EFFECTIVENESS OF OPTION B+ IN REDUCING MOTHER-TO-CHILD TRANSMISSION OF HIV: A RETROSPECTIVE COHORT STUDY OF PREGNANT WOMEN IN 6 PUBLIC HEALTH FACILITIES IN LUSAKA, ZAMBIA

Original Article

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Most countries in sub-Saharan Africa were encouraged to adopt WHO recommended Option B+ as a solution to ending mother to child transmission of HIV, but there is a general fear that the evidence for its effectiveness has not fully been demonstrated in different settings. Option B+ was recommended over the other options (A and B) because it would offer long life protection to women even after birth. This would result in suppressed viral load and thus making women live a normal life free of opportunistic infections. Option B+ is an intervention that ensures administering of life-long HIV treatment to HIV infected pregnant women regardless of their CD4 count. Zambia has a generalized HIV epidemic and thus programs that focus on reducing mother to child transmission of HIV ought to have clear evidence of the effectiveness of new interventions so as to correctly focus interventions.

Option A

Under option A, long life anti-retro therapy (ART) provided when CD4 count is ≤350 or WHO stage 3 or 4. In cases where CD4 >350, and WHO stages 1 and 2, antenatal and intrapartum prophylaxis (AZT, NVP, TDF/FTC) provided and this would be extended to infants using NVP syrup for breast feeding infants.

Option B

Under option B, all HIV-infected pregnant women to be initiated on ART regardless of CD4 count. Those with CD4 ≤350, or WHO stage 3 or 4, would be initiated on life-long ART and those with CD4 >350 and WHO stages 1 and 2 to stop ART after delivery if not breast feeding, or after cessation of breast feeding.

Option B+

Option B+ implies administering of life-long ART for all HIV infected pregnant women regardless of CD4 count.

The objective of the study was to compare the incidence of mother-to-child transmissions of HIV infant infections between options A, B and B+ cohorts at six (6) weeks after birth in selected facilities of Lusaka District in Zambia.

Using a retrospective cohort research design, clinical records of HIV+ positive women and their infants drawn from 6 public health facilities of Lusaka were analysed. A two-step analysis was used. The first step involved a bivariate analysis to determine the relationship between the infant's HIV status at 6 weeks and the mother's demographic characteristics. In addition, the relationship between lost to follow up and (prevention of mother to child transmission (PMTCT) options (i.e., options A, B and B+) was analysed. In the second approach, logistic and multinomial regression were used to measure the likelihood of the infant being HIV positive as a function of independent variables options A, B and B+.

The study findings were that options A and B+ recorded 6% infant infections whereas option B at 13%, yielded the highest rate of HIV infection. Attrition measures the rate at which people are lost from the continuum of care due to death, refusals, transfer outs and in assessing attrition levels, Option A recorded the least deaths at 21% compared to 39% in option B and 37% in option B+. Option B+ recorded 39.6% transfer outs (HIV positive pregnant women who move from one facility to another) compared to 24.7% in option B and 30.9% in option A. The results also show that Option A was just as effective as that of option B+.

Conclusion: Antiretroviral treatment (ART) and other effective interventions for the PMTCT can reduce this risk of HIV infection to below 5%. Therefore, option B+ results from the study at 6% infant infections show that the initiative has potential of reducing the HIV burden in Zambia and thereby contributing favourably to the HIV free generation dream. Support activities that ensure less attrition are critical in ensuring successful implementation of prevention interventions so as to reduce transmission of HIV in the target population.

Introduction

With the HIV prevalence rising among adolescents and youth, there is a corresponding increase in the number of children under 5 years of age infected with HIV [2]. Mother-to-child transmission (MTCT) of HIV accounts for over 90% of these cases. The risk of HIV transmission from mother to child, without preventive interventions, ranges from 15% to 40%

[1]. Fasawe, O., et al, in their analysis suggested that Option B+ can be a cost-effective strategy especially with integration of HIV prevention and treatment efforts towards the sole aim of achieving Millennium Development Goals 4, 5 & 6 as well as ensuring universal access to ART [3]. In the case of Malawi, Option B+ was considered a cost-effective strategy for ensuring universal access to ART for PMTCT. This led to significant increases in women who initiated ART during pregnancy [4]. There are studies that demonstrated the lowest risk of transmission among women who initiate ART before conception in comparison with those who initiate ART during pregnancy [5].

