusting for sex, baseline CD4, and education, AYA had a greater risk of inconsistent care than OA (RR 1.11, p=0.033). Among those in care after one year on ART, viremia was more common in AYA than OA (40% vs. 26% p=0.003, RR 1.53, p=0.002).

Conclusions—In a Nigerian cohort, AYA were at increased risk for inconsistent HIV care. Of patients remaining in care, youth was the only independent predictor of viremia at 1 year. Youth-friendly models of HIV care are needed to optimize health outcomes.

Keywords

Adolescents; HIV; young adults; older adults; inconsistent care; retention; viremia; ART; resource-limited setting

Introduction

Nigeria has the second largest global population of people living with HIV (3.4 million) (1). Successful efforts to combat the pandemic have led to reductions in HIV related morbidity and mortality (2). High rates of loss to follow-up (LTFU) and unplanned interruptions from HIV care have challenged these efforts, and may be of particular concern among adolescents and young adults (AYA) as they transition to adulthood (3–5). Indeed HIV/AIDS is now the leading cause of death among AYA in sub-Saharan Africa, and nearly 1 in 10 HIV-infected AYA worldwide reside in Nigeria (6, 7).

The WHO defines adolescents as individuals aged 10–19 years (8). This period overlaps with the transition to independence sometimes defined as youth or young adulthood (15–24 years) (9). This is a unique time of development characterized by new psychosocial stresses, desire for autonomy, risk-taking, concrete thinking, variable levels of social support, and unique perceptions of risk (10, 11). These factors, coupled with high prevalence of affective disorders among adolescents with chronic illness, often directly oppose the circumstances necessary for adherence to complex, chronic medical therapies (12). HIV-infected AYA in particular also contend with important issues around disclosure and transmission while

negotiating the framework of a chronic, stigmatizing disease (13). Poor adherence to care among AYA may have serious negative consequences in resource-limited settings (RLS) with limited access to second and third-line treatment options (10). Importantly, while HIV deaths overall have decreased by 30% in Africa over the past 8 years, deaths have increased by 50% among adolescents (8, 14).

Despite such concerning trends, HIV-infected youth, and particularly adolescents, remain understudied (15). While many reports are not disaggregated to highlight HIV outcomes in these groups, AYA with a range of chronic disease appear to have poorer adherence to care and worse clinical outcomes than children and older adults (16, 17). The aim of our study was to determine whether adolescence and young adulthood is an independent risk factor for inconsistent care after ART initiation, and to compare rates of viremia among AYA and older adults who remain in care in the first year on antiretroviral therapy (ART).

Methods

Setting

This study was conducted at the HIV clinic of the Ahmadu Bello University Teaching Hospital (ABUTH). ABUTH is located in a semi-urban community in Kaduna, Nigeria where the state's HIV prevalence is 5.1% (2, 18). With PEPFAR support, ABUTH began providing comprehensive HIV care in 2006 that was free of charge to all eligible patients. Children are cared for in the pediatric clinic from birth to 14 years, and in the adult clinic from 15 years of age on. During the study period, the clinic was managed by the AIDS Prevention Initiative in Nigeria (APIN), a PEPFAR-supported NGO. APIN is also one of the largest HIV treatment programs in Nigeria.

Study Design

We conducted a retrospective cohort study of ART eligible patients who enrolled in the ABUTH "adult" clinic between January 1, 2009 and December 31, 2011. Data were censored on December 31, 2012. Visit patterns were assessed during the first year on ART, and HIV viral load after 1 year on ART. Inclusion criteria included age >14 years at the time of enrollment and documentation of initiation of ART. Women who were pregnant at enrollment or became pregnant during the follow-up period were seen in the prevention of mother to child transmission clinic, and not included in this analysis. All data, including baseline demographic information, transmission risk factor, clinical visits and evaluations, laboratory visits with viral load results, and pharmacy drug pick-up visits were recorded on structured data collection forms and entered into APIN's electronic clinical database. These data were abstracted retrospectively for this analysis.

