

Cost-effectiveness and Feasibility of Conditional Economic Incentives and Motivational Interviewing to Improve HIV Health Outcomes of Adolescents Living with HIV in Anambra State, Nigeria

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Abstract

Background: In sub-Saharan Africa, there is increasing mortality and morbidity of adolescents due to poor linkage, retention in HIV care and adherence to antiretroviral therapy (ART). This is a result of limited adolescent-centred service delivery interventions. This cost-effectiveness and feasibility study were piggybacked on a cluster-randomized trial that assessed the impact of an adolescent-centred service delivery intervention. The service delivery intervention examined the impact of an incentive scheme consisting of conditional economic incentives and motivational interviewing on the health outcomes of adolescents living with HIV in Nigeria.

Method: A cost-effectiveness analysis from the healthcare provider's perspective was performed to assess the cost per additional patient achieving undetected viral load through the proposed intervention. The cost-effectiveness of the incentive scheme over routine care was estimated using the incremental cost-effectiveness ratio (ICER), expressed as cost/patient who achieved an undetectable viral load. A one-way sensitivity analysis examined the effect of the regimen change to Dolutegravir-based combination (which occurred during the trial) on the ICER. An in-depth interview was conducted on the healthcare personnel in the intervention arm to explore the feasibility of implementing the service delivery intervention in HIV treatment hospitals in Nigeria.

Result: The ICER of the intervention compared to routine care was US\$1,593.2 per additional patient with undetectable viral load. Going by the cost-effectiveness threshold suggested by the World Health Organization (WHO) Commission on Macroeconomics and Health, the intervention was very cost-effective as it costs less than one Nigerian GDP/capita of US\$2028.2. The effect of regimen change increased the ICER to US\$2,094.38. Healthcare professionals reported that patients' acceptance of the intervention was very high.

Conclusion: The conditional economic incentives and motivational interviewing were very cost-effective. Patients' acceptance of the intervention was very high. However, healthcare professionals believed that sustaining the intervention may be difficult unless factors such as government commitment and healthcare provider diligence are duly addressed.

Trial registration This trial is registered in the WHO International Clinical Trials Registry through the WHO International Registry Network (<https://pactr.samrc.ac.za/>: PACTR201806003040425).

Background

Adolescents living with HIV (ALHIV) have been tagged with worse treatment outcomes [1], with no evidence of practicable cost-effective interventions [2]. Previous studies showed that they had poor inclusion in care, poor knowledge of their HIV status, poor linkage to HIV care and their retention-in-care suffered greater attrition than other age groups [2–4]. All these have led to very poor adherence to antiretroviral therapy, lower rates of viral load suppression and an increase in HIV-related morbidity and mortality in the adolescent population worldwide [2]. These outcomes are worse in sub-Saharan Africa

where more than eight out of every ten of the world's ALHIV live [2]. Adherence challenges identified include poverty, poor mental and physical health, the lack of a school system that is responsive to their needs, challenges in status disclosure, various forms of stigmatization, and challenges of medical adherence leading to the need for close monitoring [5].

Retention in HIV care is vital for achieving antiretroviral therapy (ART) adherence and viral suppression. Through clinical visits, patients in care are encouraged to initiate ART, refill their medications, medication side effects monitored, treatment failures diagnosed, and when necessary, switched to second- or third-line ART regimens. Retention-in-care, therefore, helps patients to maintain high medication adherence, thereby achieving viral suppression, improving health outcomes, reducing individual and population costs and reducing the risk of horizontal transmission.

Retaining patients in care over time is problematic especially for the highly vulnerable adolescents. Poor retention-in-care and adherence to ART in adolescents may be connected to the unique psychological, social and health needs that are peculiar to the adolescent stage [6]. These coupled with lack of interventions channelled to the care of adolescents [2] have led to a 30% increase in new HIV infections among adolescents and youth (15–24 years) as well as increased HIV-related mortality and morbidity in adolescents with HIV unlike in other age groups [3], making HIV the second leading cause of death among adolescents globally [6].

Despite the increasing number of HIV-focused service delivery interventions, adolescents are constantly left behind in HIV care services that would improve diagnosis, linkage to care, adherence to ART, and retention-in-care [7]. Since adolescence is a growth phase with specific healthcare and developmental needs [8], it is imperative to have interventions tailored to meet the unique needs of this population.