Exploring the performance of the option B+ initiative in comparison with the previous interventions, presents a great opportunity to review and strengthen current and future programs. A clear understanding of both infant and maternal outcomes is helpful to ensure the realization of an AIDS free generation. In PMTCT, one of the major goals is to ensure that children born from HIV+ mothers are free of infections. Success of PMTCT programs is measured by exploring the rate of infant survival owing to being born without infection. In a country like Malawi, successful implementation of Option B+ brought about increased availability, accessibility and utilisation of PMTCT services. The main driver of the success was the rapid expansion of integrated PMTCT/ART services to all Maternal, Neonatal and Child Health (MNCH) sites [2].

Methods

Study design

A retrospective cohort study was adopted. Routinely collected health facility cohort reports and medical records that are validated for quarterly reporting were used to review the incidence of mother to child transmission (MTCT) among three cohorts that were formed based on treatment options (Options A, B and B+) prescribed. Live infants born from HIV+ pregnant women from the selected cohorts were also included in the study.

Data were collected from medical records for Option A and Option B cohorts that received services at the health facility during the period of 1st January 2012 to 31 December 2012 and the Option B+ Cohort that received services at the health facility during the period of 1st January 2014 to 31st December 2014. The differences in time periods arises from the fact that the PMTCT initiatives were not administered at the same time. Loss to follow-up (LTFU) was defined as HIV positive pregnant women who upon initiating ART did not return for continued services for over a period of three (3) months or 90 days.

Study setting

The study was conducted in predominantly low-income, high-population density urban clinic settings of Lusaka, Zambia. Lusaka is comprised of multilingual ethnic groups, with Bemba and Nyanja being the most widely spoken local languages. [6].

Sampling method

A /list of the f pregnant women in the clinical catchment areas was subsequently narrowed down to those that were HIV positive. Drawing from a total number of 23 government owned health facilities that reported their PMTCT 2014 annual program results (APR) to PEPFAR Zambia, five health facilities, which implemented prior to the commencement of option B+, and started the new initiative were selected using systematic sampling.

Sample size and selection procedure

A two-stage sample design was adopted where the first stage health facilities were selected from a frame of 23 facilities. At the second stage persons/medical records were selected from each of the selected health facilities randomly.

In this regard, sampling started by selecting an element (health facility) from the list at random. The random start was the number randomly selected between 1 and thereafter every kth element in the frame was selected until the required sample size was reached, where k, is the sampling interval: This was calculated as =N/n; where n is the sample size, and N is the population size. Therefore, with 23 facilities k was every 5th healthy facility until a sample size of 5 was reached.

The level of significance ($p<0.05$), Power of 80%, the standard deviation and understanding of underlying event rate in the population were considered during sample calculation. The formula used for calculating the sample size of individual medical records is shown below:

$$n = [(z^2 * p * q) + ME^2] / [ME2 + z^2 * p * q / N]$$

Where:

n= sample size

z= standard score

ME= Margin of error

P= proportion of sample elements that have a particular attribute.

q= proportion of sample elements that do not have a particular attribute, so q = 1 - p.

N=Total population

Statistical Analysis

Data were analyzed using STATA version 12 (12.0 Copyright 1985-2011 StataCorp LP Statistics/Data Analysis, StataCorp, 4905 Lake ay Drive, College Station, Texas 77845 USA). The analysis was done in two steps. The first step involved a bi-variate analysis in order to generate the average percentages of children who tested positive at 6 weeks. This analysis also helped to highlight the relationship between attrition levels and elimination of mother to child transmission (emtct) options (Options A, B and B+). In addition, multivariate logistic regression was used to measure the effect of independent variables on the HIV status of children at 6 weeeks.

Variables

We abstracted the following outcome variables one year after ART initiation for all women: 1) alive and on ART; 2) died for any reason; 3) defaulted (defined in the national guidelines as not seen in the ART clinic and off ART for more than 90 days, and not known to have died or transferred out); 4) Infants alive and their HIV status. Other treatment variables recorded included switching (one or more medication changes) of ART to another regimen due to toxicity.

Ethical Considerations

This research was reviewed and approved by the University of Zambia Biomedical Research and Ethics Committee (UNZABREC). Administrative approval to access clinical records was also obtained from the Ministry of Health, at national and district levels. To ensure confidentiality, medical records were reviewed at the sites without moving them to other locations. Names and other personal identifiable information were not collected during the study.

