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Impact of differentiated care service delivery systems on adherence among the HIV-positive patients receiving antiretroviral therapy in a Southeastern Nigerian State

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Abstract

Aim Globally, differentiated care has been adopted across human immunodeficiency virus (HIV) treatment cascades as part of the strategies of increasing and sustaining retention in care. This study examined the impact of this new service delivery approach on adherence among patients receiving antiretroviral therapy in Imo state, Nigeria.

Methods This was a cross sectional study carried at one tertiary and three secondary care hospitals selected across the state using a questionnaire. The study examined patients in three differentiated care models, and the usual care group. Collated data were analysed using the statistical product and service solutions (SPSS) version 24, at $p \leq 0.05$ and 95% confidence level.

Results A total of 542 questionnaires were successfully retrieved from the respondents. The female gender was predominant in all the groups, accounting for total average of 70.8%. The percentage of respondents with optimum adherence score (≥ 96.6%) for multi-months scripting, fast track, support group, and usual care groups were 70.6,69, 97.4, 59.1 respectively. Of all the groups, the support group had the highest adherence to ART. Forgetfulness, traveling, avoidance of side effects, and feeling sick topped the reasons adduced for missing drugs. Age, place of residence, occupation and engagement of voluntary activities were socio-demographics influencing adherence. Adherence had significant association with the viral load suppression (Odds ratio = 3.147, $p < 0.05$, 95% C.I 2.025–4.891).

Conclusion The study demonstrated that the adoption of differentiated care has enhanced patients' adherence to ART which differed across the models. There is need for continual counseling and support to the patients by healthcare providers so as to further improve adherence.

Keywords Differentiated care, Fast-track, Multi-month scripting, Usual care, Support group, Antiretrovirals, Adherence, Nigeria

Introduction

According to World Health Organisation (WHO), the total number of people living with HIV/AIDS (PLWHA) stands at 38.4 million (33.9–43.8 million) as at 2021 [1]. Nigeria has the 4th highest burden (1,900,000) of HIV infection in the world as at 2020 [2].

As the number of PLWHA who have commenced ART keep rising globally, challenges of long waiting times at

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the clinics, frequent appointment dates, transportation cost, as well as clinic congestion faced by PLWHA have been identified as barriers to easy access to antiretrovirals (ARVs) [3]. This challenge of ensuring continual access to ARVs which is vital in optimizing retention in care and adherence is further compounded in Nigeria due to insecurity [4]. Available reports show that Imo state is one of the states experiencing incessant security crisis in the recent years, and this has adversely affected socioeconomic activities in the area [5, 6]. Undoubtedly, such public unrest could pose challenge to steady access to ARVs which could affect their adherence to ART.

In the wake of the challenge of coping with increasing number of PLWHA and poor treatment retention, the WHO advocated for the adoption of the differentiated service delivery (DSD) of ART in supported countries to achieve greater efficiency [7].

Differentiated care (DC) operates on many models which are designed to cater for specific patients' population, different categories of patients, as well as capture the unique peculiarities of diverse settings where ART is delivered [8]. The Nigerian Federal Ministry of Health (FMOH) have adopted some models of DC which have been implemented at either pilot or full scale levels across various states [9]. Fast tract individual or group refill, facility-based ART (like, support group) and multiple-months scripting are three major facility-based Individual fast tract models already adopted in Nigeria, while community dispensary points, community pharmacy refills, home delivery, community ART group are community based models selected [9]. Study review of two states of Akwa Ibom and Cross River in Nigeria reported that DSD was significantly effective in improving patient's retention and viral load suppression [10] by increasing efficiency in service delivery as well reducing frequency of clinic attendance. In Abuja Nigeria, patients devolved to community pharmacy model was reported to have 100 percent retention in care and prescription refill [11] by providing patients with a convenient and flexible means of accessing ARVs.