Various interventions to improve adolescents' ART adherence and retention in care have been studied. MacPherson *et al* in 2015 carried out a systematic review to evaluate the effectiveness of service delivery interventions to improve adolescents' linkage, retention and adherence to ART [1]. Eleven studies carried out in the last thirteen and a half years from the year of the study were reviewed, with the majority of them being conducted in high-income countries. Only 3 studies were conducted in countries with a high burden of the HIV epidemic and where there is a higher concentration of the world's HIV-positive adolescents. Service delivery interventions identified were peer support, motivational interviewing, counselling, education, directly observed treatment and financial incentives.

The combination of conditional economic incentives (CEI) and motivational interviewing are theoretically promising interventions to improve HIV health outcomes in adolescents. While CEI produces an immediate improvement, motivational interviewing brings about long-lasting change as good behaviour is internalized [6]. However, in a resource-limited setting, it is important to determine whether allocating resources to these interventions would yield good value for money. Cost-effectiveness analysis (CEA) is the most common health economic evaluation tool used to compare at least two interventions, to identify the intervention that has a higher likelihood of producing the greatest health gains with the least resources [9]. Incremental cost-effectiveness ratio (ICER) is used to compare and rank alternative

interventions. Thus, we used cost-effectiveness analysis to assess whether the combination of CEI and motivational interviewing as a service delivery intervention applied to Nigerian HIV adolescents will produce good value for money. Additionally, we examined the feasibility of implementing the interventions in Nigerian HIV treatment hospitals by interviewing healthcare professionals to learn their experience with implementing the intervention. The results of this study will enable healthcare policymakers to take a decision on the use of the incentive scheme (conditional economic incentives and motivational interviewing) to improve HIV health outcomes of adolescents living with HIV.

Study Aim

This study is based on a cluster randomized controlled trial and aimed to assess the cost-effectiveness and feasibility of conditional economic incentives coupled with individualized face-to-face motivational interviewing on HIV health outcomes (including undetected viral load, retention-in-HIV care and adherence to antiretroviral therapy) of adolescents living with HIV in Anambra State, Nigeria.

Methods

Description of the cluster-randomized trial

This research was piggybacked on a cluster randomized controlled trial (RCT). The trial was registered in the WHO International Clinical Trials Registry through the WHO International Registry Network on 02/02/2018 (PACTR201806003040425).

Ethical permission for the cluster-randomized trial was gotten from Nnamdi Azikiwe University Teaching Hospital Ethics Committee (NAUTH/CS/66/VOL11/092/2018/052).

Twelve hospitals were selected from HIV treatment hospitals in Anambra state that were registered by the National Agency for the Control of AIDS (NACA) to render such services and were regarded as the clusters.

The hospitals were then paired as a unit according to the type of hospital (e.g. secondary or tertiary). The units were randomly allocated to either the intervention or control group, such that each group had six hospitals. The trial had two periods (intervention and post-intervention) and each period had a duration of a year. The intervention was applied to the intervention group while the control group received routine HIV-care. The intervention group received US\$5.6 when the viral load is < 20 copies/ml for the first three months, received US\$2.8 if the viral load remained suppressed for the next three months and the next 6 months, and then received US\$5.6 if the viral load remained < 20 copies/ml for the next one year. This cash reward was linked to attaining undetected viral load and also attending motivational interview sessions on each clinic visit. Further information on the methods can be found on the trial protocol [6], while the completed trial is currently under peer review for publication (unpublished data).

The primary outcome was the difference in the number of participants with an undetected viral load between the two groups (< 20 copies/ml) at the 12th month and 24th month. The secondary outcomes were the adherence to ART and hospital appointment, CD4 + count outcome and retention in care.

Cost-effectiveness analysis

Costing was based on a health provider's perspective and the base year for the analysis was 2019. The type, quantity and unit prices of all resources used during the trial for the intervention arm and control arm were documented prospectively.

Financial accounts of the hospitals used for the study and patient case folders were also reviewed where necessary.

The costs of the research exercise such as the cost of data collection by the study team were excluded. To determine the cost for each resource used in the trial, we multiplied the quantity of resource consumed by unit cost. The total cost was derived by adding up all the individual costs. All costs were expressed in 2019 United States (US) Dollars at an exchange rate of NGN360 per US Dollar (US\$).

The personnel cost per HIV client in all the 12 hospitals was calculated based on the annual salaries as provided by the healthcare personnel.

The average cost of motivational interviewing was then obtained by calculating the proportion of the average annual salary that accounts for the personnel's time invested in offering motivational interviewing during the one year trial period.