FINDINGS

The objectives of the study were to: assess the association of incidence of mother-to-child-transmission of HIV and ART treatment options A, B and B+ cohorts at six (6) weeks of age; and 2) analyze the attrition levels at 3 months after giving birth (?) among HIV+ pregnant women under options A, B and B+.

Description of the study population

This section presents the age distribution of the mothers included in the study as well as analysing the baby mother pair HIV status by age category.

Table 1: Independent variables relative to the outcome variable (Infant HIV status)

Variables	Coef.	OIM	Z	P>z	[95% Conf. Interval]	
		Std.Err.				
Option	0.025	0.005	-4.61	<0.001	-0.035	-0.014
Age	0.084	0.008	-10.46	<0.001	-0.1	-0.068
Education	0.026	0.006	-4.26	<0.001	-0.038	-0.014
Toxicity	0.467	0.015	-31.22	<0.001	-0.496	-0.44
Attrition	0.012	0.004	-2.97	0.003	-0.020	-0.004
Marital status	0.063	0.007	8.82	<0.001	0.049	0.076
Defaulted	0.039	0.014	-2.74	0.006	-0.067	-0.011
Adherence	0.089	0.015	-6.07	<0.001	-0.118	-0.061

Table 2: Distribution of Respondents age (mothers)

Age	Count	Percentage
<15	213	8.6
15-24	1013	41.1
25-34	1063	43.2
35+	174	7.1
Total	2463	100.0

Table 2 highlighted the age distribution of women that met the inclusion criteria and results showed that the highest number belonged to the age group 25-34 years at 43.2 percent. The lowest age group was that of above 35 years at 7.1percent.

Mother's age and HIV test results of the infants at 6 weeks

Table 3 showed a higher infant positivity rate of 71.4 among infants of mothers who were below the age of 15 years. This shows that age is an important factor in determining the influence of disease and designing appropriate interventions. Mothers who are below the age 15 are adolescents who may have limited understanding of the importance of PMTCT and thus this may explain the reason behind having high infant positivity in this age category.

Table 3: Mothers age and HIV test results of infants at 6 weeks

Childs HIV Status at 6 weeks	Child's HIV Status at 6 Weeks				
	Positive		Negative		
	Count	%	Count	%	Total
Mother's Age					
<15 Years	152	71.4	61	28.6	100%
15-24 years	49	4.8	964	95.2	100%
25-34 Years	6	0.6	1057	99.4	100%
35+ years	7	4	167	96	100%
Total	214		2249 P <0.001		

P <0.001

It is also prudent to realize that some of the adolescent mothers may have been born with HIV themselves and at reproductive age have a greater chance of transmitting the virus to their babies. Programs and initiatives that are aimed at providing support in a PMTCT setting need to be strategic in targeting to ensure more focus on this important age group.

