Studies on the Adherence to Antiretroviral Therapy (ART) among HIV Patients Receiving Treatment in a Major HIV Care Unit in Akure, Ondo State, Nigeria

T. A. Olusi[1], M. B. Adediran[1*] and M. O. Oniya[1]

[1]*Federal University of Technology, Akure, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. Author TAO designed the study, wrote the protocol and managed the literature searches. Author MBA performed the statistical analysis and wrote the first draft of the manuscript. Author MOO managed the analyses of the study. All authors read and approved the final manuscript.

Article Information

Original Research Article

ABSTRACT

There has been great improvement in the life expectancy for HIV patients since the introduction of Antiretroviral Therapy (ART). However, good adherence to regimen is important to surmounting health problems associated with HIV/AIDS. While availability of drugs and accessibility to it are important, many other social, psychological and clinical factors needed to be considered. This cross- sectional study seeks to determine adherence to ART among 441 patients living with HIV and attending the State Specialist Hospital, Akure for treatment. The participants included more females (79.1%) while the remaining 20.9% were males. Majority of the participants were married (71.2%) and 73.0% of them earn less than ₦18000 (about US$52) monthly. Only 29.7% of them enrolled for ART less than six (6) months to the commencement of the study. Adherence in this study was found to be 56% and was significantly related to age (χ^2 = 14.31, *P* = 0.03), marital status (χ^2 = 9.47, *P* = 0.01), medication burden (χ^2 = 9.07, *P* = 0.01) and "ART type" (χ^2 = 19.09, *P* = 0.00). The adherence rate (56%) recorded in the study is however low and underscores the need for measures necessary in ensuring total adherence among people living with HIV in Ondo State Nigeria.

_____

Corresponding author: E-mail: adediranmoras@gmail.com;

1. INTRODUCTION

The continuous increase in new HIV infections despite improved antiretroviral therapy (ART) regimen calls for concern, especially in Sub-Saharan Africa, which bears the highest burden of the infection and particularly in Nigeria, where the lowest record of reduction in new HIV infections was obtained since 2009 according to UNAIDS 2016 report. Issues bordering on factors including adherence, retention in care and issues on drug resistance were topics of hot debate few years ago while introducing ART to Sub-Saharan Africa [1]. The eventual advent of very highly active antiretroviral treatment has reduced morbidity and mortality, improved life expentancy among HIV infected persons, enhanced immunity, sustained viral load suppression and reduced the risk of transmission in countries where they have been made available and accessible. However, adherence to medication and retention in care are still factors needed to be addressed in order to achieve optimum benefits because instances of drug-resistant HIV strains and the continuous transmission of these strains in the population have long been attributed to sub-optimal adherence among HIV infected people [2].

Adherence is the rate at which an individual's behaviour, compliance to medication, sticking to a diet, changing lifestyle and compliance to schedule visits and clinicians assessment conforms to standard recommendations of health officials [3]. According to Moges and Kassa [4], adherence is classified as good if is greater than 95% and poor if it is less than 85%. Poor compliance to medication not only put an individual's health at risk but may also lead to increase in viral transmission and drug resistance which subsequently make treatment difficult [5]. The recommended percentage of adherence to maintain long term viral suppression is 95% and several studies conducted on HIV infected persons (children, adolescents and adults) were reported to fall below 95% [6,7,8,9,10,11,12].

Several factors may be responsible for non-adherence among HIV infected persons. For example in Nigeria, a structurally induced non-adherence was said to be created in the year 2004, when the national ARV programme organized by the federal government of Nigeria suffered a setback, after being affected by a shortage in the supply of drugs. This caused many patients to be out of drugs for few months [13]. There had been cases where only 15% of people in need of ARV in Nigeria had access to treatment [11]. All of these further lay credence to the fact that availability and accessibility of drugs are important in ensuring compliance. Cost of medication, adverse side effects, alcohol abuse and social stigma are among other factors reportedly to have been responsible for non-adherence. Castro [14] has however viewed barriers to adherence as dynamic interactions of biologic and social factors.