Antiretroviral (ARV) medications used by patients were collected during the trial from resource use data and their costs estimated using prices obtained from the Global Fund's Pooled Procurement Mechanism Reference Pricing for ARVs[10]. The estimation of costs of additional non-ARVs was based on the buyer's median price of the International Medical Products Price Guide, [11]. This was inflated to 2019 prices at a 5% discount rate [12].

The average cost of laboratory test (viral load) was obtained from the Virology Laboratory of Nnamdi Azikiwe University Teaching Hospital while that of CD4 count was obtained from the CD4 laboratories of St. Charles Borromeo Hospital, St Joseph Adazi-Nnukwu and Nnamdi Azikiwe University Teaching Hospital where the tests were carried out.

The cost per outpatient visit at the health centres was estimated using the WHO-CHOICE estimates for service delivery [13]. This was also inflated to 2019 prices. The inpatient costs were derived from estimations of the cost of the basic healthcare package for hospitalized patients, including additional laboratory tests.

Other recurrent costs obtained were the cost of transportation of samples to the designated laboratories for investigation and the cost of phone calls to track patients.

Details of the cost analysis are shown in supplementary file 1.

A cost-effectiveness analysis was conducted to assess the cost per additional patient achieving viral suppression through the proposed intervention. The cost-effectiveness of the incentive scheme and motivational interviewing over routine care was estimated using the ICER, expressed as cost/patient who achieved an undetectable viral load.

Given that the trial occurred during the period that HIV patients were transitioned to Dolutegravir-based combination, a one-way sensitivity analysis was conducted to examine the effect of the regimen change on ICER. The cost-effectiveness threshold used was the WHO-CHOICE GDP-related thresholds which states that interventions costing less than average per capita income per DALY averted is very cost-effective, those costing less than three times average per capita income per DALY averted are considered cost-effective, and those that exceed this level are considered not cost-effective [14].

Assessment of feasibility

Consent was obtained from all subjects in the trial. A qualitative study using an in-depth interview (IDI) was conducted on the healthcare personnel in the intervention arm, who administered the incentive scheme in the trial (three from each hospital/cluster). The IDI guide used was developed using the Pathfinder International Tool Series guideline on conducting IDI [15]. The IDI was a phone interview during which notes, and audio digital recording was taken. All recorded data were independently transcribed verbatim into the English language. A thematic content approach, guided by the Graneheim and Lundman framework, was utilized for analyzing the qualitative data [16]. Responses from the IDIs were read through systematically and repeatedly to get familiar with them, as well as to identify the meaning units. A meaning unit was identified as a string of the text that expressed a single coherent thought, up to the point where the coherent thought changed. The meaning units correspond to different codes which describes the idea or feeling expressed in the meaning units. Codes concerning the same subject were grouped into categories called themes. Information obtained during the IDIs was analyzed and merged according to the codes, themes and sub-themes. The original data were also reassessed after analysis to detect any ideas or information that may have been missed.

Results

Cost-effectiveness analysis

The effectiveness of the intervention is shown in Table 1. The difference in the percentage of participants with an undetected viral load between the participants in the intervention group and those in the control group was 11.7%.

However, the difference in the percentage of participants with an undetected viral load between the participants in the intervention group and those in the control group reduced to 8.9% when adjusted for study participants with regimen change to Dolutegravir-based combination.

The intervention cost a total of US\$356.7 per patient/year while routine care cost a total of US\$170.3 per patient/year.

The biggest cost component in the intervention arm was viral load tests as the participants in the intervention arm had 4 viral load tests per year compared to the participants in the control arm that had one viral load test per year.

Further details of the cost analysis are shown in Table 2.

The ICER of the intervention compared to the routine care was US\$1,593.2 per additional patient with undetected viral load. Adjusting the effectiveness outcome for regimen change to Dolutegravir-based combination (i.e. one-way sensitivity analysis) increased the ICER to US\$2,094.38 per additional patient with undetected viral load (Table 2).

Table 1

Effectiveness of the intervention on the proportion of subjects with undetected viral load (≤ 20 copies/ml)(N = 246)

	Intervention		Control		P value
	Number with undetected viral load (%)	Change over 12 months ($E_{12}-E_0$)	Number with undetected viral load (%)	Change over 12 months ($E_{12}-E_0$)	
At baseline	26/119 (21.8%)	-	54/127 (42.5%)	-	
At 12 months	38/119 (31.9%)	10.1%	52/127 (40.9%)	-1.6%	0.15
At 12 months adjusted*	28/77 (36.4%)	14.6%	27/56 (48.2%)	5.7%	0.12

*Adjusted for study participants with regimen change to Dolutegravir based combination.

