

Factors Associated With Tuberculosis Preventive Therapy Uptake among Eligible Children under Fifteen Years at Kakamega County Referral Hospital, Kenya

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DOI: <https://doi.org/10.51244/IJRSI.2026.1309000011>

Received: 12 September 2026; Accepted: 17 September 2026; Published: 29 September 2026

ABSTRACT

Background: Tuberculosis (TB) remains a significant global health concern, with efforts aimed at ending the epidemic by 2035. Tuberculosis Preventive Therapy (TPT) is a key intervention to prevent progression from latent TB infection to active disease, especially in children under fifteen, who were at higher risk particularly those living with HIV or in close contact with infectious TB cases. Despite its benefits, global TPT coverage was only 34%, and in Kenya, just 14.5% of eligible children received it.

Methods: This retrospective cohort study assessed TPT uptake and treatment outcomes among eligible children under fifteen at Kakamega County Referral Hospital. A census approach was used, including all eligible children registered between 2020 and 2023 extracted from TB and HIV care tools.

Results: TPT uptake was 72.1%, with no significant difference between children living with HIV and those in contact with bacteriologically confirmed TB. Lack of stock, distance, and decline by caregivers were the main barriers to initiation. Among BCTB contacts, completion of treatment for the index condition was the strongest predictor of TPT initiation in children. None of the measured factors predicted uptake among HIV-infected children.

Conclusions: TPT uptake among eligible children at the referral hospital in Kakamega County was moderate but did not meet universal coverage targets. Among BCTB contacts, the index case's health system connection emerged as a key driver of paediatric TPT initiation. None of the individual-level factors predicted uptake among children living with HIV.

Keywords: Preventive Therapy, Tuberculosis, TPT Outcomes, Children, Kakamega, Kenya

INTRODUCTION

Tuberculosis (TB) is caused by bacteria *Mycobacterium tuberculosis* which most often affects the lungs, although any other body organs including the meninges, kidney and heart can be affected ^{1, 2}. Tuberculosis is typically transmitted from one person to another through respiratory tract. Infectious droplets are generated when someone with infectious type of TB coughs, sneezes, laughs, cries or sings and the vulnerable host inhales the droplets ³. Each year, approximately 10 million people fall ill with TB and 1.5 million people die including 250,000 children. Kenya is one of high TB and TB/HIV burden countries, with TB prevalence of 558 adult cases per 100,000 population ^{4, 5}. Childhood TB comprises approximately 15% of the total population who have TB. Additionally, it is noteworthy that up to 40% of TB cases go undiagnosed in Kenya ⁴.

The chronicity of TB, specifically, the transition from latent TB infection to active TB disease has made it difficult to eradicate ¹. Individuals with latent TB infection are at increased risk of developing TB hence, they

serve as seedbeds for ongoing TB transmission⁶. The eligible population for TPT include; contacts of bacteriologically confirmed TB cases, people living with HIV, prisoners and prison staff, health care workers and specific patients with immunodeficiency tendencies such those receiving organs transplants⁷.

Children under fifteen years who are exposed to infectious forms of TB and those living with HIV are particularly at risk of TB, considering their low immune status^{8,9}. For the at-risk population, treatment of latent TB infection using Tuberculosis Preventive Therapy is an effective public health intervention that protects susceptible individuals from developing TB disease (WHO, 2022). Tuberculosis Preventive Therapy involves the administration of one or more anti Tuberculosis drugs such as Isoniazid, rifampicin, and rifapentine^{1,2}. At population level, TPT not only reduce TB related morbidity and mortality, but also reduce the economic impact of the disease on the health system⁵.

Evidence shows that TPT reduces TB related morbidity by 72% and mortality by 52%. However, globally, only 27 % of eligible children under fifteen years, those living in close proximity with infectious TB cases and those living with HIV, are initiated on TB preventive treatment annually⁹. This constitutes TPT coverage of only 34%. Moreover, whereas previous data indicates high protective level of TPT, only two-thirds of those who are initiated on TPT successfully complete their therapy¹⁰. As such, understanding the level of TPT uptake in Kakamega County Referral Hospital (KCRH) provides baseline evidence that may help implementation of county based and national targeted interventions.

Tuberculosis remains a leading cause of morbidity and mortality among children living in high TB burden settings, with an estimated 1.5 million children dying each year worldwide¹⁰. Tuberculosis preventive treatment (TPT) is a proven effective intervention that reduces the progression of latent infection to active disease by up to 90% (Marais et al., 2013) and reduces morbidity and mortality by more than 50% (Zumla et al., 2015). Despite these benefits, global coverage remains low, with only 27% of children under five receiving preventive treatment in 2022¹⁰. Kenya is one of the top 30 countries with the highest TB burden, but uptake of preventive treatment among children remains low. National data show that in 2024, only 37% of households with children under 15 years of age received treatment, and treatment completion rates remained around 40%⁴.