Adherence to ART is the primary determinant of viral suppression, risk of transmission, disease progression and death [12–14]. Unlike in the past when adherence to ART was reported by many studies to be poor in Nigeria [15, 16], a good number of recent studies in Imo state have reported high adherence level to ART [17–20]. These findings support the fact that various reforms in ART program are beginning to yield positive results. However, these studies did not categorise the patients they examined into their models of receiving care but rather used all of them attending clinics as research subjects. As stated above, the FMOH have ensured that many facilities adopted the practice of DSD. Consequent upon this, it would have been more appropriate if these patients are examined according to whether they are differentiated or not, and if they are differentiated, the type of model they belong to. This will help bring clarity to study findings and provides vital information for stakeholders in ART program as it will reveal models that need strengthening and those that will be more prioritized, particularly in states battling with insecurity in Nigeria.

It was on this premise that this study was conducted to determine adherence level based on type of facility-based model patients belong to, as well as comparing the result with that of patients receiving ART through the usual care method.

Methods

Study setting

The research was carried out in Imo state, a southeastern Nigerian state, in one tertiary and three general hospitals that spread across the three senatorial zones of the state. The state has HIV prevalence rate of 1.4% translating to about 55088 persons infected with the virus [2]. A purposeful sampling method was used in choosing the hospitals because they were among the major health facilities that provide comprehensive ART services for PLWHA in the state. Two facilities were selected from Orlu senatorial zone because of its relatively large number while the other two zones had one facility each. In these facilities, stable patients receiving antiretroviral therapy (ART) have been enrolled into one DSD model or the other but only the patients in three DC groups (models) and those of the usual care were examined in the study.

Study population

Adults HIV-positive, stable patients receiving (ART) who were enrolled into three DSD models and those of the usual care category were examined in the study. The three DSD models studied are: multi-month scripting (MMS), fast track (FT), and support group (SG). Most of them are economically disadvantaged and reside mostly in the rural areas from where they visit their respective clinics to access ART. However, a good number of them are both psychologically and economically stable.

Sample size and sampling technique

The sample size for the study was determined using Raosoft online sample size calculator [21]. Given that there are approximately 4000 patients on ART in the four hospitals used in the study. On the basis of the most conservative response distribution of 50%, allowing 0.5% margin of error at 95% confidence interval, the required sample size was calculated to be 351. However, the number was increased to 600 for better representation. Stratified sampling method was used in getting the participants

from different models, and each model represented a stratum. Using a simple random method, approximately 150 participants were selected from each model since their subpopulations did not differ significantly.

Study design and data collection

This was a cross-sectional quantitative study. A pilot study was conducted to determine the feasibility of the study using another hospital that provide similar comprehensive health care services for the HIV-infected patients in the state. A total of 40 patients participated in the pilot study. The study adapted and modified the English online version of Cuestionario para la Evaluación de la Adhesión al Tratamiento Antiretroviral (acronym CEAT-VIH) [22] and another questionnaire from a previously published literature [23] to suit local context. Prior to the study initiation, the drafted structured questionnaire was subjected to face and content validation by experts in the field of HIV/AIDS and social research. Reliability of the instrument was determined using Cronbach's alpha for internal consistency, where a value above 0.7 was considered reliable [24]. The final validated instrument had 8, 4 and 5 items for sections A, B and C respectively. Section A was designed to capture the respondents socio-demographics; section B captured the clinical characteristics while section C measured adherence to antiretroviral therapy.

Participants were randomly selected, and each of them had been informed by the clinics' service providers about the nature, scope and purpose of the study during their routine attendance at the clinic before they are invited to give their informed consent to participate in the study. The clinics' service providers also assisted in identifying the models the patients belonged to. The questionnaires were self-administered to them and were collected after filling at the spot. Patients on the support groups who normally hold periodic meetings in their respective facilities were approached during their gatherings for filling. The study duration was 4 months.

Analysis

The collated data were first entered into Microsoft Excel and cross-checked for errors and omissions, and later imported into the statistical product and service solution (SPSS) version 24 for analysis. Descriptive statistics comprising the frequency, mean percentage, and standard deviation, were used to present patients' socio-demographics and adherence data.

Adherence was measured by means of patients' self-report using the formula:

$$\%Adherenceoverlast30days = \frac{numberofdosesthatshouldhavebeentaken - misseddoses}{numberofdosesthatshouldhavebeentaken} x100$$

Good adherence was defined as taking 95% of prescribed doses over the previous month (30 days) which corresponded to missing no more than one dose in a 10-day period (in a 2 times a day dosing regimen), one dose per week (in a 3 times a day regimen) or one dose per day (in a once daily dose regimen) [25, 26]. Frequency was used to summarize other questions in this section.