Table 2
Average cost/patient

Cost item	Base Case (USD)	Data source
Intervention		
Outpatient cost	1.187	WHO-CHOICE estimates 2007
Inpatient cost	0.91	Healthcare providers
Motivational interviewing	0.0032 (0.0028)	Healthcare providers
Economic incentives	4.7	Healthcare providers
CD4 Count test	22.2	Healthcare providers
Viral Load test	133.3	Healthcare providers
Transportation of samples to lab	22.2	Healthcare providers
Medication costs	142.5	International Medical Products Price Guide; Global Fund, 2020
Phone calls to track patients	0.19	Healthcare providers
Additional laboratory investigations	29.48	Healthcare providers
<i>Total</i>	<i>356.7</i>	
<i>Control arm</i>		
Outpatient cost	1.187	WHO-CHOICE estimates 2007
Inpatient cost	0.00	Healthcare providers
CD4 Count test	5.5	Healthcare providers
Viral Load test	33.3	Healthcare providers
Transportation of samples to lab	5.5	Healthcare providers
Medication costs	118.4	International Medical Products Price Guide; Global Fund, 2020
Phone calls to track patients	0.15	Healthcare providers
Additional laboratory investigations	6.22	Healthcare providers
<i>Total</i>	<i>170.3</i>	

Cost item	Base Case (USD)	Data source
ICER = US\$1,593.2/patient with undetected viral load.		
ICER of one-way sensitivity analysis = US\$2,094.38/patient with undetected viral load		

Feasibility studies

Out of eighteen healthcare professionals in the intervention arm of the study, fifteen of them (which included 4 Doctors, 4 Pharmacists, 1 Nurse and 6 Medical Laboratory Scientists) participated in the in-depth interview.

The other three were on several attempts not available for the interview. The responses to the interview questions were classified using the thematic content analysis into major themes, including their sub-themes (Table 3).

Table 3
Themes and sub-themes from the interview

S/N	Theme	Sub-Theme	No of Persons Who Reported this
1.	Improved adherence	<ul style="list-style-type: none"> • The incentives encouraged them to adhere to treatment • The consequent reduction in viral load encouraged them the more • The adolescents became more open during motivational interviewing • Peer pressure from those who received the incentives encouraged others • The economic incentives spurred them to keep monthly appointments • Some of them used their incentives to supplement their transportation fares as this was a challenge 	15
2.	Attitude towards the disease	<ul style="list-style-type: none"> • The adolescents and their parents/caregivers gained a better understanding of the disease condition • A few of them showed a negative attitude by being rebellious, especially those who still blamed their parents for infecting them 	15
3.	Sustainability concerns	<ul style="list-style-type: none"> • Intervention implementation is very possible but would require a deep sense of commitment from the government, healthcare providers and other actors • Intervention may not be feasible in the long run • Too much workload on healthcare staff thus may require an increase in remuneration • Lack of political will from the government as other costs of HIV care are already being covered by the government • Economic incentives may not be available in a real-life setting, therefore other types of incentives may have to be considered for example skill acquisition programs for the adolescents. • Modification of the traditional adherence counselling to an intensified adherence counselling such as motivational interviewing. • May require capacity building for the motivational interviewers 	15
4.	Healthcare provider-adolescent relationship	<ul style="list-style-type: none"> • The motivational interviewing and regular visits brought about an improved relationship between the healthcare providers and the adolescents 	10

S/N	Theme	Sub-Theme	No of Persons Who Reported this
5.	Caregivers' influence	<ul style="list-style-type: none"> • Some adolescents depend on their caregivers who may not be disposed to bring them to the hospital for care and for laboratory investigations when needed. • Poor disclosure habit which inhibited the adolescents' proper understanding of the disease condition. 	15
6.	Cost implication	<ul style="list-style-type: none"> • Phone calls and short message service (SMS) to remind the adolescents of their monthly appointments/laboratory investigations • Use of phone consultations for those living far away. 	13

Seven major themes and twenty-six sub-themes were identified. The identified themes were improved adherence, attitude towards the disease, sustainability concerns, healthcare provider-adolescent relationship, caregivers influence, cost implications and intervention implementation challenges.