Figure 1: Mother's age against infant HIV test results

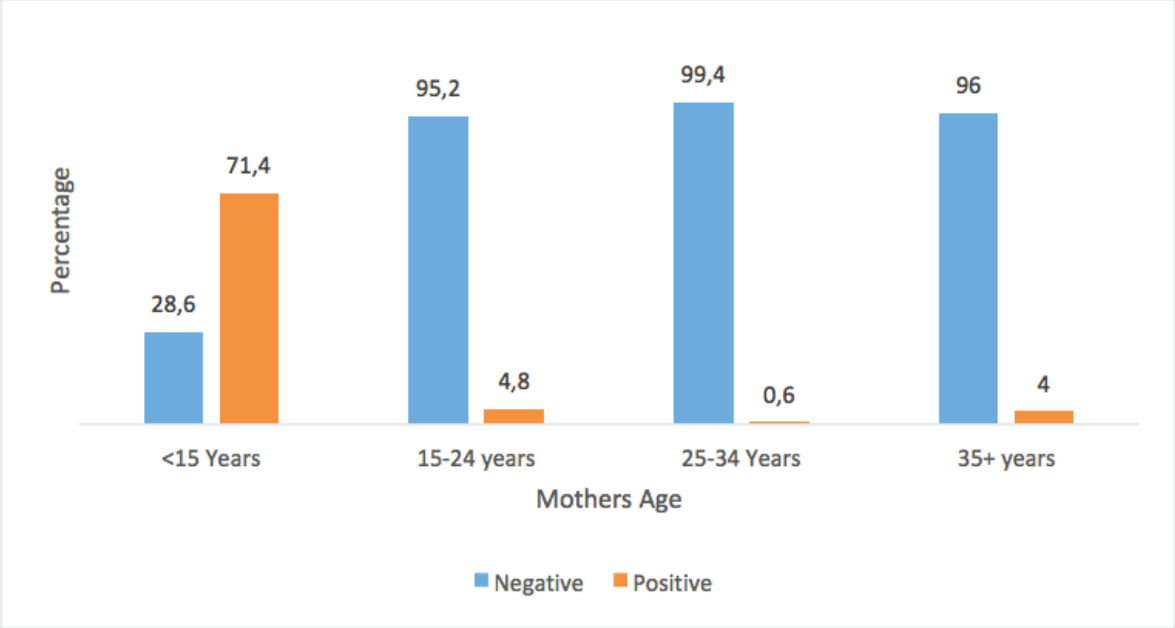


Figure 1 highlights the need to conduct cohort monitoring in HIV/AIDS programs so as to ensure that prevention initiatives produce results that contribute to epidemic control. Therefore, the number of women tested in a PMTCT setting is important, but it is now crucial to also measure the positivity yield by age and location for effective epidemic control. For example, the age group of women above 35 may be neglected in prevention education and activities but further analysis may help to understand the disease burden and aid in developing age appropriate initiatives.

Education of mother and their infant HIV test results

Table 4 helps to evaluate the influence of the education of a mother on the HIV results of their infants at 6 weeks. Women with no education recorded the highest rate of 43.6% infant positivity rate across all the cohorts. The findings have shown association between the mother's level of education and the Child's HIV status at 6 weeks of survival (p<0.001).
ts born from HIV+ pregnant

Figure 1: Mother's age against infant HIV test results

Childs HIV Status at 6 weeks	Child's Status at 6 Weeks				
	Positive		Negative		
	Count	%	Count	%	Total
Mother's Education Level					
No Education	199	43.6	257	56.4	100%
Primary	5	0.6	813	99.4	100%
Secondary	10	1	1014	99	100%
Total	214		2084		

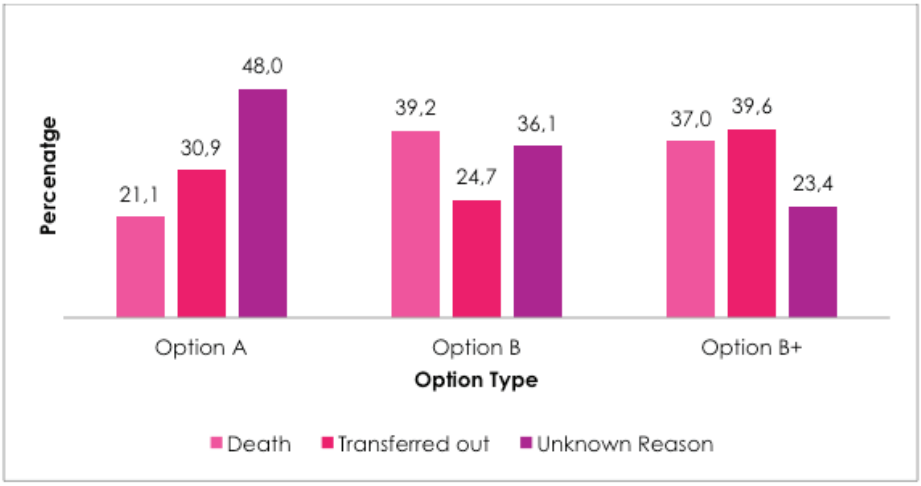
P <0.001

The results from Table 4 above clearly bring out the importance of an educated population in understanding the importance of prevention initiatives. Further, this evidence implies that women who are not educated are more likely to transmit HIV to the infants compared to their educated counterparts.

Attrition levels

The results from figure 2 show that Option A recorded the least deaths of mothers at 21% compared to 39% in option B and 37% in option B+. Option B+ recorded 39.6% transfer outs compared to 24.7% in option B and 30.9% in option A. This shows that option B+ does not show superior results in reducing death among HIV positive pregnant.

Figure 2: PMTCT Options and attrition



HIV status of Infants

In exploring whether we can confidently rank Option B+ as the most effective method of preventing infant HIV infections from HIV positive mothers, the results in table 5 show that Option A was just as effective as that of option B+, because both options A and B+ had a 6% infant positivity rate with option B yielding a 13% infant positivity at 6 weeks.