Visits were most frequent in the first 2 months after ART initiation when patients are scheduled to be seen at 2, 4, 8, and 12 weeks for adherence counseling, clinical examination, and Tuberculosis (TB) symptom screening (clinical visits). Subsequently, patients are seen for ART pick-up every 4 weeks (pharmacy visits); clinical examination and adherence counseling every 12 weeks (clinical visits), and laboratory testing (including CD4 count and HIV viral load) every 24 weeks (laboratory visits) (19).

Outcome Measures

Outcomes were assessed at the end of the first year on ART. We categorized patients into two mutually exclusive groups based on their visit patterns. A visit was defined as any clinic visit for clinical, laboratory, or pharmacy services. Patients were defined as being *in care* if the time between any two consecutive visits was ≤3 months, and the time between the last visit and censor date was ≤6 months. All other patients were defined as having *inconsistent care*. The latter group comprised both patients who had *unplanned care interruption (UCI)* (if the time between any two consecutive visits was ever >3 months, but they returned to clinic before the censor date) and patients who were *inactive* from the clinic (if the time between any two consecutive visits was ≤3 months, but the time between the last visit and the censor date was >6 months) (Figure 1). Patients known to have transferred care or died during the follow-up period were categorized based on their visit patterns prior to transfer or death. Under routine circumstances, an absence from the clinic of at least 3 months implied that a patient missed three ART pick-up visits, and at least one clinical visit. In select circumstances, clinic protocol permitted dispensing of 2-month ART prescriptions (usually reserved for patients virologically suppressed on ART for >1 year). We chose a 3-month window to define UCI to ensure no overlap with this select group of stably suppressed patients.

Statistical Analysis

Baseline Demographic and Clinical Parameters—We compared baseline demographic and clinical parameters including sex, level of education, employment status, marital status, co-infection with tuberculosis, and median CD4 count, between AYA and adults (at the time of ART initiation). Binary and ordinal variables were compared using Chi Squared tests, proportions of continuous variables were compared using test of proportions, and medians of continuous variables were compared using Kruskal Wallis tests.

Patterns of Care Utilization—We determined the proportion of AYA and adults in care and with inconsistent care at the end of the first year on ART to standardize follow-up time. We used Chi square tests to determine if the proportion of patients who remained in care differed between AYA and OA.

Risk of Inconsistent Care in the First Year on ART—Using the entire cohort of patients, (both those who were in care and those who had inconsistent care), we built bivariate and multivariate negative binomial regression models to assess the association between baseline age category (AYA vs. older adults) and the risk of inconsistent care during the first year on ART. We adjusted for potential confounders including sex (male vs. female), education level (no primary education vs. any primary, secondary, or advanced education), marital status (married vs. single), employment status (employed vs. unemployed vs. student), baseline TB diagnosis (no vs. yes), and CD4 count at the time of ART initiation (<100 cells/μL vs. 100–200 cells/μL vs. 201–350 cells/μL vs. >350 cells/μL vs. missing). Covariates demonstrating marginally significant bivariate associations ($p \leq 0.10$) were advanced to the multivariate model.

Risk of Viremia Among Patients In Care in the First Year on ART—HIV RNA testing is recommended as a "desirable test" at baseline before ART initiation, and every 6 months on ART, according to the 2010 Nigerian national guidelines (19). In the subset of patients who remained in care during the first year on ART, we abstracted HIV RNA values obtained 12 months after ART initiation (+/− 6 months), dichotomized these values (>1000 copies/mL vs. ≤1000 copies/mL), and compared the risk of viremia between AYA and adults using a negative binomial regression model. Model building was approached as described above. A threshold of 1000 copies/mL was chosen to be consistent with virologic failure (as suggested by the WHO), and to ensure that we did not include low-level blips in this definition (20). However, given limitations on the capacity of viral load testing in this setting, we could not adhere to WHO's guidance suggesting repeat HIV RNA testing within 3 months to confirm this value (20).

Sensitivity Analysis

There is substantial variation in how consistent and inconsistent HIV care are defined in the literature (21). Consequently, we varied the definition of consistent care from having ≤60 days to ≤90 days between laboratory, pharmacy, and clinic encounters in sensitivity analysis. Statistical analysis was conducted with Stata Statistical Software (StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX, USA).

IRB Approval

We obtained IRB approval from Partners HealthCare (Protocol number: 2013P000219) and Harvard T. H. Chan School of Public Health in Boston, MA, USA, and the Nigerian Institute for Medical Research in Lagos, Nigeria.