Some of the excerpts from the themes as stated by the healthcare professionals interviewed are shown below:

Improved adherence

From the perspective of the healthcare professionals interviewed, the economic incentives and motivational interviewing played a huge role in improving ART adherence and reducing viral load. Even though not all the adolescents achieved the target viral load of < 20copies/ml, there was a marked drop in the HIV- RNA (Human Immunodeficiency Virus-Ribonucleic acid) of most of the adolescents. One of the trial implementation doctors stated the following

"Before we started implementing the intervention, many of the adolescents always had one excuse or the other for not coming for appointments. However, when they were made to understand what the program was all about, and that there would be incentives for those whose viral loads were < 20copies/ml, they became interested and increased the frequency at which they presented for their appointments." (Doctor, Immaculate Heart Hospital and Maternity, Nkpor, Nigeria).

Positive peer group influence was observed as an adherence-stimulating factor as those who didn't receive the monetary benefits felt compelled to do so on seeing their peers rewarded. A medical laboratory scientist involved in the trial stated that:

"The economic incentives spurred them to adhere to their treatments, especially those who had not been adhering. Out of 14 enrolled adolescents in our arm, 9 achieved viral load suppression. Those who didn't

achieve suppression felt remorse on seeing others get monetary benefits and were challenged to do better.

The parents/caregivers of those who did well were very happy and more willing to encourage their children/wards”.

(Medical Laboratory Scientist, Community Health Centre, Neni)

Attitude towards the disease

The intervention brought about a positive attitude in the participants. When the adolescents got enrolled in the study, they were made to understand what it was about. As they experienced a drop in their viral load, they understood the relationship between adherence to treatment and virological and immunological outcomes. They, therefore, became more optimistic about their health outcomes. A medical laboratory scientist involved in the trial stated that

“Before their enrollment into the study, some adolescents didn’t know what they were taking drugs for. But during the intervention implementation, we made them understand how the ART worked and how their health conditions would improve upon adhering to treatment. Hence, they became eager to take charge of their health.”(Medical Laboratory Scientist, Community Health Centre, Neni).

Some participants in the intervention still displayed a negative attitude.

Although there was high patient acceptability of the intervention, a few others who still blamed their parents for infecting them were indifferent. A doctor involved in the trial informed us that:

“Some of the adolescents still exhibited a nonchalant attitude towards the incentive scheme. They still felt animosity towards their parents for infecting them and felt they would, therefore, be doing them a favour by taking their drugs religiously.” (Doctor, Nnamdi Azikiwe University Teaching Hospital, Nnewi).

Healthcare personnel and HIV adolescents’ relationship

The motivational interviewing fostered the relationship and allowed for better interaction between the healthcare providers and adolescents. A pharmacist involved in the trial implementation stated that

“The monthly motivational interviewing made the adolescents open up the more and enabled me to gain a better understanding of the challenges to adherence that they faced. Therefore, we were able to work together to address these challenges for a better outcome.” (Pharmacist, Nnamdi Azikiwe University Teaching Hospital, Nnewi)

Sustainability of the intervention

Most of the interviewees saw the intervention as worthwhile but expressed doubts about the possibility of sustaining the intervention in the long run unless there is a great sense of commitment on the part of both the government and the healthcare providers. A pharmacist and a nurse involved in the trial implementation stated the following

“This intervention and its benefits can actually be maintained over time. The implementers which include the government, healthcare providers and even the beneficiaries (ALHIV) need to be truly and actively committed. (Pharmacist, Nnamdi Azikiwe University Teaching Hospital, Nnewi).

“The government already has a lot on their plates as regards HIV/AIDS management. Some of the costs of care that were initially borne by HIV support agencies are now born by the HIV clients, Therefore, I don’t think it will be feasible for the government to sustain these economic incentives in the long run”. (Nurse, St. Joseph’s Hospital Adazi-Nnukwu)

One of the interviewees, however, stated that instead of monetary rewards which may be stopped halfway, other forms of incentives which can help build entrepreneurial skills in these adolescents and thus a source of financial empowerment could be combined with motivational interviewing to achieve the intervention sustainability. He said:

“Sustainability would require more than financial incentives. Skill acquisition programs could be designed for these adolescents as a way of empowering them to make some money to take care of their transportation fares to the hospital”. (Doctor, Community Health Centre, Neni)

Another participant suggested that an increase in the healthcare personnel’ remuneration may boost their morale as it will be extra work added to their already loaded schedule.