Table 5: PMTCT Options and corresponding infant HIV status

Results/Status	OPTIONS						
	Option A		Option B		Option B+		Total
Negative	766	94%	741	87%	742	94%	2249
Positive	48	6%	115	13%	51	6%	214
Total	814	100%	856	100%	793	100%	2463

P<0.001

Discussion

The main drive behind the research was to explore the effectiveness of option B+ in comparison to options A and B. Option B+ would ensure long life treatment of HIV regardless of CD4 count. The research aimed at examining HIV infant infections among the options as well as exploring attrition levels. Kieffer, M.P., et al, in their analysis indicated that with Option B+, the total proportion of HIV+ pregnant women in ANC accessing ART across selected countries increased to 80%–95%,with a proportion of pregnant women already on ART at entry into ANC lingering around 30% as of December 2013in most countries.[7]

Some of the documented benefits of option B+ include:

• Protection from Mother To Child Transmission of HIV in current and subsequent pregnancies

• Protection for negative partners in sero-discordant couples

• Reduction in HIV-related maternal mortality [8]

Is cardinal to be borne in mind that both options A and B have not been directly tested in a trial to ascertain efficacy but the general studies demonstrate that the lowest rates of transmission occur among women on ART at the time of conception. In addition, there are modeling studies that predict improved maternal health outcomes with the use of B+. For example, Ahmed, S indicated a prediction of an increased undiscounted maternal life expectancy of 1.16 and 1.12 years as compared to A and B, respectively. In the circumstances,

it is still important to remind ourselves that we have no randomized clinical trials that can help to determine whether starting lifelong ART at higher CD4 results in measurable health benefits in comparison to delaying initiation until CD4 declines to 350 or less [9].

The results from the research clearly show that option B+ was closer to the WHO findings in averting infant infections. On the contrary, there are some studies that used focused group discussions and the participant's expression on Option B+ was negative because of the fear of drug side and challenges of lifelong daily medication [11]. It is therefore, important to also note that on its own, option B+ is not a panacea to the global strategy of an HIV free generation. Other prevention and education strategies are required to ensure effectiveness such as adherence to medication, good nutrition, use of condoms in prevention and best practices that help in averting infant infections are implemented in a PMTCT setting.

Some of the research conducted in some parts of the world show partial benefits of option B+ but this also came with concerns such as the risk of long-life ART to fetuses and infants, as well as adherence challenges for pregnant and breastfeeding mothers.[9]. The foregoing statement is in line with the current research findings which highlighted very high levels of attrition even in option B+. A comprehensive approach to implementation of option B+ as well as other HIV prevention strategies should be adopted so as to bring about more gains in achieving the desired goals. One of the documented strategies highlights the need to employ counselling on people affected and infected with HIV on the side effects of ARV drugs. This does not eliminate the problem because women who experience side effects of ARV drugs are in most cases less likely to develop trust in the treatment and adhere to it [12].

From the research findings, it was clear that education and age levels were critical in influencing the results of initiatives such as PMTCT. A country like Zambia with high illiteracy levels requires a comprehensive approach to combating the spread of HIV from mothers to their un-born infants. Education of mothers in their local languages on the importance of ensuring an HIV free generation should be stepped up to ensure reduction of infant infections in the population with low education levels. Age-appropriate techniques are also required to ensure that the most at risk populations of adolescent girls are reached with suitable prevention messages. Other countries have adopted the safe space technique that ensures environments where young women can freely express themselves and thereby helping to break the stigma and low uptake of services.

The Zambian context requires the availability of ongoing adherence and retention tracking systems that can help to better inform program implementers and stakeholders of possible challenges so as to bring about quick interventions. Some studies agree by suggesting the need to invest in data systems, the development of more sensitive indicators to follow each mother–baby pair through the risk period for MTCT, and the enhancement of training and mentoring in order to accurately collect, analyze, and interpret such data [7].

The results from the study also highlighted the need to reduce on attrition levels to acceptable levels so as to ensure effectiveness of interventions such as option B+. Some schools of thought ague that attrition from ART care is influenced by an interplay of personal, social and health systems status. It is further argued that long waiting times for medical care and time lost seeking health services actually force individuals to balance physical health with social integrity, and thus may decide to opt for faith healing and traditional medicine [6].

