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Empowerment Through Skill Acquisition and Its Impact on ART Adherence Among HIV-Positive Adults in Lagos, Nigeria during the COVID-19 Pandemic

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Abstract: This study investigates the impact of a skill acquisition intervention on Antiretroviral Therapy (ART) adherence among HIV-positive adults in Lagos, Nigeria during the COVID-19 pandemic. The research explores demographic characteristics, changes in adherence rates before and after the intervention and the effectiveness of the intervention. A total of 50 participants were divided into experimental and control groups. Demographic data, including age, gender, income, and education were collected. ART adherence was measured before and after the intervention. Statistical analysis included descriptive statistics, Wilcoxon signed ranks tests and Mann-Whitney U tests. Before the intervention, the control group exhibited higher ART adherence rates compared to the experimental group. However, both groups showed significant improvements in adherence after the intervention. The intervention effectively narrowed the adherence gap between the groups. Wilcoxon signed ranks tests confirmed significant improvements in adherence in both groups before and after the intervention. Mann-Whitney U test results indicated that before the intervention, the control group had higher ART adherence rates compared to the experimental group. However, after the intervention, the Mann-Whitney U test revealed a significant difference in ART adherence between the experimental and control groups. The experimental group had higher adherence rates after the intervention compared to the control group. This study highlights the positive impact of skill acquisition interventions on ART adherence among HIV-positive adults in Lagos, Nigeria. The intervention effectively improved adherence rates and reduced disparities between groups. These findings emphasize the importance of scaling up similar interventions in HIV care programmes. However, future research with larger samples and longer follow-up periods is recommended to validate and expand on these results.

Keywords: HIV, Antiretroviral Therapy, Adherence, Skill Acquisition, COVID-19, Empowerment

1. Introduction

The advent of Antiretroviral Therapy (ART) has led to the paramount advancement in the treatment of HIV/AIDS as a chronic and controllable infection. Today HIV patients who benefit from appropriate and timely treatment are estimated

to have similar survival rates to HIV- uninfected patients [1-2]. The long-term success of ART was noticeable after the year 2000 following the rigorous implementation of the treatment principles for various classes of ARV drugs. These precise drug combinations were outlined in 1996 as highly active antiretroviral therapy (HAART) and later referred to as combined antiretroviral therapy which has contributed to the transformation of HIV infection into a treatable chronic disease [3]. However, despite the significant decrease in mortality and transmission risk, empowerment intervention, for instance skills acquisition is very essential for economic development of adults infected with HIV. While antiretroviral therapy has drastically improved the clinical status of many patients with HIV infection, attention is increasingly focusing on the role of treatment adherence to this therapy. This is because evidence has shown that poor adherence to antiretroviral treatment regimens has serious consequences for HIV-infected patients, including treatment failure, an increased likelihood of developing drug resistance, the development of clinical complications, and shortened survival [4]. The central role of adherence to antiretroviral therapy to achieve successful treatment of HIV has prompted a myriad of research into adherence and increased clinicians' interest in attempting to address adherence issues. Adherence to antiretroviral therapy remains unsatisfactory and varies between 27 and 80% across different population in various studies, compared with the required level of 95% to suppress virus and avoid developing drug resistance [5]. Adults are much at a higher risk of non-adherence [6] due to the fact that the initiation of ART and the implementation phase may be deficient either due to fears of being detected with HIV or discrimination due to lack of time needed for medical care. For adequate adherence to ART especially by adults, instrumental support in terms of skill acquisition is very essential. The lack of adherence to ART can lead to poor health conditions and this may lead the patients to second line treatment that requires more expensive drugs to suppress the viral load. Research has shown since the earliest days of ART that individuals who suppress their virus have much lower rates of death and opportunistic diseases [7]. Several methods for improving adherence to ART have been proposed in the literature which include directly observed therapy, dose simplification, phone reminders and counselling [8-11] among other strategies proposed but no attention has been paid to empowerment intervention in the developing world. The economy of Nigeria is rather stagnant and poverty remains a grave concern as large segments of the population are poor in physical and economic terms [12]. Some of the policies that have been put in place by the government to eradicate poverty have not focussed on those that are infected by communicable diseases like HIV, TB, et c. It is skill acquisition that will serve as a means of empowerment as this will reduce unemployment and enhance self- sustenance by adults living with HIV in the country. This will ultimately reduce the risk of complications in case of infection with SARS-CoV-2 since the empowerment programme will spur the participants to regularly pick up