She said:

We already have a lot of workloads here at the HIV unit, therefore additional remuneration could serve as a form of encouragement”. (Pharmacist, General Hospital Onitsha)

Caregiver’s influence

Because younger adolescents lacked the autonomy to get themselves to the hospitals for appointments or laboratory investigations, they had to wait on their caregivers who may be pre-occupied with other activities/engagements.

A medical laboratory scientist involved in the trial stated that

“The adolescents didn’t present for laboratory tests as and when due. Most of them depended on their parents who may not be disposed to bring them to the hospital when they are supposed to.”(Medical Laboratory Scientist, St. Charles Borromeo Hospital, Onitsha)

Cost implications

Fear of stigmatization was found to influence parents’/caregivers’ choice of hospitals to enrol their children/wards in. They, therefore, preferred hospitals far away from their neighbourhood. This came with the challenge of the high cost of transportation, thus impacting negatively on their attendance at the monthly appointments. A doctor involved in the trial informed us that

“Some of the caregivers are afraid of being seen as HIV positive when they are not.

Some who do not want their children/wards to be identified by friends or relatives as HIV client would rather enrol in hospitals far from their places of residence.

This made it difficult for them to keep up with their monthly appointments due to the increased cost of transportation.” (Doctor, Immaculate Heart Hospital and Maternity, Onitsha)

Also, the healthcare providers had to continuously use phone calls or text messaging to remind the adolescents and/or their parents/caregivers about monthly appointments/laboratory investigations. A nurse involved in trial implementation stated that:

“I always send text messages or make phone calls to remind them to come for monthly appointments and they are always happy to attend because of the expectations of winning incentives.” (Nurse, St. Joseph’s Hospital, Adazi-Nnukwu).

Intervention implementation challenges

A lot of challenges were experienced by the program implementers during the trial and they include low attendance for the quarterly laboratory investigations, distance barriers, death of some clients, failure of samples to show results and difficulties in tracing lost-to-care clients. A medical laboratory scientist stated that

“Some of the adolescents didn’t understand that the laboratory investigations benefitted them more than it even benefitted the investigators. They felt that they were being pressured to attend compulsory laboratory investigations.” (Medical Laboratory Scientist, St. Joseph’s Hospital Adazi Nnukwu, Nigeria)

Some healthcare providers found it difficult to get those who were lost-to-care to initially enrol in the clinical trial and also for continuation in the study for those enrolled as their phone numbers remained unavailable.

A doctor involved in trial implementation stated that:

“Tracking some lost-to-care patients was difficult as some of their phone numbers were unreachable. Some of them were nonchalant and would always give reasons for not coming for appointments.”(Doctor, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria).

Besides, some samples for viral load assay kept failing. Therefore, it was burdensome for the affected adolescents to continue coming for repeated laboratory investigations and yet not knowing his or her viral load status and eligibility for the financial incentive. A laboratory scientist involved in the trial stated that:

A particular sample kept on failing on the test without a reason. The client felt reluctant to repeatedly present for more tests. An investigation is still on however to know the cause of that in a particular client in my facility. Only his baseline viral load result was successful.” (Laboratory Scientist, Community Health Centre, Neni, Nigeria)

Discussion

This study examined the cost-effectiveness of applying conditional economic incentives and motivational interviewing (Incentive Scheme) to HIV-positive adolescents in Nigeria to improve their health outcomes. This is the first trial to assess the cost-effectiveness of using conditional economic incentives and motivational interviewing to improve the health outcomes of adolescents living with HIV in sub-Saharan Africa. The study also explored the perspective of the healthcare providers on the feasibility of implementing the incentive scheme in Nigerian HIV treatment hospitals.

The incremental cost-effectiveness ratio expressed as the incremental costs per patient with the desired outcome (undetectable viral load) was US\$1,593.2 per additional patient with undetected viral load. Going by the cost-effectiveness threshold suggested by WHO Commission on Macroeconomics and Health, the Incentive Scheme applied in this randomized-controlled trial is very cost-effective as it costs less than Nigeria's GDP/capita of US\$2028.2 [17], for each patient that achieved undetected viral load. The intervention remained cost-effective after adjusting the effectiveness outcome for regimen change to Dolutegravir-based combination (i.e. one-way sensitivity analysis) as the ICER obtained (i.e. US\$2,094.38 per additional patient with undetected viral load) was still less than three times Nigeria's Gross Domestic Product(GDP)/capita of US\$6084.6. Thus, ICER obtained in our study showed that the intervention is very cost-effective. This is particularly so since the future medical cost that will arise from unsuppressed viral load will be averted. Such future medical costs include the cost of treating opportunistic infections, cost of switching to second-line medications which are more expensive, with the associated adverse effects.