Results

Baseline Demographic and Clinical Parameters

There were 3,137 patients who enrolled at the ABUTH clinic between 2009 and 2011. Fifty-four patients were excluded because there was no documentation of ART initiation during the study period; 589 patients were excluded because they initiated ART after the censor date (Figure 1). Our analysis cohort was comprised of 354 AYA (15–24 years) and 2,140 older adults (>24 years) who initiated ART at the ABUTH clinic during the study period (Table 1). Most patients (95%, n=2,366) identified heterosexual sex as a transmission risk factor. No AYA identified perinatal transmission as their mode of infection, though 5% (n=18) reported an unknown risk factor, and 2% (n=6) reported transfusion-related transmission. The vast majority of AYA were female (89%) compared to 65% of older adults ($p<0.0001$). Thirty-percent of AYA (n=107) reported having no education compared to 22% (n=464) of older adults ($p<0.0001$). Students and unemployed made up a greater proportion of the AYA population than the older adult population (23% vs. 6% and 49% vs. 26% respectively, $p<0.0001$). Half of AYA were married compared to 62% of older adults ($p<0.0001$). AYA started ART with a higher median baseline CD4 count [252/μL; IQR 107, 404/μL] than older adults [204/μL; IQR 96, 447/μL] $p=0.0024$].

Patterns of Care Utilization

At the end of the first year on ART, fewer AYA remained in care than older adults (46% vs. 53%, p=0.011). By the end of the follow-up period (median 1.8 years) only 33% of AYA remained in care compared to 43% of older adults, p=0.001. Thirty percent of AYA (n=106) and 25% of older adults (n=526) had periods of UCI lasting more than 3 months, and subsequently returned to care within the first year on ART (p=0.03). In contrast 25% (n=87) of AYA and 23% (n=485) of older adults remained inactive in care for more than 6 months, and did not return to care within the first year on ART (p=0.43). As such, the difference in inconsistent care for both AYA and older adults was driven primarily by brief interruptions in care, and not by longer periods of inactivity or "loss to follow-up" from clinic (Figure 2).

Risk of Inconsistent Care in the First Year on ART

In bivariate analysis, AYA had increased risk of inconsistent care compared to older adults [RR 1.15, p=0.008] (Table 2). Male sex [RR 1.13, p=0.003] was associated with increased risk of inconsistent care; however in stratified analysis of AYA, the data did not suggest that male youth were at increased risk of inconsistent care compared to female youth [RR 1.15, p=0.317]. In addition to AYA, being a student [RR 1.17, p=0.029], single [RR 1.17, p<0.001], co-infected with TB [RR 1.20, p<0.038] and having a baseline CD4 count greater than 350/μL [RR 1.36, p<0.001] or missing value for baseline CD4 count [RR 1.33, p<0.001] were also associated with increased risk of inconsistent care in the first year on ART. Having any education [RR 0.91, p=0.039] and having baseline CD4 count 100–200/μL [RR 0.85, p=0.026] or 201–350/μL [RR 0.73, p<0.001) were associated with decreased risk of inconsistent care. In multivariate analysis AYA remained at increased risk for inconsistent care compared to older adults [RR 1.11, p=0.03] even after adjusting for sex, educational level, marital status, baseline TB diagnosis, and baseline CD4 count. The final multivariate model was not adjusted for employment category, as student status was found to be collinear with AYA age. The relationship between age group and risk of inconsistent care remained robust when the definition of UCI we varied from 60 to 90 days in sensitivity analysis.

Rates of Viremia In the First Year on ART

Among all patients in care at the end of the first year on ART (n=1,292), 12-month HIV RNA values were available for 86% of AYA and 87% of older adults. Forty percent of AYA had an HIV viral load >1000 copies/mL at 12-months compared to 26% of older adults (p=0.033). In univariate analysis, being an AYA was the only independent predictor of having an increased risk of viremia at 12-months [RR 1.54, p=0.002], (Table 3). None of the other covariates (sex, education level, employment status, marital status, TB co-infection, or baseline CD4 count) were associated with risk of viremia after 1 year on ART for patients who remained in care. Consequently, an adjusted analysis was not performed. The relationship between age group and risk of viremia remained robust when we varied the definition of UCI from 60 to 90 days in sensitivity analysis