their drugs for use. Both national and international organisations are spending huge amount of money on the first line medications to treat HIV patient for a year. However, if any patient is non-adherent and drug resistance occurs and second line drugs must be used, the costs increase exorbitantly. So, proffering solution to non-adherence caused by inadequate or no regular income, by patients can improve adherence to picking up and taking medications as and when due. This is crucial as the need to feed, transport, pay for registration fee at the clinic and other financial challenges are attached to this even if the drugs are given on gratis. As a result, stigma and discrimination are not the only challenges faced by HIV patients but financial difficulty to sustain the required level of adherence to medications. A level of not less than 95% adherence to antiretroviral drugs is required to achieve and sustain viral suppression and minimize the risk of transmission [13]. Patient empowerment through skill acquisition that will lead to economic empowerment has not been established in Nigeria. Comprehensive review of literature has shown that studies on empowering patients to improve adherence have been traced to North America and Asia with entirely diverse cultural backgrounds [14]. Empowerment and social support could be helpful assets among HIV infected adults to improve their quality of life, reduce stigma and improve adherence to ART in poor resource settings. Attention must be properly paid to the welfare of the HIV infected adults as negligence could cause treatment discontinuation that will give rise to non-adherence by the HIV patients. This study was therefore conducted to determine the effects of an empowerment intervention through skill acquisition on ART adherence among adult patients living with HIV in Lagos, Nigeria. The study commenced during the pandemic of coronavirus 2019 (COVID-19) that emerged at the end of year 2019 (COVID-19) which posed a major global health concern worldwide [15]. Coronavirus 2019 status of the participants were confirmed so as to reduce the risk of complications in case of infection with SARS-CoV-2 [16].

2. Methodology

Study Design: The study design was a prospective cohort survey. It was designed to examine the effect of an empowerment intervention through skill acquisition on antiretroviral drug adherence among adult living with HIV and attending the adult clinic at the Nigerian Institute of Medical Research (NIMR) HIV Care and Treatment Centre at Yaba, Lagos. The HIV infected patients aged 15 to 45 years who had less than 95% adherence were randomly selected from the clinic using pharmacy records. Any patient that did not want to participate in the study was replaced by another eligible patient. Their baseline records of adherence to drugs pick up were compared with the adherence records achieved at the end of the study. Two groups were considered for the study. One group (n = 25) received an intervention that was based on empowerment involving skill acquisitions and empowerment materials for start-up while

the other group (n = 25) served as the control group. All participants in both groups received the standard prescription of drugs to be taken.

Study Setting: The HIV Care and Treatment Centre in NIMR is one of the centres with a large number of HIV patients in the country with approximately 25,000 patients that have cumulatively enrolled since its establishment in 2002. The HIV Care and Treatment Centre caters for patients who reside in Lagos and across the country as well as few patients from neighbouring African Countries.

Study Population: This comprised all patients aged 15 to 45 years attending the adult clinic at NIMR who have been on antiretroviral therapy for at least three months and were also eligible according to the inclusion criteria. Out of 24,710 HIV patients at NIMR clinic, there are 16,105 (65.2%) adult patients. The population of the adult patients justified the need for this study on adult's adherence to ART. This study was conducted as a pilot study to generate data on the effect of empowerment intervention to improve ART adherence among HIV patients.

Inclusion Criteria: Adult patients between 15 and 45 years of age who had less than 95% adherence and expressed willingness to participate in the programme were included in the study. The patients that were either unemployed or not gainfully employed were also considered. The patients between the same age who had less than 95% adherence, employed and had expressed willingness to participate in the study were included as control group.

Exclusion Criteria: Patients that were not ART naïve at the enrolment were not included in the study.