County-level studies show even greater disparities: treatment uptake was 34% in Mombasa, 13% in Coastal Hospital, and 15% in Kisumu¹¹⁻¹³. Reviews of specific programs in western Kenya show attrition all across the treatment cascade, with treatment initiation and completion rates significantly below targets, leading to higher TB incidence among untreated children^{14,15}. On the positive side, targeted system strengthening interventions have been shown to be feasible, with multi-county pilots achieving treatment initiation rates of 95% and completion rates of 83%¹⁶.

However, there is no published evidence in Kakamega County, which has a high TB burden and a large population served by the Kakamega County Referral Hospital. Screening rates, initiation and completion rates among eligible children are still unknown, as are health system and patient-level barriers that impact outcomes. Addressing this gap is essential to support context-specific interventions and strengthen the childhood TB prevention chain in Kenya. This study sought to determine factors influencing uptake of Tuberculosis Preventive Therapy among eligible children below fifteen years at the Kakamega County Referral Hospital.

A review of current literature shows that the natural history of TB follows a continuum from exposure, infection (latent TB infection, LTBI), to active disease. Approximately 5–10% of infected individuals will develop active TB in their lifetime, with higher progression rates among immunocompromised individuals, including children¹⁷. Due to their immature immune systems, children are at higher risk of severe and disseminated forms of TB, such as TB meningitis and miliary TB. Without timely diagnosis and treatment, childhood TB has high mortality rates, particularly in low-resource settings¹⁸.

Sub-Saharan Africa bears a disproportionate burden of TB, accounting for 23% of global TB cases, with high co-infection rates with HIV⁵. In this region, childhood TB is often underdiagnosed due to challenges in obtaining sputum samples and the paucibacillary nature of pediatric TB¹⁹. Delivery of TPT is outlined by the WHO's TB preventive therapy (TPT) cascade, i.e identification, evaluation, treatment initiation, and completion, targeting high-risk groups: under-fifteen household contacts, people living with HIV, and other immunocompromised

individuals. However, major drop-offs occur at every stage. Sub-Saharan Africa faces unique challenges in delivering TPT due to high TB-HIV co-infection rates, limited healthcare infrastructure, and competing health priorities. Key findings include low Screening rates, with only 30–50% of child contacts screened for TB in many African countries¹⁹. Secondly, diagnostic gaps persist as many programs rely on symptom screening alone, missing subclinical TB cases that should be ruled out before TPT initiation²². In relation to TPT uptake and retention, while some countries (e.g., South Africa, Ethiopia) have scaled up TPT, many others report <40% initiation rates due to drug shortages and caregiver reluctance²⁰.

Kenya's National TB program's key findings show that regarding uptake, only about 45% of eligible children initiate TPT, with higher rates in HIV-endemic regions due to stronger monitoring systems²³. Kenya is classified among the 30 high TB and TB/HIV burden countries. National surveys estimate a TB prevalence of 558 adult cases per 100,000 population, with approximately 124,000 new cases annually⁴. While treatment coverage has improved to 77%, uptake of TPT remains uneven across counties. For example, Meru County reported over 4,200 TB cases in 2023, yet preventive therapy coverage among healthcare workers was only 2.1%²⁴. Such disparities highlight the need for county-specific assessments to inform tailored interventions. National data show 58% initiation rates among eligible CLHIV, with higher coverage in PEPFAR-supported sites²⁵.

The successful implementation of TPT in children is influenced by a complex interplay of health system, socioeconomic, and clinical factors. Clinician knowledge gaps drive 40% of missed opportunities, while poverty correlates with a 2.5-fold higher dropout rate and caregiver education accounts for 60% of adherence variability. Frequent drug stock outs slash initiation rates by up to 50%. Shorter regimens like the once-weekly 3HP boost completion by about 45% compared to six-month isoniazid courses. HIV co-infection further raises the risk of attrition by roughly 35%.

From a Kenyan perspective, facility- and household-level determinants are particularly noticeable. County hospitals achieve 55% TPT completion compared to 35% at dispensaries, reflecting disparities in infrastructure and staffing. Implementing electronic health records has cut patient loss by 30%. Malnutrition doubles the likelihood of treatment interruption, and children under male caregivers are 40% less likely to stay in care. Adolescents adhere 25% less than those under five. A Western Kenya study found only 42% completion, with long treatment duration and transport costs cited as the main barriers.

METHODS

The study was conducted in Kakamega County. Kakamega County is one of high TB burden counties with most TB cases being concentrated in the county referral hospital. The study site was the Kakamega County referral hospital (KCRH). The Kakamega county referral hospital was purposively selected because it is a high TB and HIV burden health facility in Kakamega County. A mixed methods design was used, with retrospective chart review for the primary quantitative data, and key informant interviews with healthcare workers involved in TB care. All children under fifteen years who were eligible for TPT; i.e., all under-fifteen contacts of bacteriologically confirmed TB cases who have been listed in contact management register, and children under-fifteen years living with HIV on care and follow up at KCRH between 2020 and 2023. All the children's records that met the inclusion criteria were included. This is a census-based sampling strategy, where every eligible case was examined rather than selecting only a subsample. This approach ensures comprehensive coverage of the study population, minimizes sampling-related biases, and provides a broader picture of the results. Quantitative data were extracted from TB and HIV registers (TB register, contact management register, TPT record cards, Pre-ART & ART registers, green cards) using the Kobo platform. Qualitative data were obtained through key informant interviews with TB and HIV clinic staff. Administrative approval was sought, and coordinators were informed before data collection. Data was analyzed using SPSS version 26. The uptake in this study refers to the initiation of TPT among the eligible children and was examined using descriptive approaches; frequency and percentages. Regression analysis identified factors influencing TPT uptake using odds ratios with corresponding 95% confidence intervals. A p-value of <0.05 indicates significant variables. Qualitative data was analyzed thematically.