In Nigeria, reports of previous studies shows adherence to have ranged from as low as 44% to more than 95% [15,16]. Several studies on adherence have been reported in cities such as Ibadan, Enugu, Port-Harcourt, Benin, Ijesha, keffi and kano [17]. Reports on adherence of patients receiving ART in Ondo state are still limited and therefore necessitate enquiries to generate data for effective decision making on intervention measures that gives better hope for positive improvements. This study was therefore, designed to investigate adherence of HIV infected individuals to ART in Akure the capital city of Ondo-State and factors influencing non-adherence.

2. MATERIALS AND METHODS

2.1 Study Site

The study was conducted at the HIV care unit of the Ondo State Specialist Hospital in Akure These facilities attend to patients living in Akure and indeed most towns in the state on a daily basis but operate full clinic activities on Tuesdays and Thursdays.

2.2 Study Population

The study population includes 441 individuals living with HIV who are on ART whose ages ranged between six (6) and sixty-five (65) years. Criteria for inclusion includes HIV positive status, ART not less than three months to the time of study, willingness to participate and availability of parents of patients less than 18 years of age (most of these parents were found also to be living with HIV). Appropriate sample size was calculated based on the number of patients enrolled in the facility. During the study period of four months, a total of 1,286 patients

visited the HIV clinics out of which 441 were recruited to take part in the study. The sample size was calculated based on the estimated population proportion of 50 percent, a confidence level of 90 percent and alpha value of 0.05 using $z^2_{1-\alpha/2}P(1-P)/d$ [18].

2.3 Study Design

The study design was a facility based cross sectional study. Consenting patients and parent of patients less than 15 years old were interviewed by the researcher using a pretested and structured questionnaire adapted from AACTG (Adults Clinical Trials Group) that covered socio demographic information, psychosocial characteristics, ART duration, medication burden, type of ART (whether free treatment, paid treatment or both).

2.4 Adherence Measurement

The golden standard for assessing adherence is the ARV level in the blood. Viral load could also be used as a measure for adherence but data emanating from self-reports are easily accessible (Afe et al., 2018) and according to Dolezal et al. [9] self reported data correlates with viral loads. Therefore, for this study, adherence was rated through the self reported data obtained from the participants using a 4-day recall semi structured follow up questionnaire adapted from Adults AIDS Clinical Trials Group (AACTG) [19]. The percentage of adherence was obtained by dividing the total number of drugs taken in the last four days by the total number of drugs recommended to be taken for the four days multiplied by 100 as summarized below. Adherence was then categorized as greater or equal to 95% and non-adherence as less than 95%.

((Total number of drugs taken / Total number of drugs prescribed) x (100/1))

2.5 Statistical Analysis

Data collected were entered into Excel 2007 worksheet and imported into SPSS version 23.0 for Windows. The Chi-square test was used to measure adherence in relation to socio demographic variables, while the logistic regression was used to find association between risk factors that could have influenced non-adherence in HIV infected people. The strength of associations were measured using adjusted odd ratios (95% confidence interval). *P* values less than 0.05 were considered statistically significant.

3. RESULTS

3.1 Socio-economic and Demographic Characteristics of Participants

The 441 subjects recruited for this study comprises of 92(20.9%) males and 349(79.1%) females, an indication that the majority of them were females and all the subjects had formal education though not to tertiary level as majority 235(53.3%) had secondary education, while only 40(9.1%) had tertiary education and the remaining had primary education 166(37.6%). Most of the participants 225 (50.5%) were engaged in business as means of income while a good number of them 103(23.4%) were not employed. A larger percentage of them were married 314(71.2%) with 72 (16.3%) of them separated from their spouses while 55 (12.5%) of them had never married. A larger percentage of the participants had less than ₦18,000 has their average monthly income 322(73.0%).