Sample Size: Fifty HIV patients aged 15 to 45 years in both groups who had less than 95% adherence were randomly selected from the HIV Care and Treatment Centre in NIMR. As at the time of enrolment of the study participants, there were 3,488 HIV patients in the stated age category that were non-adherents. The appropriate formula of a known population number was used in calculating the sample size [17] as follows:

$$n = \frac{p_1(1 - p_1) + p_2(1 - p_2)}{(p_1 - p_2)^2} * C$$

where

n = Sample size for the experimental group; p_1 and p_2 = Proportion of the two groups

C = Standard value for the corresponding level of α and β selected for the study. From the available data, proportion of the two groups is taken, i. e., 6.6% and 73.4%, respectively. The corresponding level for α (0.05) at 95% CI and β (80% power for the study) is given as 7.85.

The sample size of 50 HIV patients between the age of 15 and 45 years old in both groups who have less than 95% adherence were randomly selected from the HIV Care and Treatment Centre in NIMR.

Study Methods: Two data collection forms were prepared. One was meant to capture information on socio-demographic data comprising age, gender, level of education, type of family, household size, type of accommodation, personal income, source of income person/organization responsible for the patient financial support (if any), distance from home to HIV Care and Treatment Centre in NIMR, duration since the discovery of HIV, duration of the antiretroviral drugs treatment and reasons for not taking antiretroviral drugs as prescribed. The second form was used to collect data on antiretroviral drug adherence using pharmacy records and self-report. The skills acquisition model as a means of empowerment programme was in two phases. The first phase of the study was based on empowerment lectures which conducted by the research team. The participants were theoretically engaged to first recognize the essence of empowerment to improve adherence to ART. This consisted of four intensive sessions of 3 hours per session over three weeks' period. In the first phase, all participants were exposed to all the skills acquisition programme in the study. In the second phase, participants were grouped into their skills acquisition programme of choice (Each group of the participants chose any acquisition skills such as catering (on a small scale), bead-making, hair-making, liquid soap-making and soya-milk making) to receive the training starting from 10.00am till 6pm of Saturdays and Sundays between July and August, 2022. They were empowered after the training with items and materials they can use to start practising on a small scale and sell to make little money as part of the study intervention.

Participants were followed up for 3 months to ensure that the selected participants trained truly understand the empowerment process. A review meeting held in February 2023 to tackle some of the challenges noticed during follow up and period and both chartered accountant and an economist who were members of the research team presented on financial management and economic benefit of the empowerment to improve adherence to HIV drugs. The research team had baseline, 3 months and 6 months drug adherence records for every participant.

2.1. Data Management

The study end points will include achievement of not less than 95% ART adherence as well as undetectable viral load at six months regardless of the value at baseline and improvement in CD4 count of greater than or equal to 100 cells/µL. Data obtained from the study were entered and saved in Excel Spreadsheet and analysed using R software.

2.2. Ethical Consideration

Ethical approval was obtained from the Institutional Review Board (IRB) at the Nigerian Institute of Medical Research (NIMR). The prospective participants were duly informed of their rights to either participate or not and to withdraw at any time. All the participants were required to sign a consent form of participation in the research.

3. Results and Discussion of Findings

Table 1 presents results on demographic and health characteristics of HIV-positive adults in the experimental and control groups during the COVID-19 pandemic. In the experimental group, 84% of participants were aged 35-45, while in the control group, 60% fell into this age range. There was no significant difference in the mean age between the two groups. The experimental group had a mean age of 38.36 years, while the control group had a mean age of 36.16 years. Gender distribution showed a significant difference. In the experimental group, 80.0% of participants were female, while in the control group, only 48% were female. The chi-square test indicates a significant association (p = 0.02).

Both groups had similar marital status distributions, with the highest percentage being married individuals. There was no significant difference in marital status between the two groups. The majority of participants in both groups were engaged in sales and services, with the experimental group having a higher percentage (44.0%) in this category. Occupation between the two groups has no significant difference. In terms of education level, the experimental group had a higher percentage of participants with secondary education (56.0%), while the control group had more tertiary-educated (44.0) participants. There was a borderline significant difference (p = 0.05) in the distribution of education levels between the two groups. Both the experimental and control groups had a similar distribution of family types with the former having 21 (84.0%) and 4 (16.0%) while the latter had 23 (92.0%) and 2 (8.0%) nuclear and extended families, respectively. Both the experimental and control groups had a similar distribution of types of accommodation (own house versus rented apartment) and there were no significant differences in family type or accommodation type between the two groups (p>0.05).