The proportions of adherence scores of respondents were compared with the DSD models type and the usual care group using chi square test of independence. A multiple linear regression model was used to test for the influence of socio-demographics on adherence. All the analyses were performed at p-value ≤ 0.05 and 95% confidence interval.

Results

Sociodemographic characteristics of patients

A total of 542 questionnaires were successfully retrieved from the respondents, giving a response rate of 90.0%. In the subgroups, multiple month scripting recorded the highest number of 163 respondents, while the fast tract, support group and usual care had 155, 114 and 110 respondents respectively. As in Table 1, the female gender was predominant in all the groups. The highest population were found within the range of bracket of 36–45 years.

Clinical characteristics of the patients.

Majority 444 (81.9%) of the respondents are on first-line regimen across the groups. Highest percentage 25 (22.7%) of second-line drug was among the patients receiving their drugs through the usual care methods. Nearly half of the patients (45.9%) had undetectable viral load of less than 20 copies/ml. See Table 2.

Patients' adherence levels

The percentage adherence scores of 95% and above (very good and excellent) for fast track, multiple months scripting, support group, and usual care members were 97.1, 70.5, 68.4, 59.1 respectively (Table 3).

Table 1 Socio-demographic characteristics of patients who received care under differentiated care models and usual care system in Imo State, Nigeria

Characteristics	Fast track group N (%) (n = 155)	Multiple month scripting group N (%) (n = 163)	Support group N (%) (n = 114)	Usual care group N (%) (n = 110)	Chi-square test *P-value*
Gender					**0.037****
Female	107 (69)	112 (68.7)	93 (81.6)	72 (65.5)	
Age					**< 0.001****
18–25	18 (11.6)	11 (6.7)	0 (0.0)	13 (11.8)	
26–35	36 (23.2)	36 (22.1)	28 (24.6)	27 (24.5)	
36–45	56 (36.1)	50 (30.7)	23 (20.2)	37 (33.6)	
46–55	24 (15.5)	41 (25.2)	32 (28.1)	21 (19.1)	
56–65	17 (11)	21 (12.9)	11 (9.6)	11 (10)	
66–85	4 (2.6)	3 (1.8)	20 (17.5)	1 (0.9)	
Educational level					**< 0.001****
None	5 (3.2)	8 (4.9)	2 (1.8)	5 (4.5)	
Elementary	35 (22.6)	51 (31.3)	48 (42.1)	24 (21.8)	
Secondary	67 (43.2)	75 (46)	62 (54.4)	54 (49.1)	
OND/NCE/HND	19 (12.3)	20 (12.3)	2 (1.8)	16 (14.5)	
Degrees	29 (25.2)	8 (4.9)	0 (0.0)	11 (10.0)	
Employment status					**< 0.001****
Studying	10 (6.5)	8 (4.9)	0 (0.0)	4 (3.6)	
Working	119(76.8)	115 (70.6)	97 (85.1)	79 (71.8)	
Unemployed/Retired	25 (16.1)	40 (24.5)	17 (14.9)	26 (23.6)	
Participation in HIV activities					**< 0.001****
Yes	35 (22.6)	29 (17.8)	20 (17.5)	19 (17.3)	

** = significant p value

Comparison of the adherence scores of the patients among the differentiated care groups.

A chi square test of independence between adherence levels and the type of DSD model respondents were enrolled shows significant association, ($\chi^2(6) = 51.48$, $p > 0.000$). As in Table 4 and Fig. 1, the highest proportion of patients with adherence level of ≥ 96.6% was found in support group while lowest was found in usual care group.

Influence of socio-demographics on the patients' adherence to ART using multiple regression analysis

As in Table 5, factors determining adherence were in two categories- socio-demographic and clinical factors. For the socio-demographic factors, type of differentiated care model and age significantly predicted adherence. Side effect, a clinical factor, was the only significant predictor of adherence.

Influence of adherence on viral load

From the multivariate logistic regression analysis shown in Table 6, adherence significantly predicted viral load suppression after potential covariates were adjusted for. The odds of having viral load suppressed was 3.144 times in those who were adherent than those who were not ((Odds ratio (OR) = 3.144, $p < 0.05$, 95% C.I 1.664–5.941).