3.2 ART Type of Participants

Majority of the participant 269 (61.0%) were on free medication while 63 (14.3%) preferred buying their medications and 24.7% of them engaged in both options i.e they were also on free medications but purchase when their antiretrovirals clinics were out of stock). Almost all the participants of aged 61 and above (91.7%) received free medications. A larger percentage of the female participants 236 (67.6%) were on free medication. Most patients that depended on free medication 113(68.1%) had only primary education while many participants who buys their medication (45.0%) were educated up to the tertiary education level. Most of those who prefers free ART (65.6%) were business men and women and they are married (64.6%) earning less than ₦18000 monthly income (68.3%).

3.3 HIV Patients Adherence to ART

As shown in Table 3, the highest percentage of adherence was recorded among the female participants 210 (60.2%) while 51.1% of males adhered. Adults aged between 41-50 adhered most while participant between ages 21-30 had the highest percentage for non-adherence

33(56.9%). Participants who are educated up till tertiary level and those unemployed had the highest percentage of adherence 27(67.5%) and 58(63.7%) respectively. Most of the married participants (62.7%) adhered to medication while participant who no longer live with their spouses had the least adherence (55.6%). Participants who benefitted from free medication when accessible and pay for it when out of stock had the highest level of adherence (76.1%) while those who only prefers buying their medication at all times had the lowest adherence (49.2%).

3.4 Adherence to ART in Relation to Socio-demographic Factors

Table 4 summarizes adherence among attendees of HIV care unit in Akure, Ondo state, based on their socio-demographic parameters. Adherence was higher among female patients. Adherence was higher among female patients 60.2% (210/349) with no significant difference in adherence on the basis of sex (χ^2= 2.47, P=0.12). There is however a significant variation in the adherence of patients in relation to their ages (χ^2= 14.31, P=0.03). Adherence in relation to their level of education varies from 54.0% to 67.5% (χ^2= 4.10, P=0.13). With regard to marital status and occupation of the patients, adherence varied between 44.4% and 62.7% (χ^2= 9.47, P=0.01) and 38.8% and 63.7% (χ^2= 9.55, P=0.05) respectively. Married patients significantly adhered (62.7%, 197/314) compared to others, also patients who are not employed adhered significantly with 63.7% (58/91).

3.5 Participant's Adherence in Relation to Psycho-socio Factors

Patients with family support adhered significantly (66.8%) compared to those without family support (Table 5). Participant who reported no adverse effect of medication adhered more (61.1%) to treatment compared to 52.4% level recorded among patients who reported adverse effect of medication although the variation is statistically not significant (χ^2 =3.05, P = 0.08). Adherence in relation to the overall clinic

Table 1. Socio-economic and demographic characteristics of participants

Factors	Total examined (%)
Age group	
0-10	39(8.8)
11-20	23(5.2)
21-30	58(13.2)
31-40	156(35.4)
41-50	116 (26.3)
51-60	37(8.4)
61 and above	12(2.7)
Sex	
Male	92(20.9)
Female	349(79.1)
Educational level	
Primary	166 (37.6)
Secondary	235(53.3)
Tertiary	40(9.1)
Employment	
Student	61 (13.8)
Civil servant	37(8.4)
Business	223(50.5)
Farming	17(3.9)
Not employed	103(23.4)
Marital status	
Married	314(71.2)
Separated	72(16.3)
Never married	55(12.5)
Average monthly income	
<18000	322(73.0)
18,000-40,000	73(16.6)
>40,000	46(10.4)

Table 2. Distribution of patients living with HIV undergoing treatment based on their ART type