The experimental group had a significantly higher percentage of participants with an average monthly income in the range of 0-15,000 (64% in experimental versus 32% in control, p = 0.008). There was no significant difference in the source of income/financial support between the two groups and the majority of participants in both groups lived more than 10 kilometers from the hospital. There was no significant difference in the distance from home to the hospital between the two groups. The majority of participants in the experimental (84.0%) and control (72.0%) groups had been living with HIV for more than 6 years. In terms of ARV treatment duration, the experimental group had a significantly higher percentage of participants on treatment for more than 12 months (88% in experimental versus 80% in control, p < 0.0001). The reasons for not taking ARVs varied, with "Forgot"(28.65) and "Others"(42.9%) being the most common reasons in the experimental group and "Forgot"(63.6%) and "Tired of taking ARVs"(18.2%) in the control group. While there were no significant differences, the chi-square test showed a p-value of 0.15, indicating a trend worth exploring further. Very few participants had a positive COVID-19 status at enrolment (one participant in the control group). Most participants had not been tested for COVID-19, and the chi-square test did not show significant differences in COVID-19 testing or test results between the two groups (p>0.05).

Table 1. Demographic and Health Characteristics of HIV-Positive Adults in the Experimental and Control Groups during the COVID-19 Pandemic.

Personal data	Experimental group (n=25)		Control group (n=25)		χ^2	p-value
	Number	Percent	Number	Percent		
Age (years)						
15-24	3	12.0	5	20.0	2.22	0.14
25-34	1	4.0	5	20.0		
35-45	21	84.0	15	60.0		
X (SD.)	38.36 (8.88)		36.16 (10.17)			
Range	16-45		18-45			
Gender						
Male	5	20.0	13	52.0	5.56	0.02
Female	20	80.0	12	48.0		
Marital status						
Never married	7	28.0	7	28.0	0.32	0.57
Married	13	52.0	16	64.0		
Divorced/Separated	1	4.0	0	0.0		
Widowed	4	16.0	2	8.0		
Occupation						
Unemployed/Student	3	12.0	5	20.0	1.07	0.30
Unskilled manual	4	16.0	1	4.0		
Skilled manual	5	20.0	6	24.0		
Clerical	1	4.0	1	4.0		
Sales and services	11	44.0	3	12.0		
Professional/managerial/technical	1	4.0	9	36.0		
Level of education						
Informal	2	8.0	0	0.0	3.55	0.05
Primary	3	12.0	3	12.0		
Secondary	14	56.0	10	40.0		
Tertiary	6	24.0	11	44.0		
Postgraduate	0	0.0	1	4.0		

Personal data	Experimental group (n=25)		Control group (n=25)		χ^2	p-value
	Number	Percent	Number	Percent		
Age (years)						
Type of family						
Nuclear family	21	84.0	23	92.0	0.76	0.38
Extended family	4	16.0	2	8.0		
Number of family members (persons)						
1–5	20	80.0	20	80.0	0.0001	0.98
6–10	5	20.0	5	20.0		
Type of accommodation						
Own house	2	8.0	2	8.0	0.0001	0.98
Rented apartment	23	92.0	23	92.0		
Average monthly income						
0-15,000	16	64.0	8	32.0	7.13	0.008
15,001-25,000	3	12.0	4	16.0		
25,001-35,000	2	8.0	1	4.0		
35,001-55,000	3	12.0	3	12.0		
55,001-75,000	1	4.0	9	36.0		
Source of income/financial support						
Self-employment	16	64.0	11	44.0	1.36	0.24
Paid employment	6	24.0	10	40.0		
Others	3	12.0	4	16.0		
Distance from home to hospital (kilometer)						
< 10Km	1	4.0	3	12.0	1.09	0.30
≥ 10Km	24	96.0	22	88.0		
Duration since the discovery of HIV infection (years)						
<1	2	8.0	1	4.0	0.26	0.61
< 3	0	0.0	2	8.0		
3–6	2	8.0	4	16.0		
> 6	21	84.0	18	72.0		
Duration of the antiretroviral drugs treatment (months)						
< 6	2	8.0	0	0.0	0.0001	0.97
6–12	1	4.0	5	20.0		
> 12	22	88.0	20	80.0		
Reasons for not taking antiretroviral drugs as suggested						
Forgot	2	28.6	7	63.6	2.06	0.15
No money for transportation to NIMR clinic	2	28.6	1	9.1		
Tired of taking ARVs	0	0.0	2	18.2		
Others	3	42.9	1	9.1		
Positive COVID-19 status as at the time of the enrolment						
Yes	0	0.0	1	4.0	1.04	0.31
No	23	92.0	24	96.0		
Don't Know	2	8.0	0	0.0		
COVID-19 test history						
Yes	6	24.0	7	28.0	0.10	0.75
No	19	76.0	18	72.0		
COVID-19 test result						
Positive	2	33.3	3	42.9	0.31	0.58
Negative	4	66.7	4	57.1		