Discussion

We examined consistency of clinical care, and rates of viremia among AYA and OA in a large clinic in Nigeria. Our findings highlight that compared to older adults, AYA have more

than a 10% increased risk of inconsistent HIV care after starting ART. Moreover, even AYA who remain in care after starting ART are 50% more likely than older adults to have ongoing viremia at one year. High rates of viremia among patients in our cohort who consistently attended clinic, lab, and pharmacy visits suggest medication adherence (but not medication pick-up) challenges, especially among AYA. These data substantiate the growing evidence that HIV-infected AYA have poorer use of life-saving HIV care services and clinical outcomes relative to older adults (10, 11, 22).

In our cohort, consistent engagement in HIV care in the first year on ART was low for all patients, but much worse for AYA than older adults. Despite our findings, outcomes of HIV-infected youth may not be directly comparable due to varying definitions of retention. In our cohort, the proportion of patients who became inactive from care during the first year on ART, approximately 1 in 4, remained fairly consistent across age groups. As such, the differences in inconsistent care between AYA and OA seemed to be driven primarily by differences in rates of UCI. In one systematic review representing 23 low and middle-income countries, pediatric ART retention was similar to that of older adults (23). This analysis included studies in which median age ranged from 3 to 9 years. In contrast, another large analysis, from 7 sub-Saharan African countries, reported higher rates of LTFU among adolescents and young adults aged 15–24 years (24). Unlike most other studies of retention in this group, our definition of retention distinguished between transient interruptions in care and longer periods of inactivity from clinic. Failure to account for these transient interruptions may yield mixed findings on retention or LTFU.

Data on the outcomes of HIV-infected youth may also not be directly comparable due to disparate age classification. Studies from South Africa and Malawi have found that older adolescents and young adults (15–24 years), but not younger adolescents (<15 years), were more likely to be lost to follow-up than older adults (>24 years) (25, 26). Our results are consistent with these findings. While some have hypothesized that younger adolescents may have more parental or caregiver support to promote retention than older adolescents, few data exist to support this (27).

Despite varied reports of retention among HIV-infected AYA, most studies report poor rates of virologic suppression in this age group relative to older adults (22, 28). Our analysis is consistent with these findings, but further emphasizes an important difference in rates of virologic suppression even among youth who remain in care. The absolute rate of virologic suppression among patients who consistently attend clinical, pharmacy, and lab visits was 14% lower for youth compared to older adults. Notably, being an AYA was the only independent predictor of significant viremia one year after starting ART. Taken together, these findings suggest discordance between adherence to clinical visits and adherence to ART, a phenomenon which seemed to be more pronounced in youth compared to older adults. This poses the question of whether youth who are consistently engaged in HIV care are less likely to have optimal adherence to antiretroviral medication than adults who are consistently engaged in HIV care. If so, they may warrant distinct adherence interventions.

The effect of gender and CD4 count on interruptions from HIV care is inconsistent across multiple studies (3, 26, 29). In our cohort, females were over-represented amongst AYA

compared to older adults, and AYA had a higher median CD4 count at baseline than older adults. A prior analysis by our group showed that high baseline CD4 is an independent risk factor for UCI from HIV care suggesting that patients who initiate ART with higher CD4 counts may be less likely to comply with care because they do not feel “sick” (30–32). In our Nigerian cohort, it is possible that the high baseline CD4 in the younger population may be accounted for by a predominance of females, who tend to be diagnosed with higher CD4 counts than males (33, 34). The reasons for this are unclear, but may reflect earlier diagnosis in the context of routine antenatal care (35). Young females (15–25 years) are an important target population for HIV prevention, representing more than 40% of new infections among all women >15 years (1). Furthermore, recent surveys from sub-Saharan Africa show that girls in the same age group are five times more likely to be infected with HIV than young boys (6). Despite these data, adolescent and young girls were not at increased risk for inconsistent care compared to young boys in our cohort. Importantly, even after adjusting for sex, baseline CD4 count, TB coinfection, marital status, and education level, youth remained at increased risk of inconsistent care in the first year on ART.