Factors	Paid ART treatment (%)	Free ART treatment (%)	Free and paid treatment (%)	Total examined (%)
Age group	63(14.3)	269(61.0)	109(24.7)	441(100)
0-10	6(15.4)	28 (71.8)	5 (12.8)	39(8.8)
11-20	4 (17.4)	16 (69.6)	3 (13.0)	23(5.2)
21-30	12 (20.7)	29 (50.0)	17 (29.3)	58(13.2)
31-40	21 (13.5)	87 (55.8)	48 (30.8)	156(35.4)
41-50	11 (9.5)	76 (65.5)	29 (25.0)	116 (26.3)
51-60	8 (21.6)	22 (59.5)	7 (18.9)	37(8.4)
61 and above	1 (8.3)	11 (91.7)	0 (0.0)	12(2.7)
Sex				
Male	24 (26.1)	33(35.9)	35 (38.0)	92(20.9)
Female	39 (11.2)	236 (67.6)	74 (21.2)	349(79.1)
Educational level				
Primary	13 (7.8)	113 (68.1)	40 (24.1)	166 (37.6)
Secondary	38 (16.2)	138 (58.7)	59 (25.1)	235(53.3)
Tertiary	12 (30.0)	18 (45.0)	10 (25.0)	40(9.1)
Employment				
Student	11 (18.0)	34 (55.7)	16	61 (13.8)
Civil servant	12 (32.4)	16 (43.2)	9 (24.3)	37(8.4)
Business	28 (12.6)	146 (65.6)	49 (22.0)	223(50.5)
Farming	3 (17.6)	7 (41.2)	7 (41.2)	17(3.9)
Not employed	9 (8.7)	66 (64.1)	28 (27.2)	103(23.4)
Marital status				
Married	39 (12.4)	203 (64.6)	72 (22.9)	314(71.2)
Separated	16 (22.2)	34 (47.2)	22 (30.6)	72(16.3)
Never married	8 (14.5)	32 (58.2)	15 (27.3)	55(12.5)
Economic tatus				
<18000	24 (7.5)	220 (68.3)	78 (24.2)	322(73.0)
18,000-40,000	21 (28.8)	33 (45.2)	19 (26.0)	73(16.6)
>40,000	18 (39.1)	16 (34.8)	12 (26.1)	46(10.4)
Time since starting ART				
<6	20 (15.3)	96 (73.3)	15 (11.5)	131(29.7)
12-24	24 (15.4)	94 (60.3)	38 (24.4)	156(35.4)
>24	19 (12.3)	79 (51.3)	56 (36.4)	154(34.9)

satisfaction of the patients varied from Excellent or very good (59.9%) to fair or poor (57.0%) with no significant difference (χ^2 =0.39, P=0.54). With regards to alcohol consumption, adherence rate of 59.6% was recorded among tattlers while 36.0% of those who reportedly take little quantities of alcohol adhered to ART medication.

3.6 Participant's Adherence in Relation to Medication

Patients taking just a single pill of medication adhered significantly (χ^2=9.07,P= 0.01) compared to those burdened with between 2-3(60.9%) or more pills(44.3%). There is also a significant difference (χ^2=19.09, P= 0.00)

among patients preference of access to ART. The highest percentage of adherence (76.1%) was obtained among those who sometimes pay for treatment whenever free supply is not accessible. With regard to knowledge of medication and number of hospitalizations due to HIV related illnesses, adherence varied between 58.1% and 58.9% (χ^2=0.02;P = 0.88) and between 67.0% and 55.9% (χ^2= 3.76; P = 0.15), respectively.

4. DISCUSSION

Adherence to medication regime is very important in the management of HIV infection because it helps to sustain viral suppression,

Table 3. Compliance to ART among the various socioeconomic group of attendees (N=441)

Factors	Adherence (%)	Non-adherence(%)	Total examined (%)
Sex			
Male	47 (51.1)	45 (48.9)	92(20.9)
Female	210 (60.2)	139 (39.8)	349(79.1)
Age group			
0-10	21 (53.8)	18 (46.2)	39(8.8)
11-20	12 (52.2)	11 (47.8)	23(5.2)
21-30	25 (43.1)	33 (56.9)	58(13.2)
31-40	92 (59.0)	64 (41.0)	156(35.4)
41-50	81 (69.8)	35 (30.2)	116(26.3)
51-60	18 (48.6)	19 (51.4)	37(8.4)
61 and above	8 (66.7)	4 (33.3)	12(2.7)
Educational level			
Primary	103 (62.0)	63 (38.0)	166(37.6)
Secondary	127 (54.0)	108 (46.0)	235(53.3)
Tertiary	27 (67.5)	13 (32.5)	40(9.1)
Employment			
Student	38 (62.3)	23 (37.7)	61(13.8)
Civil servant	19 (38.8)	30 (61.2)	49(11.1)
Business	133 (59.6)	90 (40.4)	223(50.6)
Farming	9 (52.9)	8 (47.1)	17(3.9)
Not employed	58 (63.7)	33 (36.3)	91(20.6)
Marital status			
Married	197 (62.7)	117 (37.3)	314(71.2)
Separated	32 (44.4)	40 (55.6)	72(16.3)
Never married	28 (50.9)	27 (49.1)	55(12.5)
Type of ART			
Free ART	142 (52.8)	127 (47.2)	269(61.0)
Pay out of pocket	32 (50.8)	31 (49.2)	63(14.3)
Both	83 (76.1)	26 (23.9)	109(24.7)
Family support			
Yes	231 (66.8)	115 (33.2)	346(78.5)
No	26 (27.4)	69 (72.6)	95(21.5)