On the feasibility assessment, the healthcare providers reported that patients' acceptance of the intervention was very high, as evident from the regular attendance of monthly appointments. We gathered that the views of the healthcare providers on the new intervention could be placed into seven major themes: improved adherence, attitude towards the disease, sustainability concerns, healthcare provider-adolescent relationship, caregivers influence, cost implications and intervention implementation challenges.

A systematic review of 60 articles on the cost-effectiveness of HIV interventions in Africa by Cheese *et al* revealed that HIV prevention strategies such as selective blood safety measures, targeted condom distribution and treatment of sexually transmitted infections prevented HIV/AIDS for USD 11 and a DALY (Disability-adjusted Life Years) averted for USD 1, while single-dose nevirapine, short course zidovudine for prevention of mother-to-child transmission, voluntary counselling and testing and tuberculosis prevention cost below USD 75 per DALY averted [18]. Although the ICER of the intervention obtained in our study was high compared to the aforementioned interventions which used other methods of economic analysis, the Incentive Scheme is of significance given the need for a targeted service delivery intervention for adolescents in HIV care. Service delivery interventions like Incentive Scheme (CEI and motivational interviewing) are essential not only to improve individual health for adolescents living with HIV but also to reduce transmission [6].

The findings from the cluster-randomized trial and the view of the healthcare providers suggest that the Incentive Scheme increased the virologic outcomes of adolescents living with HIV. Previous studies on interventions to improve adolescents' adherence to therapy have shown that monetary rewards influence behaviours. In a single-centre adherence intervention combining financial incentives (total expenditure £1,350) with motivational interviewing for adolescents with perinatally-acquired HIV infection, there was improved virological outcomes [19]. For young people who may not fully comprehend the implication of having to live with the virus, with the consequent lifelong use of medications, low adherence to regimen would be very common. Therefore, to increase adherence rates, it may be necessary to reward them for doing what they ought to be doing anyway.

In our trial, the monetary rewards attracted the adolescents to the scheme, while the motivational interviewing provided an avenue for them to connect with the healthcare providers.

This connection brought about an intrinsic motivation that would sustain lifelong positive behaviour change. The client-centred counselling style of motivational interviews likely helped the patients move away from a state of indecision and towards motivation to making positive decisions.

The expectation of monetary rewards was an extrinsic motivator. Unfortunately, it is known that cash incentive may not be able to bring about lifelong positive behaviour change. A few post-intervention evaluations found that adherence rates diminish when interventions are withdrawn [20, 21]. Motivational interviewing was found to foster a better relationship between healthcare providers and adolescents. It has also been found effective in influencing health behaviours, improving adherence and changing harmful lifestyle among people with chronic diseases [22]. In an integrative review to examine the use of motivational interviewing to improve health outcomes in persons living with HIV, it was discovered that studies using motivational interviewing either alone or in conjunction with other service delivery interventions, recorded improved adherence, decreased depression, and decreased risky sexual behaviour [23].

The IDI participants also reported a positive relationship between motivational interviewing and treatment adherence.

It also improved the adolescents' understanding of their disease condition.

The interventions hold promising prospects, but doubts have been expressed by the IDI participants about sustainability.

Although none of them expressed frustrations about any disruptions in clinic workflow during the intervention implementation emanating from the trial, there were concerns about the increase in workload and financial requirements for the incentives in a real-life setting. Therefore, a team of dedicated healthcare providers would be needed to drive the intervention in a real-life setting. Additional remuneration for the staff involved was also recommended. Healthcare staff providing the motivational interviewing needs to exude confidence in their capacity to conduct it. Thus, the capacity building of healthcare staff on motivational interviewing would enhance the impact of the intervention. The skillset required for successful implementation of motivational interviewing includes but not limited to gaining

an understanding of the philosophy behind it, acquisition of basic client-centred counselling skills, as well as recognizing and reinforcing change [24].

Another concern expressed by the health care workers is the financial sustainability of the Incentive Scheme.