Adherence to care and to antiretroviral therapy may be influenced by a range of structural, socio-cultural, and patient-level barriers that uniquely impact young people, who are themselves in the midst of important physical and psychological development (11). Structural problems standing in the way of successful adherence include work and school obligations conflicting with clinic appointments, housing or food instability, and inability to afford transportation to the clinic or clinic-based fees (11, 13, 36). Additionally, the lack of trained healthcare professionals in adolescent healthcare management may further impact strategies adopted to guide the transition to adult care for HIV-infected adolescents in RLS (4, 11). Studies of perinatally and behaviorally infected youth in the US shower lower rates of retention and greater rates of ART discontinuation among youth cared for in pediatric compared to adult clinics (11, 37). Socio-cultural factors, especially around perceived and enacted stigma and comfort with disclosure and parental or family support may also influence adherence behaviors (38, 39). One study from Botswana of mostly perinatally infected adolescents found that absence of a parent from clinic visits was associated with a 4-fold increased risk of virologic failure (40). Patient-level factors such as altered perceptions of risk, treatment fatigue, and emotional unpreparedness to cope with a stigmatizing illness may lead to poor adherence (11, 39).

There are few data to guide interventions to improve HIV outcomes among AYA, especially in resource limited settings. However, successful models of care for HIV-infected AYA may require multi-level approaches to address structural factors such as provider expertise, youth-friendly adult clinics, and both food supplementation and transportation assistance for needy youth; socio-cultural factors such as support around coping with HIV disclosure and managing stigma; and finally patient-level factors such as continued parental engagement in care, and less intensive ART administration (e.g. weekends off, long acting ART (7, 13, 36, 38). Behavioral economics interventions relying on conditional cash transfers or social protection have been successfully utilized to reduce risk of new HIV infection among youth in sub-Saharan Africa, and may hold promise for promoting adherence to ART (41, 42). Integration of social media, and mobile technologies for “e-health” beyond SMS or text reminders may also be quite important to engage youth in consistent HIV care (43, 44).

While some of these factors are unique to youth, others are not, but might need to be addressed differently in youth compared to their adult counterparts."

Our study had some important limitations. Since our study was conducted in an urban environment at one university-affiliated clinic, with a small population of AYA relative to older adults. As such, it may not be fully generalizable to other settings. Additionally, our definition of inconsistent care combined fewer patients who were inactive from clinic with more patients who interrupted but returned to clinic, and may have masked factors that were more prevalent in the inactive group. Nevertheless, use of APIN's robust electronic health record allowed us to adjust for potential confounders between these groups, and quantify inconsistent care by relying on a range of healthcare visits (clinical, laboratory, and pharmacy) over the first year on ART. Additionally, our analysis is one of the first in Nigeria to compare rates of viremia between AYA and older adults.

Globally, the magnitude of differences in HIV clinical outcomes and the determinants influencing them have not been well quantified or described (6, 22, 28). While there is an important but small minority of perinatally infected patients who are approaching adolescence and young adulthood in sub-Saharan Africa, the majority of HIV-infection among young people is sexually acquired (45). This study of horizontally infected AYA in Nigeria underscores that age certainly matters for important HIV health outcomes, and that AYA need additional focused attention to ensure they maximally benefit from HIV care. We found not only that AYA are more likely to have inconsistent HIV care after starting ART, but also that even those engaged in care had a greater risk of virologic failure. These disparate outcomes suggest a need to better understand the obstacles to engagement in care and medication adherence in this setting. Our data also suggest that youth-centered clinics and strategies, as earlier described, may be important to optimally address the unique health needs and ensure the best clinical outcomes in this age group.

Acknowledgments

Funding Sources

Research reported in this publication was supported by the National Institute of Allergy and Infectious Diseases of the National Institutes of Health under Award Numbers: K23 AI106406, R01 AI058736-09S1, R01 MH090326, and P30AI060354. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. This study was also supported in part by cooperative agreement number 5U2GPS001058 from the Centers for Disease Control and Prevention, and by the President and Fellows of Harvard College.