Discussion

Socio-demographics of respondents

This study accessed the impact of DSD in HIV treatment on adherence among patients receiving ART in Imo state, Nigeria. The result of the study revealed that patients across the groups were majorly females (70.8%), and this figure collaborates with that of a study carried out in Imo state Nigeria [27] and in Ethiopia [28]. This higher percentage of women seen at the clinics in this study could partly be due to the fact that females are more exposed to the disease or were more conscious of their health than men, therefore, tend to seek medical attention more. The highest number of respondents was found within the age brackets of 26–45 years. This in consistent with results of other studies in South Africa and Nigeria which reported highest number of respondents within 30–39 years age interval [27, 29]. Regrettably, this age bracket represents the active ages of our nation's workforce. Majority of

Table 2 Clinical characteristics of patients under differentiated care models and usual care system in Imo State, Nigeria

Characteristics	Fast track group N (%) (n = 155)	Multiple month scripting group N (%) (n = 163)	Support group N (%) (n = 114)	Usual care group N (%) (n = 110)
How many times do you take your antiretroviral drug in a day?				
Once (First line)	140 (90.3)	132 (81.0)	102 (89.5)	70 (63.6)
Twice (Second line)	2 (1.3)	2 (1.2)	3 (2.6)	25 (22.7)
Not sure	0 (0.0)	0 (0.0)	0 (0.0)	5 (4.5)
Missing	9 (5.8)	29 (17.8)	9 (7.9)	10 (9.1)
How long have you been on antiretroviral treatment?				
< 1 year	1 (0.6)	0 (0.0)	3 (2.6)	56 (50.9)
1–2 years	35 (22.6)	49 (30.1)	61 (53.5)	16 (14.5)
Above 2 years	119 (76.8)	114 (69.3)	50 (43.9)	38 (34.5)
How would you describe the intensity of the side effects likely related to your antiretroviral treatment?				
Strongly intense	8 (5.2)	11 (6.7)	0 (0.0)	5 (4.5)
Intense	10 (6.5)	7 (4.3)	0 (0.0)	4 (3.6)
Median intense	15 (9.7)	19 (11.7)	10 (8.8)	16 (14.5)
Low intense	19 (12.3)	14 (8.6)	2 (1.8)	13 (11.8)
No side effects	102 (65.8)	106 (65)	102 (89.5)	71 (64.5)
What was your last viral load count? (copies/ml)				
> 1,000 (High)	13 (8.4)	22 (13.5)	4 (3.5)	52 (47.3)
> 20 ≤ 1,000 (unsuppressed)	4 (2.6)	15 (9.2)	7 (6.1)	15 (13.6)
< 20 (Undetectable)	80 (51.6)	49 (30.1)	95 (83.3)	25 (22.7)
Not yet eligible for viral load	0 (0.0)	0 (0.0)	0 (0.0)	14 (12.7)
Missing	58 (37.4)	77 (47.2)	8 (7)	4 (3.6)
What was your last CD4 cell count?				
< 200 (Bad)	0 (0.0)	6 (3.7)	2 (1.8)	3 (2.7)
≥ 200 ≤ 500 (Moderate)	6 (3.9)	10 (6.1)	1 (0.9)	6 (5.5)
> 500 (Good)	30 (19.4)	37 (22.7)	20 (17.5)	17 (15.5)
Missing	119 (76.8)	110 (67.5)	91 (79.8)	84 (76.4)