recover immunity, reduce morbidity due to infection and hinder the development of drug resistance strain of the virus [20]. The present study shows 56% (χ^2=2.47, *P*=0.12) adherence among participants studied at the HIV care unit in the Ondo state specialist Hospital Akure. Some other studies across the country have reported a higher proportion of adherence between 70% to 86% [17,21,22,23], (Uzochukwu et al., 2009). A recent study done in the southwestern states of Nigeria reported 42% adherence among study participants [24]. Some other studies have equally reported adherence of between 44%-65% [25, 26], (Uzochukwu et al., 2009).

Adherence was found in this study to be significantly related to age (χ^2= 14.31, *P*=0.03) where adults aged 41-50 years recorded the highest rate of adherence of 69.8%.This agrees with the findings of Suleiman and Momo [17]

where adherence in participants studied in Bayelsa state were found to be age related. Most of the parents and guidance of children less than 15 years opined that forgetfulness is a major barrier to adherence on their part. This was also applicable to participants of between ages 20 and 40 where preoccupation with other domestic chores and fear of side effects were the major hindrance to optimum adherence. Adherence on the basis of marital status of participants was also found to be statistically significant (χ^2= 9.47, *P*=0.01), where participants who are married adhered to ART more than others who were either single or separated from their spouses. This is different to the findings of Afe et al., [24] where no relationship exist between marital status and adherence.

Family support have been identified as an important factor that determines adherence to ART. This study observed that patient with good

family support adhered more in comparism with their counterparts who do not have support. Interactions with the patients in the course of the study revealed that many participants without support are persons who conceal their status from their families. It was also observed that patients who were no longer living with their spouses admitted that their health status was the actual cause of separation and if given another chance, they would not disclose to their spouses. Some other patients mostly from polygamous families had vowed never to disclose their status to anyone since they did not even know how they got infected with HIV. Adherence based on medication burden was also found to be statistically significant as the rate of adherence decreased with increase in the number of pills. This is in support of the opinions of Ogba [27], Lucas and Gilles [28] that increase in the complexity of regimen for many chronic diseases

including HIV/AIDS often leads to decrease in adherence.

Based on "ART type," participants for the study were grouped into three. These include *(i)* those that solely depended on free anti-retroviral drugs *(ii)* those that prefer buying their medication (pay out of pocket) and *(iii)* those who get free drugs but buys when clinics were out of stock. Adherence among the three groups was found to be statistically significant (x^2= 19.09, *P*=0.00) as 76.1% of the third category adhered to their medication. This group of patient can however be said to be self- motivated to take ART. This support the findings of Achappa et al., [29] where patients, who were self-motivated recorded high level of adherence. In a study by Sarna et al., [18], adherence was found to be low among patients receiving free ART. According to Ayenigbara [30], non-availability of ARV drugs is

Table 4. Univariate and multivariate analysis of participants' adherence in relation to socio demographic factors (N=441)