Abbreviations

AYA	Adolescents and young adults
LTFU	loss to follow-up
ART	antiretroviral therapy
RLS	resource-limited settings
ABUTH	Ahmadu Bello University Teaching Hospital

APIN	AIDS Prevention Initiative in Nigeria
UCI	unplanned care interruption
TB	Tuberculosis

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Implications and Contributions Statement

This study highlights important differences in clinic use and virologic outcomes between AYA and older adults in Nigeria, home to 10% of HIV-infected AYA. The findings underscore both the importance of reporting AYA-specific outcomes, and of considering age-appropriate interventions to eliminate unacceptable disparities in clinical outcomes.

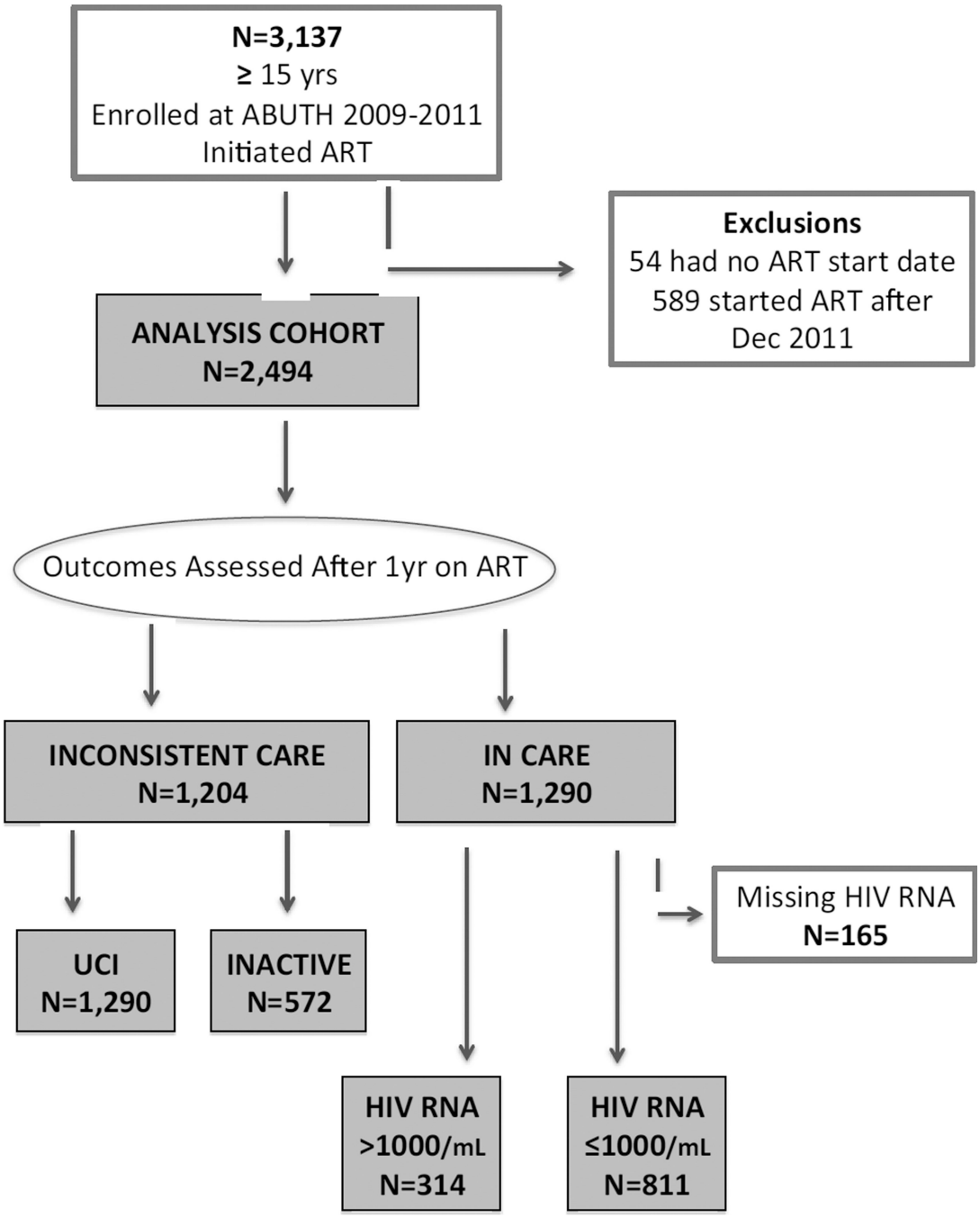

Figure 1. Schematic of Adolescents and Young Adults Included in Study Cohort Assessing Risk of Inconsistent Care and Rates of Viremia in First Year After ART Initiation