Table 3 Patients' adherence to antiretroviral drugs and reason for missing pills

Characteristics	Fast track model N (%) (n = 155)	Multi-month scripting model N (%) (n = 163)	Support group model N (%) (n = 114)	Usual care group N (%) (n = 110)
In the past 30 days, how often have you missed taking your antiretroviral drugs?				
Nearly every day (very poor adherence)	8 (5.2)	1 (6.0)	–	4 (3.6)
Three or more times a week (poor adherence)	8 (5.2)	7 (4.3)	–	7 (6.4)
Once or twice a week (fair)	15 (9.7)	12 (7.4)	–	13 (11.8)
Two or more times a month (good)	14 (9.0)	26 (16.0)	3 (2.6)	21 (19.1)
Once a month (very good) 95%	25 (16.1)	31 (19.0)	17 (14.6)	21 (19.1)
Never (Excellent) 100%	81 (52.3)	84 (51.5)	94 (82.5)	44 (40)
Reasons for non-missing drugs in the last 30 days				
Was taking other drugs	1 (0.6)	2 (1.2)	1 (0.9)	1 (0.9)
Travelled but did not want people to know	2 (1.3)	2 (1.2)	0 (0.0)	0 (0.0)
Wanted to avoid side effects	2 (1.3)	4 (2.5)	0 (0.0)	4 (3.6)
Simply forgot	18 (11.6)	24 (14.7)	1 (0.9)	15 (13.6)
Ran out of medicines	7 (4.5)	2 (1.2)	2 (1.8)	1 (0.9)
Felt good	11 (7.1)	12 (7.4)	0 (0.0)	9 (8.2)
Felt ill or sick	10 (6.5)	7 (4.3)	1 (0.9)	12 (10.9)
Felt depressed	2 (1.3)	2 (1.2)	0 (0.0)	1 (0.9)
Fell asleep/slept through dose time	3 (1.9)	3 (1.8)	1 (0.9)	2 (1.8)

Table 4 Association of DSD models and usual care group with patients' adherence level

	Levels of adherence				
	Optimal adherence (≥ 96.6%)	**Sub-optimal adherence (86.6–93.3)**	**Poor adherence (≤ 60%)**	**Chi-square (χ^2)**	**P-value**
Types of differentiated service delivery models				51.48	> 0.000
Multi-month scripting	115	28	8		
Fast track	107	29	16		
Support group	111	3	0		
Usual care group	65	34	11		

($\chi^2(6) = 51.48$, $p > 0.000$)