Factors	Adherence (%)	Total examined	x^2	*P*	AOR (95% CI)	*P*
Sex			2.47	0.12	0.69(0.44-1.09)	0.12
Male	47 (51.1)	92				
Female	210 (60.2)	349				
Age group			14.31	0.03	0.88(0.77-1.01)	0.07
0-10	21 (53.8)	39				
11-20	12 (52.2)	23				
21-30	25 (43.1)	58				
31-40	92 (59.0)	156				
41-50	81(69.8)	116				
51-60	18 (48.6)	37				
61 and above	8 (66.7)	12				
Educational level			4.10	0.13	1.06(0.79-1.44)	0.69
Primary	103 (62.0)	166				
Secondary	127 (54.0)	235				
Tertiary	27 (67.5)	40				
Marital status			9.47	0.01	1.40(1.07-1.84)	0.01
Married	197 (62.7)	314				
Separated	32 (44.4)	72				
Never married	28 (50.9)	55				
Employment			9.55	0.05	0.92(0.79-1.07)	0.29
Student	38 (62.3)	61				
Civil servant	19 (38.8)	49				
Business	133 (59.6)	223				
Farming	9 (52.9)	17				
Not employed	58 (63.7)	91				

Key: AOR = adjusted odd ratio

Table 5. Univariate and multivariate analysis of participant's adherence in relation to psycho-socio factors

Factors	Adherence (%)	Non-adherence (%)	Total examined	χ^2	P	AOR (95% CI)	P
Family support				47.57	0.00	5.33 (3.22-8.82)	0.00
Yes	231 (66.8)	115 (33.2)	346				
No	26 (27.4)	69 (72.6)	95				
Adverse effect				3.05	0.08	0.70 (0.47-1.05)	0.08
Yes	76 (52.4)	69 (47.6)	145				
No	181 (61.1)	115 (38.9)	296				
Over all clinical satisfaction				0.39	0.54	1.13 (0.77-1.65)	0.54
Excellent/very good	118 (59.9)	79 (40.1)	197				
Fair/poor	139 (57.0)	105 (43.0)	244				
Alcohol				5.41	0.02	2.62 (1.13-6.08)	0.02
No drinking	248 (59.6)	168 (40.4)	416				
Low drinking	9 (36.0)	16 (64.0)	25				

Key: AOR = adjusted odd ratio

Table 6. Univariate and multivariate analysis of participant's adherence in relation to medication

Factors	Adherence (%)	Total examined	χ^2	P	AOR (95% CI)	P
Medication burden			9.07	0.01	1.49(1.11-2.01)	0.01
One	62 (63.9)	97				
2-3	156(60.9)	256				
4 or more	39 (44.3)	88				
Knowledge of medications			0.02	0.88	0.97 (0.61-1.53)	0.88
Knows medications	201 (58.1)	346				
Does not know	56 (58.9)	95				
Type of ART			19.09	0.00	0.54 (0.39-0.79)	0.00
Free ART	32 (50.8)	63				
Pay out of pocket	142 (52.8)	269				
Both	83 (76.1)	109				
No of hospitalization due to HIV related illness			3.76	0.15	0.77 (0.53-1.11)	0.17
Never	185 (55.9)	331				
Once	63 (67.0)	94				
Twice or more	9 (56.3)	16				

Key: AOR = adjusted odd ratio

a major cause of non-adherence especially for patients who completely rely on free supply of ARV drugs from government established HIV clinics. Paying for antiretroviral therapy may be a strong motivation for adherence but the financial implication may cause some setbacks.

The nature of participants employment was found to significantly ($\chi^2 = 9.55$, $P=0.05$) influence their rate of adherence. Patients who were not employed were recorded the highest (63.7%), followed by those who engaged in business or are self-employed (59.6%). Civil servants had the least adherence rate of 38.8%. Majority of them cited forgetfulness as barrier to adherence as they would have gotten to their places of work before remembering that they had not taken the drugs. The suggestion of keeping the drugs in office bags and inside office was rejected by the patients because their children often search their bags and could find the drugs, others do not want people in their offices to know that they are living on drugs. Other reasons accounting for non-adherence in this study include pills stock out, busy schedules, religious fasting, and fear of experiencing side effects.

Factors such as gender, knowledge of medication, number of hospitalizations due to HIV related illnesses, adverse effect, overall clinic satisfaction and educational status do not vary significantly among study participants.