The ART adherence in the experimental group ranged from a minimum of 27.00% to a maximum of 92.00% with a mean adherence rate of 68.76%. The median adherence rate was 71.00% with an interquartile range (IQR) of 22. This suggests a moderate level of adherence to ART before the intervention. After the intervention, the adherence rates improved significantly. The range of adherence increased to a minimum of 97.00% and a maximum of 143.00%, with a notably higher mean adherence rate of 109.72%. The median adherence rate was 107.00%. This indicates a substantial increase in ART adherence after the intervention.

In the control group, the ART adherence before the intervention ranged from 39.00% to 92.00%, with a mean adherence rate of 83.66%. The median adherence rate was 90.00%, and the IQR was 9. This group exhibited a relatively good level of adherence before the intervention. Similar to the experimental group, the control group also experienced an improvement in ART adherence after the intervention. The range of adherence expanded to a minimum of 48.00% and a maximum of 129.00%. The mean adherence rate increased to 99.44%. The median adherence rate after the intervention was 107.00%, and the IQR was 11.5. This indicates a significant increase in ART adherence in the control group as well. Both groups showed improvements in ART adherence after the intervention, as evidenced by the higher mean adherence rates and widened ranges. The experimental group had a larger increase in mean adherence (from 68.76% to 109.72%) compared to the control group (from 83.66% to 99.44%). However, it is essential to note that both groups achieved a similar median adherence rate of

107.00% after the intervention, suggesting a similar central tendency in adherence between the two groups. The Wilcoxon signed ranks test indicated highly significant p-values (p < 0.0001) for both groups before and after the intervention, confirming that the observed improvements in adherence rates were not due to random chance. These results underscore the effectiveness of the intervention in enhancing ART adherence in the experimental group during the COVID-19 pandemic. The findings showed that the intervention had a positive and statistically significant impact on ART adherence in the experimental group, indicating its effectiveness in improving medication adherence among HIV-positive adults in Lagos, Nigeria during the challenging circumstances of the COVID-19 pandemic (Table 2).

Table 2. *Changes in ART Adherence Before and After Intervention in Experimental and Control Groups.*

Study Group	Percentage of ART adherence					Wilcoxon signed ranks test	
	Min–Max	Mean	SD	Median	IQR	Z	*p-value*
Experimental group (n=25)							
Before intervention	27.00– 92.00	68.76	19.44	71.00	22	-6.103	0.0001
After intervention	97.00–143.00	109.72	9.93	107.00	7.5		
Control group (n=25)							
Before intervention	39.00 - 92.00	83.66	15.19	90.00	9	-3.939	0.0001
After intervention	48.00– 129.00	99.44	17.33	107.00	11.5		

IQR = interquartile range

The results presented in Table 3 focusses on changes in ART Adherence between the experimental and control groups. Before the intervention, the Mann-Whitney U test yielded a highly significant p-value (p < 0.0001), indicating that there was a significant difference in ART adherence between the experimental and control groups following the intervention. Specifically, the control group had higher adherence rates before the intervention. After the intervention, the Mann-Whitney U test revealed a significant difference in ART adherence between the two groups. Specifically, the experimental group had higher adherence rates after the intervention compared to the control group (Table 3).