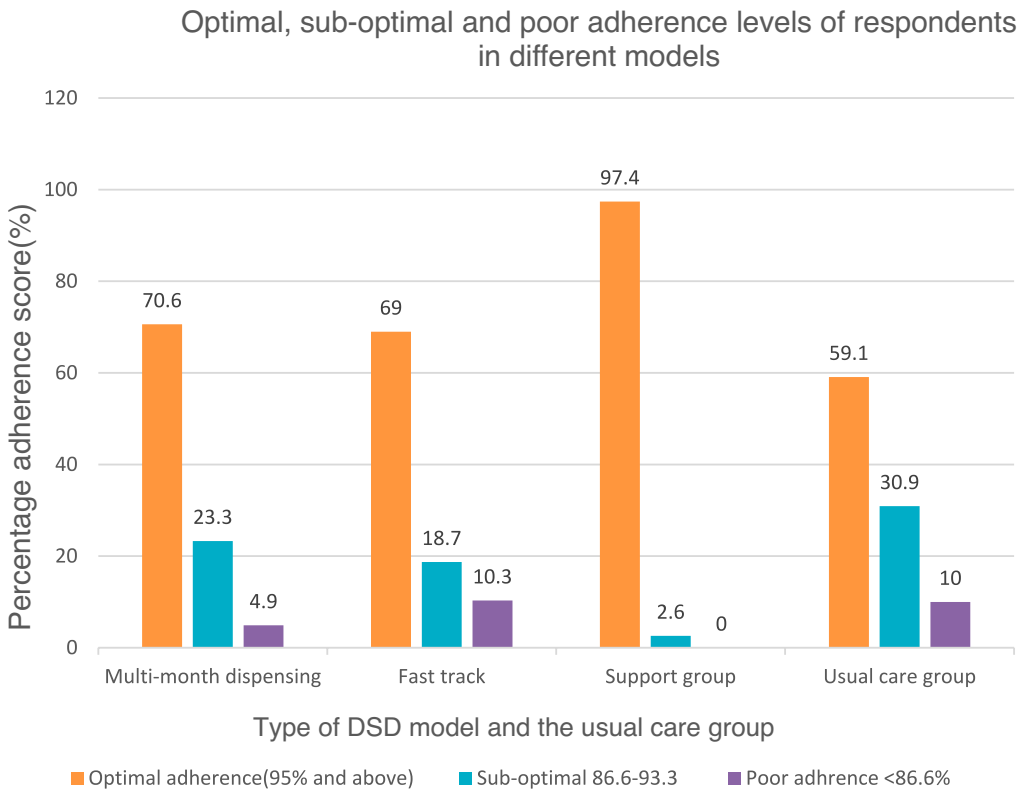

Fig. 1 Adherence levels of respondents in different DSD and usual care group

the participants only attended primary and secondary schools, and this is similar to findings from a survey conducted in China [30]. This could have stemmed from the type of setting where the studies were carried out. In this study. Percentage of unemployment on approximation was found to be one fifth of the total number. A study has revealed high rates of unemployment in South Africa among HIV-infected persons old enough to belong to the labour force [31]. Till today, HIV/AIDS is regarded as a disease associated with promiscuous lifestyle, and also it is generally believed to be highly contagious. As a result, infected people may likely suffer social discrimination, loss of jobs, financial predicaments, and so on, that collectively impose huge burden on them.

Patients participation in HIV activities and voluntary works were low across the groups examined in the study and this is similar to the findings of an African study [29]. Various treatment facilities in collaboration with the treatment partners, have instituted support group initiative which serves as the platform for the provision of psychosocial support, promotion of social unity, patients' education, among others to the PLWHA. Findings of

Table 5 Influence of socio-demographics on the patients' adherence to ART using multiple regression analysis

	B	S.E	Sig	Exp(B) or OR	95% C.I for Exp(B)	
					Lower	Upper
Gender	0.105	0.250	0.675	1.110	0.681	1.811
Type of care model: multiple month scripting (REF)						
Fast track	0.157	0.295	0.594	1.170	0.656	2.086
Support group	1.047	0.336	0.002	2.849	1.475	5.503
Usual care	− 0.413	0.290	0.154	0.662	0.375	1.168
Participation in activity						
No (REF)						
Yes	0.420	0.315	0.182	1.522	0.821	2.821
Age(yrs) 18–25 (REF)						
26–35	0.090	0.511	0.860	1.094	0.402	2.978
36–45	1.244	0.506	0.014	3.470	1.286	9.365
46–55	0.998	0.539	0.064	2.714	0.944	7.799
56–65	0.796	0.584	0.173	2.217	0.706	6.960
66–85	0.774	0.781	0.322	2.168	0.469	10.022
Employment status: employed (REF)						
Unemployed/Retired	0.148	0.269	0.582	1.160	0.684	1.964
Studying	− 0.460	0.637	0.470	0.631	0.181	2.201
Side effects						
No side effect (REF)						
Low intense	− 0.772	0.375	0.039	0.462	0.222	0.963
Median intense	− 1.122	0.544	0.001	0.326	0.166	0.639
Intense	− 1.122	0.510	0.010	0.270	0.100	0.734
Strongly intense	− 0.490	0.656	0.000	0.83	0.028	0.300

Dependent Variable: Adherence Score of Patients

B unstandardized beta, *S.E* standard error, *OR* odds ratio, *C.I* confidence interval

REF reference group or dummy group

this study show that greater percentage of patients who enrolled and participated in the social support groups perceived their economic condition to be at par with that of other members of the society, and none of them perceived their economic condition as being worse than that of other people. This could be one of the positive impacts of social support on the psychological well-being of PLWHA. A study in England which examined the benefits of a social support group for the women reported that support group attendance had resulted in positive cognitive, emotional and behavioral changes in PLWHA [32]; similar to study finding in China [30]. In view of the foregoing, provision of ARV alone is important but not sufficient to guarantee all round improvements in the well-being of people living with the disease [33].

Adherence to ART

Optimal adherence (≥96.6%) to ART was reported by majority of the patients in this study. The support group model had the highest percentage (97.4%) of patients with optimal adherence while the usual care group had the lowest.

The higher adherence reported by the respondents in support group was not surprising considering the well-established fact that effective management of HIV infection requires multiple approaches other than just access to ARVs alone. According to WHO, participation in treatment support meetings has been found to enhance adherence to ART to over 95% [33]. Of all the four groups examined, the respondents in the usual care group, which comprises new patients, pregnant and lactating mothers, those with other co-morbidities, as well as some patients who were yet to be enrolled or preferred not to enroll, had the least optimal adherence percentage. Non adherence has been found to be more prevalent among newly enrolled patients on ART [34].