Entire cohort (in care* and inconsistent care patients[+]) used to determine risk of inconsistent care in the first year on ART

Subset of patients in care* used to determine rates of viremia in the first year on ART

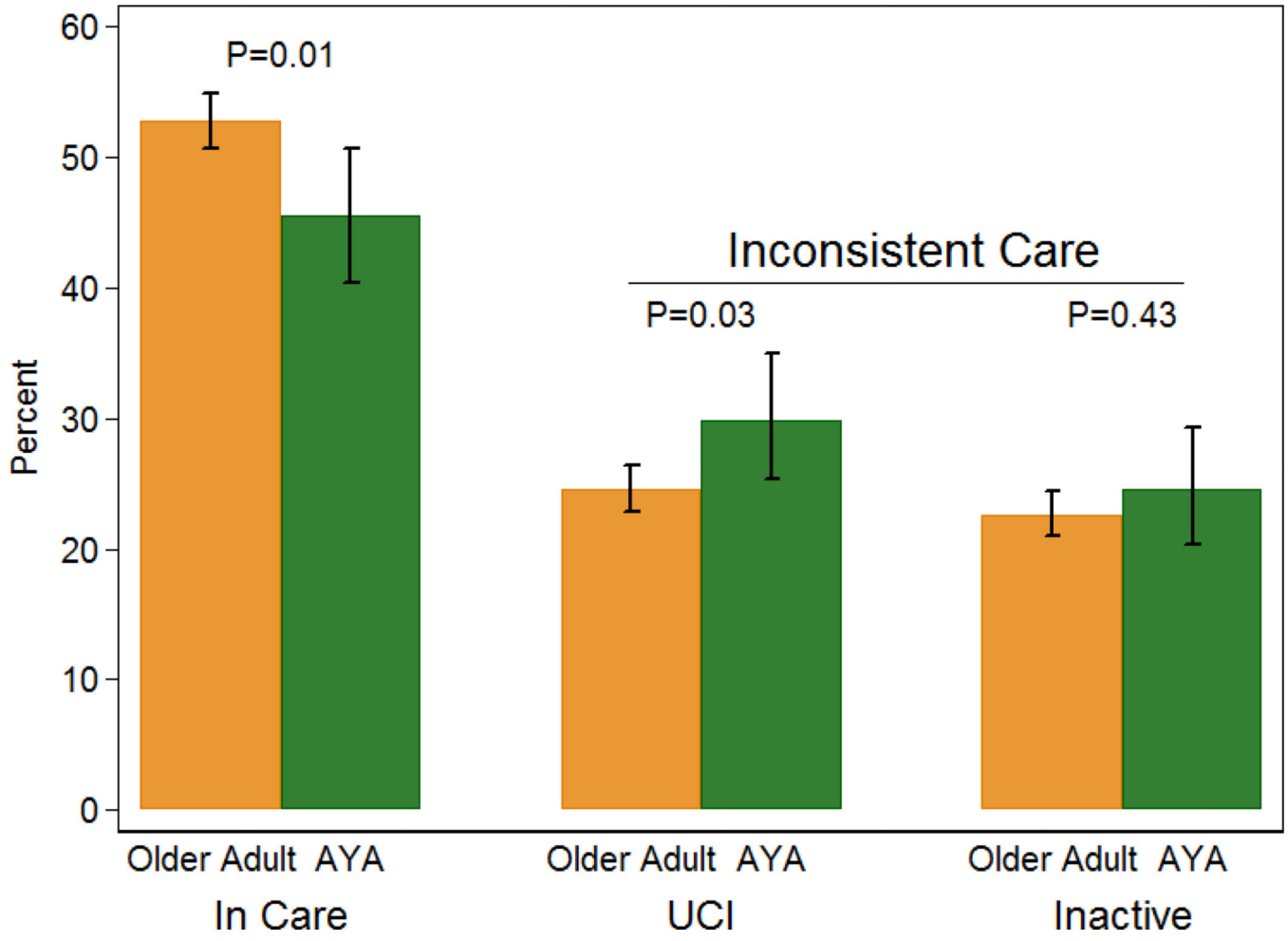

Figure 2. Patterns of Care Use in a cohort of HIV-infected Nigerian adolescents and young adults compared to older adults