We believe that the Incentive Scheme can be sustained financially by incorporating it as one of the social welfare schemes that are operational in Nigeria such as the school feeding programme [25] and *Tradermoni* [26]. The Incentive Scheme could be targeted to assist adolescents who cannot afford transportation fares for hospital appointments or applied to hospitals in rural and poor settings as a way of reducing the cost of implementation. Incentive scheme as social welfare programme will have the dual purpose of improving the health and economic status of the beneficiaries.

The healthcare providers indicated that the orphaned adolescents were cared for by guardians who may have limited earning capacity.

This places immense financial stress on them as much of their income is spent on household expenses. Also, the interviewees stated that the majority of the HIV adolescents came from poor backgrounds and hence have difficulties affording transportation fares to the hospitals. A lot of HIV adolescents need financial support for self-sustenance. A report by the Joint United Nations Programme on HIV/AIDS (UNAIDS) stated that in sub-Saharan Africa, more than 11 million children under the age of 15 have lost at least one parent to HIV/AIDS, with 34 million children being orphaned overall [27].

The study had some limitations. Since the effectiveness outcome was not measured as disability-adjusted life years (DALY) averted, the cost-effectiveness threshold was used approximately to gauge the cost-effectiveness of the intervention. The interview was not all-inclusive as it focused on the healthcare personnel without also exploring the perspectives of the HIV clients who are the direct beneficiaries of the intervention. Therefore, we may have missed some vital information that may enhance or hinder the feasibility of the incentive scheme from the ALHIV. However, the interviewees bared their minds based on their several contacts with the adolescents. Also, the assessment of the effectiveness outcome was on a short-term basis. It was not clear whether the intervention effect could be sustained after intervention withdrawal, in which case the ICER would be lower, translating to a more attractive intervention.

Given the dwindling funding for HIV program, there is a need for careful consideration of any intervention to be included as part of the HIV program.

In this study, we have illustrated how cost-effectiveness analysis can be applied to an HIV service delivery intervention to establish its efficiency. Such analysis will better enable public health decision-makers to determine health interventions that will produce the greatest benefits given resource constraint.

Conclusion

Our results showed that conditional economic incentives and motivational interviewing were cost-effective and have the potential to improve adolescents' HIV outcomes. Patients' acceptance of the intervention was also very high from the perspective of health professionals. However, the health

professionals believed that sustaining the intervention may be difficult unless factors such as government commitment and healthcare provider diligence are duly addressed. We, therefore, conclude that for this service delivery intervention to thrive, the government and all the implementers need to be actively involved in providing these services to adolescents with HIV.

Abbreviations

ART: Antiretroviral Therapy

HIV: Human Immunodeficiency Virus

ICER: Incremental Cost-effectiveness Ratio

IDI: In-depth-interview

WHO: World Health Organisation

NGN: Nigerian Naira

WHO-CHOICE: World Health Organization's Choosing Intervention that is Cost Effective

GDP: Gross Domestic Product

AIDS: Acquired Immunodeficiency Syndrome

ALHIV: Adolescents Living with HIV

CEI: Conditional Economic Incentives

CEA: Cost-effectiveness Analysis

NACA: National Association for the Control of AIDS

NAUTH: Nnamdi Azikiwe University Teaching Hospital

ARV: Antiretroviral

HIV-RNA: Human Immunodeficiency Virus-Ribonucleic Acid

DALY: Disability Adjusted Life Years

QALY: Quality Adjusted Life Years

UNAIDS: Joint United Nations Programme on HIV/AIDS

US: United States

Declarations

Ethics approval and consent to participate: The study was conducted according to the Helsinki Declarations on ethical principles for medical research involving human subjects[28]. The study protocol was approved by the Nnamdi Azikiwe University Teaching Hospital Ethics Committee (NAUTH/CS/66/VOL.11/092/2018/052). Informed consent was obtained from all subjects or, if subjects are under 18, from a parent and/or legal guardian. Unique identifiers and a password-protected database were used to protect the personal information of the study participant. Participants' data were domiciled with the Principal Investigator. Participants were free to purposely leave the study at any time, without any effect on the care received in the study hospital. Ethical approval for any amendments to the protocol was sought before implementing any changes when necessary.

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analysed during this study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: OIE, CJO, CEO and MA designed the study. OIE, CJO, MA and SK implemented the study. PUE and GUE supervised study implementation. OIE, CJO and CEO analysed the study data. OIE and CJO drafted the first protocol. All authors participated in reviewing the final version to be published. All authors read and approved the final version of the protocol.

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