This result is in consistent with findings of many recent studies on adherence carried out in the state [17, 19, 20, 35]. Beyond the state, similar results were reported in Southeast Nigeria [36] and Ethiopia [37]. As stated

Table 6 Relationship between adherence and viral load suppression in a multiple regression analysis

Factors	B	S.E	Sig	Exp(B)	95% C.I. for EXP(B)	
					Lower	Upper
Gender	0.630	0.335	0.060	1.877	0.974	3.617
Participation in activity: No (REF)						
Yes	0.329	0.432	0.446	1.389	0.596	3.238
Place of residence: City (REF)						
Town	0.643	0.554	0.246	1.902	0.643	5.631
Village	− 0.124	0.454	0.784	0.883	0.362	2.151
Marital Status: Single (REF)						
Married	1.187	0.397	0.003	3.276	1.504	7.137
Widowed	1.054	0.503	0.036	2.870	1.071	7.687
Divorced	− 19.673	0.081	0.999	0.000	0.000	
Type of care model: Multiple month Scripting (REF)						
Fast track	1.190	0.452	0.008	3.289	1.355	7.982
Support group	1.828	0.451	0.000	6.223	2.571	15.061
Usual care	− 1.556	0.393	0.000	0.211	0.098	0.455
Adherence: Non adherent (REF)						
Adherent	1.146	0.325	0.000	3.144	1.664	5.941

Dependent variable: viral load suppression (suppressed = 1, unsuppressed = 0)

B unstandardized beta, *S.E* standard error, *OR* odds ratio, *C.I* confidence interval, *REF* reference group or dummy group

earlier, participants in those studies were not separated by their DSD models as the researchers examined all the patients attending clinics. And because most hospitals have started implementing DSD, one could say that many of respondents that participated in those studies were already enrolled in facility-based models of DSD which this study examined. However, there are some studies that examined patients according to their models of care. Findings from those studies indicated that DSD resulted to a relatively higher adherence level than the previous methods of service delivery. In Myanmar, and Ethiopia for instance, DSD resulted in excellent outcomes of 98.7% retention in care, 0.4% dead, 0.8% lost to follow-up [38, 39] reduced both direct and indirect medical costs. In view these positive findings, policy makers should work to encourage the adoption of DSD across various facilities where DSD is yet to commence and strengthen and support the models that have demonstrated excellent outcomes.

Nevertheless, a South African study has reported suboptimal adherence level among adolescents enrolled in adherent club model of DSD [40].

Prior to the DSD era, adherence to ART was generally poor across the states in Nigeria and countries in Africa. A study conducted in Owerri, Imo state and Ibadan, Oyo state, Nigeria reported poor optimal adherence [15, 16].

However, improved adherence in the recent time might have stemmed from the fact that the optimized dolutegravir (DTG)-based regimen currently prescribed is not associated with much side effects and has reduced pill burden [40]. Thus, in this study, DSD may not be solely responsible for the improved adherence reported; simplified regimen with low side effects profile could have subtly enhanced adherence.

Reasons for being non adherent were sought in order to identify areas of focus for future interventions on adherence. 'Forgetfulness', followed by 'travelled and forgot medicine at home', 'felt good', 'feeling sick', 'ran out of medicine', 'wanted to avoid side effects' topped the reasons for missing drugs. Various other studies also identified similar reasons [35, 41], as well as pill burden [42] for non-adherence to ART. Other reasons for non-adherence include: fasting and praying, feeling depressed, and taking other medicines. In contrast, results from southeastern Nigeria [20] reported medication side effects to be major significant predictor of adherence among children. Possible explanation for this observation could be because paediatric formulation of DTG, known for low profile side effects, was not available in Nigeria then.

Although adherence was observed in this study to have significant correlation with the viral load, generalization of this finding may be inappropriate in view fact that DTG-based regimen currently used as first-line ARV is very efficacious against HIV. However, such correlation has been reported in many other studies [43, 44].