5. CONCLUSION

The overall 56% adherence to ART among HIV infected people receiving care at the state specialist hospital Akure is very poor and calls for strategies to improve adherence to treatment and consistency in attendance of the patients bearing in mind that adherence is central to the overall wellness of these patients and therefore the above suggested recommendations may be employed.

6. RECOMMENDATIONS

- Setting up adherence counseling forum where patients are counseled on the importance of adherence
- Creating adherence monitoring team among the patients where they help remind each other through phone communications
- Effective management of depression where patients learn to see themselves as not lesser than those who are not infected
- Setting up of ART alert in Global System Mobile (GSM) phones of patients
- Ensuring sustained availability and accessibility of drugs at no cost in public HIV care units

CONSENT AND ETHICAL APPROVAL

Permission to carry out the investigation was obtained from the Ondo State Ministry of Health, after thorough scrutiny of the research proposal by the ethical approval committee of the Ministry. Patients' consent were individually sought before their enrollment into the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Assefa Y, Jerene D, Lulseged S, Ooms G, Van Damme W. Rapid scale-up of antiretroviral treatment in Ethiopia: Successes and system-wide effects. PLoS Med. 2009;6(4):e1000056.

2. Blower S, Ma L, Farmer P, Koenig S. Predicting the impact of antiretrovirals in resource-poor settings: Prevention of HIV infection whilst controlling drug resistance. Curr Drug Targets Infect Disord. 2003;3:345-53.

3. World Health Organization. Global Health Observatory (GHO) data HIV/AIDS; 2015.
   Available: http://www.who.int/gho/hiv/en/
   (Accessed: January 9, 2016)

4. Moges NA, Kassa GM. Prevalence of opportunistic infections and associated factors among HIV positive patients taking Anti-retroviral Therapy in Debre Markos Referral Hospital, Northwest Ethiopia. Journal of AIDS& Clinical Research. 2014;5(5):1-6.

5. Yang YU, Luo D, Chen X, Huang Z, Wang M, Xiao S. Medication adherence to antiretroviral therapy among newly treated people living with HIV. BMC Public Health. 2018;18:825.

6. Reddington C, Cohen J, Baldillo A, Toye M, Smith D. Adherence to medication regimens among children with human immunodeficiency virus infection. Pediatr Infect Dis J. 2000;19:1148-1153.

7. Murphy DA, Wilson CM, Durako SJ, Muenz LR. Adolescent medicine HIV/AIDS research network antiretroviral medication adherence among the REACH HIV-infected adolescent cohort in the USA. AIDS Care. 2000;13:27-40.

8. Steele RG, Anderson B, Rindel B, Dreyer ML, Perrin K. Adherence to antiretroviral, therapy among HIV positive children: Examination of the role of caregiver. Health Beliefs; AIDS Care. 2001;13:617-629.

9. Dolezal CM, Brackis-Cott E, Abrams EJ. The reliability of reports of medical adherence from children with HIV and their adult caregivers. Journal of Pediatric Psychology. 2003;28:355-361.

10. Farley J, Hines S, Musk A, Ferrus S, Tepper V. Assessment of adherence to antiretroviral therapy in HIV-infected children using the medication event monitoring system, pharmacy refill, provider assessment, caregiver self-report and appointment keeping. Journal of Acquired Immune Deficiency Syndrome. 2003;33:211-218.

11. WHO. World Health Statistics. Geneva, Switzerland: World Health Organization; 2007.

12. Goode M, McMaugh A, Crisp J, Wales S, Ziegler JB. Adherence issues in children and adolescents receiving highly active antiretroviral therapy. AIDS Care. 2010;15:403-408.

13. Monjok E, Smesny A, Okokon IB, Mgbere O, Essien EJ. Adherence to antiretroviral therapy in Nigeria: An overview of research studies and implications for policy and practice. HIV/AIDS-Research and Palliative care. 2010;2:69-76.

14. Castro A. Adherence to antiretroviral therapy: Merging the clinical and social course of AIDS. PLoS Med. 2005; 2(12):e338.