UCI: Unplanned care interruption

Table 1

Baseline social and clinical characteristics, and virologic outcomes in HIV infected adolescent and young adults compared to older adults in Nigeria, n=2494

	Adolescents and Young Adults (n=354)	Older Adults (n=2140)	p value
Transmission Risk Factor			
Heterosexual	330 (93.2)	2034 (95.0)	0.171
Perinatal	0 (0.0)	9 (0.4)	0.222
Transfusion	6 (1.7)	43 (2.0)	0.693
IVDU	0 (0.0)	1 (0.1)	0.684
Unknown	18 (5.1)	53 (2.5)	0.005
Sex			
Female	315 (89.0)	1398 (65.3)	<0.001
Education Level			
None	107 (30.2)	464 (21.7)	<0.001
Employment			
Unemployed	170 (48.7)	542 (25.6)	<0.001
Employed	100 (28.7)	1450 (68.6)	
Student	79 (22.6)	122 (5.8)	
Marital Status			
Married	178 (50.3)	1328 (62.1)	<0.001
Baseline TB Diagnosis			
Yes	8 (2.3)	89 (4.2)	0.087
Median Baseline CD4 Count cells/μL	252 IQR [107, 404]	204 IQR [96, 447]	0.002
<100	67 (18.9)	448 (20.9)	
101–200	47 (13.3)	410 (19.2)	
200–350	77 (21.8)	489 (22.8)	
>350	92 (26.0)	398 (18.6)	
Missing	71 (20.1)	395 (18.5)	

	Adolescents and Young Adults (n=354)	Older Adults (n=2140)	p value
Virologic Failure* (HIV RNA>1000copies/mL)	55 (39.9)	259 (26.2)	0.001

TB: Tuberculosis

* HIV RNA assessed after 1 year on ART among patients remaining In care, N=1125

Table 2

Relative risk of inconsistent care* in the first year on ART among Nigerian adolescents and young adults compared to older adults in a cohort initiating ART 2009–2011

	Bivariate Analysis		Multivariate Analysis	
	RR	**p value**	**RR**	**p value**
Age Category				
Older Adult	1		1	
Adolescent or Young Adult	1.15	0.008	1.11	0.033
Sex				
Female	1		1	
Male	1.14	<0.003	1.23	<0.001
Educational Level				
None	1		1	
Any	0.91	0.039	0.92	0.058
Employment Status				
Unemployed	1			
Employed	0.97	0.464		
Student	1.17	0.029		
Marital Status				
Married	1		1	
Single	1.17	<0.001	1.18	<0.001
Baseline TB Diagnosis+				
No	1			
Yes	1.20	0.038		
Baseline CD4				
<100	1		1	
100–200	0.85	0.026	0.86	0.045
201–350	0.73	<0.001	0.75	<0.0001
>350	1.36	<0.001	1.42	<0.0001
Missing	1.33	<0.001	1.35	<0.0001

*Inconsistent Care: time between any two consecutive clinic, laboratory, or pharmacy visits was >3 months

+Baseline TB diagnosis was not included in the multivariate model because of low TB prevalence of the cohort, leading to a failure of model convergence.

Table 3

Relative risk of viremia 12-months after starting ART among Nigerian adolescents and young adults compared to older adults in a cohort starting ART 2009–2011

Bivariate Analysis		
	RR	**p value**
Age Category		
Older Adult	1	
Adolescent or Young Adult	1.52	<0.001
Sex		
Female	1	
Male	0.94	0.551
Educational Level		
None	1	
Any	0.91	0.11
Employment Status		
Unemployed	1	
Employed	0.92	0.434
Student	0.91	0.654
Marital Status		
Married	1	
Single	1.02	0.877
Baseline TB Diagnosis		
No	1	
Yes	1.04	0.884
Baseline CD4		
<100	1	
100–200	0.80	0.143
201–350	0.98	0.884
>350	1.18	0.263
Missing	0.99	0.932