The results from figure 5 clearly show that option B+ had attrition levels that were over 10% and as such this had a bearing on the acceptable aversion levels of infant HIV infections. The results give emphasis on the importance of managing attrition to very low levels so as to bring about success of a program. The predominant factors enabling uptake of HIV testing are deterioration of physical health and/or death of sexual partner or child [13]. The administering, therefore, of medications without considering factors such as attrition levels and their management thereof may result in poor achievements even from initiatives that may have been proven to be successful in other settings. Some studies however still encourage the scale up of option B+ in countries with the highest rates of loss to follow up and mortality [14]. However, others argue that more patient-level research may be required to adequately guide policy recommendations and implementation [15].

In responding to the research questions and objectives that aimed at finding out whether option B+ had superior results in averting infant HIV infection, the results in table 3 indicated that at 6% positivity rate, option B+ was a very effective method in preventing mother to child transmission of HIV. The risk of HIV transmission from mother to child, without preventive interventions, ranges from 15% to 40% [1]. Countries like Malawi consider option B+ as the only choice for the country because of option A and B's dependency on accessible, functional, and efficient laboratory services for CD4 count testing, which are not universally available in Malawi [16].

Option B+ results from this study produced results that were below the WHO estimates and thus was effective in helping to reduce infant infections of HIV from positive mothers. Other options in the study (A and B), were also below the WHO estimates at 6% and 13% infant infections respectively. Option B+, therefore, had results that were good enough to prove that it is a very effective initiative.

Estimates indicate that, in all four countries, transmissions from mother to child are lower in Option B+ compared with Option B because of lower risks of transmission when the mother is on ART before the initiation of pregnancy. In Kenya and Zambia, because of high fertility rates and short birth intervals, the additional time on maternal ART prophylaxis in Option B+ compared with Option B is very short. These additional costs of ART are outweighed by its benefits in averting infant infections and future costs.[17].

Option B+ was conceived with the vision of eliminating new cases of HIV infection among children. Early results show adequate uptake and retention of pregnant and breastfeeding women in Option B+,8,9 and this study shows good results for programme retention among HIV-exposed infants. It is likely that HIV infections in infants will decrease and that follow-up of exposed infants will improve over time, as, by removing the gating CD4 step from the HIV care cascade, more mothers will receive ART.[18]

Conclusion

The aim of the study was to evaluate the effectiveness of options A, B and B+ in eliminating mother to child infection of HIV. Further, the analysis brought out the comparisons between options B+ and the prior options so as to help the understanding of the shifts in averting infant HIV infections from their HIV positive mothers at 6 weeks. Attrition was also an important consideration in the objectives which would help to ascertain effectiveness. Results from the study showed that option B+ was very effective in reducing infant infections despite not being more superior to option A.

Notwithstanding the benefits of Option B+, this medical approach had very high attrition levels of 37% deaths, 40% transferred out and 23% unknown reasons which were above acceptable limits of 5-10%. The results show that to ensure effectiveness of option B+, a more comprehensive approach to PMTCT initiatives is required that focuses on promoting adherence to treatment and addressing attrition levels. This entails more intensified and personalized counseling to identify potential defaulters and promote the benefits of uptake of treatment regardless of one's physical condition.

This means a cascade approach that ensures that programs in PMTCT cover all the key aspects of treatment, breast feeding and messaging. In addition, general prevention monitoring is needed for effective management and prevention of new infections. Without treatment, the likelihood of HIV passing from mother-to-child is 15 to 45%. However, antiretroviral treatment (ART) and other effective interventions for the prevention of mother-to-child transmission (PMTCT) can reduce this risk to below 5%.[19] Therefore, option B+ results from the study at 6% infant infections show that the initiative has potential of reducing the HIV burden in Zambia and thereby contributing favorably to the HIV free generation dream.

Declarations

I hereby declare that this research paper has not been submitted for publication in any other journal.

Ethical approval and consent to participate

The study was approved by the University of Zambia Biomedical Ethics Committee. Administrative approval was also obtained from the Zambian Ministry of Health.

Availability of data and materials

The authors declare that the data supporting the findings of this study are available within the article.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

BH conceptualised the study, conducted data collection and analysis, and wrote the draft manuscript. MM, LN, JB contributed towards the conceptualisation of the study, providing input in the analysis, interpretation of findings and drafting of the manuscript. All authors have given final approval of the version to be published

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