Table 3. *Changes in ART Adherence between Experimental and Control Groups.*

Study Group	Percentage of ART adherence					Mann-Whitney U test	
	Min–Max	Mean	SD	Median	IQR	Z	*p-value*
Before intervention							
Experimental group	27.00– 92.00	68.76	19.44	71.00	22	-3.768	0.0001
Control group	39.00 - 92.00	83.66	15.19	90.00	9		
After intervention							
Experimental group	97.00–143.00	109.72	9.93	107.00	7.5	-2.018	0.044
Control group	48.00– 129.00	99.44	17.33	107.00	11.5		

IQR = interquartile range

Discussion of Findings

The findings of this study shed light on the impact of a skill acquisition intervention on ART adherence among HIV-positive adults in Lagos, Nigeria during the COVID-19 pandemic. The study provides valuable insights into the demographic and health characteristics of the study participants, changes in ART adherence before and after the intervention, and the effectiveness of the intervention itself. Demographically, the study revealed that the experimental group had a significantly higher proportion of female participants compared to the control group. This gender difference may have implications for ART adherence, as previous research has indicated that gender can be a significant factor in medication adherence among HIV-positive individuals [18]. Income disparities were also evident with the experimental group having a larger proportion of participants with lower incomes. Economic factors, such as income and employment status, are known to influence medication adherence. The study demonstrated that both the experimental and control groups experienced significant improvements in ART adherence after the intervention. The Wilcoxon signed ranks test results showed highly significant p-values, indicating that these improvements were not due to random chance. The intervention effectively enhanced adherence to ART, which is crucial for managing HIV and maintaining viral suppression.

Interestingly, the Mann-Whitney U test results indicated that before the intervention, the control group had higher ART adherence rates compared to the experimental group. However, after the intervention, the Mann-Whitney U test revealed a significant difference in ART adherence between the two groups. Specifically, the experimental group had higher adherence rates after the intervention compared to the control group.

4. Conclusion

This study demonstrates the positive impact of the intervention on ART adherence in both groups, effectively narrowing the gap in adherence rates. While the control group initially exhibited higher adherence before the intervention, the experimental group surpassed them in adherence after the intervention. These findings highlight the importance of targeted interventions to improve ART adherence among HIV-positive individuals. These findings

are consistent with previous studies that have highlighted the positive impact of empowerment and education interventions on ART adherence [19-20]. Further investigation into the specific components of the intervention and individual characteristics that contributed to this difference could provide valuable insights for future interventions.

5. Limitations

Despite the promising results, this study has some limitations. First, the relatively small sample size might limit the generalizability of the findings to a broader population. Additionally, the study did not assess long-term adherence sustainability beyond the intervention and three months follow-up period, which is critical for understanding the intervention's lasting effects. Future research could benefit from larger sample sizes, longer follow-up periods, and objective measures of adherence.

6. Recommendations

Based on the study findings and limitations, several recommendations can be made. Given the positive impact of the skill acquisition intervention, healthcare providers and policymakers should consider scaling up similar interventions in HIV care and support programmes to improve adherence rates among HIV-positive individuals. Future studies should incorporate longer follow-up periods to assess the sustainability of adherence improvements over time. Furthermore, the gender disparity has been observed in this study and therefore interventions that consider gender-specific barriers to adherence will be of immense benefit. Last but not least, addressing economic disparities and providing further financial support to individuals with limited income could further improve adherence rate.

References

[1]   Bhaskaran K, Hamouda O, Sannes M, Boufassa F, Johnson AM, Lambert P C, et al. Changes in the risk of death after HIV seroconversion compared with mortality in the general population. JAMA, Pub. Med. 2008; 300 (1): 51- 9.

[2]   Wing EJ. HIV and aging. Int. J. Infect. Dis. 2016; 53: 61–68.

[3]   Simona AI, Diana GI, Gheorghita J. improving the adherence to antiretroviral therapy, a difficult but essential task for a successful HIV treatment-clinical points of view and practical considerations. Front Pharmacol. 2017; 8: 831.

[4]   Miller LG, Hays RD. Adherence to combination antiretroviral therapy: synthesis of the literature and clinical implications. AIDS Read. 2000; 10: 177–85.