15. Iliyasu IS, Kabir M, Abubakar IS, Babashani M, Zubair ZA. Compliance to antiretroviral therapy among AIDS patients in Amino Kano Teaxhing Hospital, Kano, Nigeria. Nig J Med. 2005;14(3):290–294.

16. Mohammed MD, Sarki R. Adherence to antiretroviral drugs in North-Central zone of Nigeria. East and Central African Journal of Pharma-ceutical Sciences. 2004;7(3):52–55.

17. Suleiman IA, Momo A. Adherence to antiretroviral therapy and its determinants among persons living with HIV/AIDS in Bayelsa state, Nigeria. Pharmacy Practice. 2016;14(1):631.
DOI: 10.18549/PharmPract.2016.01.631

18. Sarna A, Pujari S, Sengar AK, Garg R, Gupta I, Dam JV. Adherence to antiretroviral therapy and its determinants amongst HIV patients in India. Indian J Med Res. 2008;127:28-36.

19. Chesney MA, Ickovics JR, Chambers DB, Gifford AL, Neidig J, Zwickl B. Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: The AACTG adherence instruments. Patient Care Committee and Adherence Working Group of the Adult AIDS Clinical Trials Group (AACTG). AIDS Care. 2000;12:255-66.

20. Bijal S, Louise W, Robert C, Bollinger DG, Saple AG, Shruti HM, Jeetender P, Ramnani RD, Kharkar. Adherence to antiretroviral therapy and virologic suppression among HIV-Infected persons receiving care in private clinics in Mumbai. India Clinical Infectious Diseases. 2007;44: 1235–1244.

21. Mukhtar-Yola M, Adeleke S, Gwarzo D, Ladan ZF. Preliminary investigation of adherence to antiretroviral therapy among children in Aminu Kano Teaching Hospital, Nigeria. Afr J AIDS Res. 2006;5(2):141–144.

22. Bello SI. HIV/AIDS patients' adherence to antiretroviral therapy in Sobi Specialist hospital, Ilorin, Nigeria. Glob J Med Res. 2011;11:16-25.

23. Olisah VO, Baiyewu O, Sheikh TL. Adherence to highly active antiretroviral therapy in depressed patients with HIV/AIDS attending a Nigerian University hospital clinic. Afr J Psychiatry. 2010; 13(4):275-279.

24. Afe AJ, Motunrayo O, Ogungbade GO. Factors influencing adherence to HAART among patients living with HIV infection in Southwest Nigeria: A cross-sectional analysis iMedPub Journals, Journal of HIV & Retro Virus. 2018;4(1):1–9.
[ISSN: 2471-9676]
Available: https://doi.org/10.21767/2471-9676.100033

25. Erah PO, Arute JE. Adherence of HIV/AIDS patients to antiretroviral therapy in a tertiary health facility in Benin City. Afr J Pharm Pharmacol. 2008;2:145-152.

26. Pennap GR, Abdullahi U, Bako IA. Adherence to highly active antiretroviral therapy and its challenges in people living

with Human Immunodeficiency Virus (HIV) infection in Keffi, Nigeria. J AIDS HIV Res. 2013;5(2):52-58.

27. Ogba E. Non Adherence to HIV/AIDS Therapy is Dangerous, Pharma news, Nigeria's Foremost Health Journal. 2004;26:7.

28. Lucas AO, Gilles HM. A short textbook of preventive medicine for the tropics. Hodder and Stoughton, London; 2003.

29. Achappa B, Madi D, Bhaskaran U, Ramapuram JT, Rao S, Mahalingam S. Adherence to antiretroviral therapy among people living with HIV. North American Journal of Medical Sciences. 2013; 5(3):220-223.
Available:https://doi.org/10.4103/1947-2714.109196

30. Ayenigbara GO. Constraints in effective management of HIV/AIDS with antiretroviral (ARV) therapy in Nigeria. Journal of Pharmacy (IOSRPHR). 2012;2 (4):01-04.
[ISSN: 2250-3013]

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/53020