In the light of the poor clinical and humanistic outcomes fallouts of non-adherence, efforts geared towards mitigating the challenges of maintaining optimal adherence should be intensified. Missing doses because of other medications or having other disease conditions simply allude to poor education from the health providers. Unlike some antiretrovirals such as nevirapine, efavirenz, and protease inhibitors that have multiple drug-drug and drug-food interactions, DTG-based regimen has a very low record of such aforementioned interactions [45], and thus should not preclude patients from taking their ARVs, except when there is contrary professional advice. Proper information with regards to this should be well communicated to the patients.

Patients characteristics including participation in HIV activities, age, occupation, and place of residence had significant bearing on the adherence in this study. Contrary to the common believe that increasing education will positively affect adherence, perhaps due to increase knowledge of HIV and of ARVs, the multivariate analysis did not prove such relationship in this research and this collaborated with a study in Ethiopia [37], Understandably, participation in HIV activities can help promote adherence as such engagements can be instrumental in enhancing psychosocial well beings [18, 30]. Increasing age was associated with higher adherence, an observation that has also been found in other similar studies in Nigeria [27, 46]. Expectedly, having stable means of earning livelihood increased adherence as observed because even though the provision of ART in the study settings is said to be gratis, there are subtle charges such as cost of transportation and some laboratory tests, associated with receiving treatment.

Limitations

This study employed self-reported adherence method, and like many other subjective methods of measurement, is associated with some limitations. The study examined only the facility-based models. These may limit the scope of the generalization of the findings. Research involving the direct extraction of viral load result data from the patients' folders will help increase the reliability and generalization of the findings.

Additionally, the improved adherence observed cannot be totally ascribed to the implementation of differentiated care because patients in the three models (multiple month scripting and support group) already had good history of adherent to ART before enrolment. The optimised regimen (TLD) presently prescribed could have contributed to the improved adherence since its side effects profile is still very low.

Conclusion

This study has demonstrated that the adoption of differentiated care service delivery models in ART program has greatly improved adherence to antiretrovirals. Findings of the study also show that adherence level differs from one model to another. The support group members had the highest adherence to ART, while the usual care group were more non adherent when compared with others. This could serve as an essential information to the relevant stakeholders in making policies that are evidenced based. There was a significant correlation with reported viral load result. Contributors to non-adherence to ART were 'Forgetfulness', 'travelled and forgot medicine at home', 'felt good', 'feeling sick', 'ran out of medicine', 'wanted to avoid side effects', fasting and praying, feeling depressed, and taking other medicines. Participation in HIV activities, age, occupation, and place of residence are the patients' characteristics which were significantly associated with adherence to ART. Future research could be carried out to determine if DSD could be adopted in the management of other illnesses in Nigerian hospitals.

Abbreviations

AIDS	Acquired immune deficiency syndrome
ART	Antiretroviral therapy
ARVs	Antiretrovirals
CAGs	Community ART groups
CD4	Cluster differentiation 4
COVID-19	Corona virus disease-19
DSD	Differentiated service delivery
FMOH	Federal Ministry of Health
HAART	Highly active antiretroviral therapy
HIV	Human immunodeficiency virus
TLFU	Lost to follow up
MMS	Multiple months scripting
NACA	National action committee on AIDS
PLWHA	People living with HIV and AIDS
SPSS	Statistical product and service solutions
TB	Tuberculosis
TLD	Tenofevir Lamivudine Dolutegravir
WHO	World Health Organisation

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Author contributions

All authors participated in the design of the study. Maxwell O. Adibe (MOA), a professor, served as the supervisor of the study. Azubuike A. Ekwuofu (AAE) and Obinna F. Dim (OFD) did data collection from study subjects, while data preparation for statistical analysis was carried out by AAE. AAE and OFD wrote the first draft of the manuscript which was proofread and corrected by MOA. All authors read and approved the final manuscript before submission to this journal.

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Availability of data and materials
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request. Raw data used for the analysis are availability and will be released upon request. No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Ethical approval for the research was granted by the ethical committee of Imo State University Teaching Hospital, Umuna, Orlu, Imo State (IMSUTH/CS/121) and The State AIDS and STI Program Control, Department of Public Health, Imo State Ministry of Health, Owerri. Authorized written permissions were obtained from each of the management of the study facilities. Patients' consent was sought before their participation in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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