[5]   Chesney M. Adherence to HAART regimens. AIDS Patient Care & STDS. 2003; 17, 169–177.

[6]   Ortego C, Huedo-Medina TB, Santos P, Rodrígue E, Sevilla L, Warren M, et al. Sex differences in adherence to highly active antiretroviral therapy: a meta-analysis. AIDS Care. 2012; 24, 1519–1534.

[7]   Murphy EL, Collier AC, Kalish LA, Assmann SF, Para MF, Flanigan TP, et al. Highly active antiretroviral therapy decreases mortality and morbidity in patients with advanced HIV disease. Ann Intern Med. 2001; 135 (1): 17–26.

[8]   Glikman D, Walsh L, Valkenburg J, Mangat PD, Marcinak JF. Hospital-based directly observed therapy for HIV-infected children and adolescents to assess adherence to antiretroviral medications. Pediatrics. 2007; 119: 1142–1148.

[9]   McKinney RE Jr, Rodman J, Hu C, Britto P, Hughes M, Smith ME et al. Long-term safety and efficacy of a once-daily regimen of emtricitabine, didanosine, and efavirenz in HIV-infected, therapy-naive children and adolescents. Pediatric AIDS Clinical Trials Group Protocol P1021. 2007; 120 (2): e416–23.

[10] Puccio JA, Belzer M, Olson J, Martinez M, Salata C, Tuker D et al. The use of cell phone reminder calls for assisting HIV-infected adolescents and young adults to adhere to highly active antiretroviral therapy: a pilot study. AIDS Patient Care STDS. 2006; 20 (6): 438–44.

[11] Rogers AS, Miller S, Murphy DA, Tanney M, Fortune T. The TREAT (Therapeutic Regimens Enhancing Adherence in Teens) program: theory and preliminary results. J Adolesc Health. 2001; 29 (3 Suppl): 30–38.

[12] Martins NI, Damian KA. Empowering the rural poor through vocational skills acquisition: Nasarawa state in focus. International Journal of Development and Sustainability. 2017; 6 (3): 115-129.

[13] Spratt ES, Papa CE, Mueller M, Patel S, Killeen T, Maher E, et al. Using Technology to improve adherence to HIV medications in transitional age youth: Research Reviewed, Methods Tried, Lessons Learned. J Gen Med. 2017; 1 (1): 1 – 8.

[14] Ratchaneekorn K, Nongyao K, Jittaporn C, Richard MG. Effect of an empowerment intervention on antiretroviral drug adherence in Thai youth. Behavioural Medicine: 2015; 41 (4): 186-194.

[15] Adewale B, Raheem T, Osuolale K, Chukwu E, Liboro G, Odewale E, et al. Utility of temperature measurement using non-contact infrared thermometer in detecting elevated temperature as an infection control measure in the era of Covid-19. African Journal of Medical and Health Sciences. 2021; 20 (6): 80- 84.

[16] Coronavirus disease 2019 (covid-19) and HIV: key issues and actions. Prepared by The UNAIDS Cosponsors Regional Group (UCRG) for Latin America and the Caribbean. 20 March, 2020.

[17] Sharma SK, Mudgal SK, Thakur K, Gaur R. How to calculate sample size for observational and experimental nursing research studies? Natl J Physiol Pharm Pharmacol 2020; 10 (01): 1-8.

[18] Mills EJ, Nachega JB, Bangsberg DR, Singh S, Rachlis B, et al. (2006). Adherence to HAART: a systematic review of developed and developing nation patient-reported barriers and facilitators. PLoS Med, 3 (11), e438. doi: 10.1371/journal.pmed.0030438.

[19] Sabin LL, Mansfield L, DeSilva MB, Vian T, Li Z, et al. (2018). Why it Worked: Participants' Insights into an mHealth Antiretroviral Therapy Adherence Intervention in China. Open AIDS J, 12, 20-37.

[20] Ware NC, Idoko J, Kaaya S, Biraro IA, Wyatt MA, et al. (2009). Explaining adherence success in sub-Saharan Africa: an ethnographic study. PLoS Med, 6 (1), e11.