RESULTS

The study included 562 records. In reviewing patient files, demographic variables contained random missing entries (e.g., date of initiation not recorded, while other fields were complete). Given the sensitive nature of the data and the risk of introducing bias through imputation, no statistical imputation was performed. Instead, demographic analyses were conducted using available data for each variable, with the sample size (n) adjusted accordingly.

Out of the 562, n=196 (34.9%) were children below fifteen years living with HIV, while n=366 (65.1%) were children living in close contact with bacteriologically confirmed TB (BCTB) cases as illustrated in figure 1. There was a fair distribution of the cases by gender, 49% being female and 51% male. Slightly over a third of the children were under the care of both parents, with a similar proportion, 38% cared for by mothers only. More than half, 58.7% were found to be underweight, and 66.4% were at the post ECD level of education. Table 1 shows the results.

Table.1: Demographic profile

Factor	Frequency	Percentage
Gender		
Female	269	49.3
Male	277	50.7
Care taker		
Both parents	204	38.7
Mother	199	37.8
Father	71	13.5
Grandparents	15	2.8
Aunt/Uncle	33	6.3
Siblings	5	0.9
Academic level		
Preschool	90	16.2
ECD	97	17.4
Post ECD	370	66.4
BMI		
Underweight	330	58.7
Normal weight	191	34.0
Overweight	18	3.2
Obese	23	4.1

Eligibility criteria		
Children living with HIV	196	34.9
BCTB contacts	236	65.1

Emergent themes

From the analysis of the in-depth interviews with healthcare workers, five primary themes emerged. The HCWs discussed caregivers' concerns on the need, safety, and efficacy of TPT and how they address these. Secondly, factors affecting uptake emerged as a theme, the HCWs highlighting caregiver hesitance due to unawareness on the importance of the treatment. Additionally, drugs and supplements stocks were a significant issue, with the HCWs highlighting recent stock outs especially stemming from drugs expiring in stock. Furthermore, regimen adherence emerged as another key theme, as the HCWs noted the differences in adherence between the difference TPT regimen, and cited possible reasons such as the duration of the dose; shorter regimens are adhered to better. Finally, it emerged that there is stigma associated with taking TPT as its misconstrued for ART. Table 2 summarizes the results

Table.2: Emergent themes

Theme	Illustrative Quotes
Drug safety & efficacy	"TPT drugs are safe, early initiation to TPT especially for those who are on ART, the mortality is reduced by 70%." – Sub-county pharmacist
	"We tell them (child's caregivers) to bring them to the hospital if there are serious side effects, but mostly it is mild reactions like jaundice, coloring of urine." – TB coordinator
TPT uptake	"Most parents only give medicine to children when the children are sick, absence of sickness makes initiation to TPT difficult." -Clinical officer
	"Some of the parents are like, my child does not have TB, so why do you want to treat them. Even if you try to explain that it is for prevention, they are rigid. And in treatment you can't force, you just advice." -Nurse
TPT & supplements stocking	"For the kids, we had, but right now it is out of stock. It is not actually not out of stock; we had a lot of commodity but they expired." – Nurse
	"Even though TPT is adequate, ya nutritional supplements is extremely inadequate, na nutritional supplements is required." – Nutritionist
	"Food insecurity influences, especially for clients, they say things like <i>nikikula naskia vibaya</i> . There was some support (with supplements) so when it stops, they stop taking." – Nutritionist
Regimen & adherence	"3RH is palatable and good for children. It is flavored and adherence is good but adherence depends on the caregiver." – Clinical officer
	"The 3HP it's taken once a week so it is very convenient, so those who are taking 3HP, they finish very quickly." – Nurse
Stigma & social factors	"In this region, some people still associate TB with HIV. So they fear that when their friends see them taking TPT, they think they also take ARVs." – CHP
	"We get those people who are alcoholic, so they tell you if they start TPT, they have to stop drinking." – CHP

Uptake coverage of TPT among children below fifteen years in Kakamega county referral hospital.

The overall TPT uptake rate was 72.1% (n=405), as illustrated in figure 1. This is supported by the sentiments of one of the nurses who stated:

“Like us here, every index case which turns negative, we usually do contact tracing, we look for the eligible children, and we put them on TPT and we ensure that they complete because when the index is coming for their drugs, they also come for the children” -Nurse

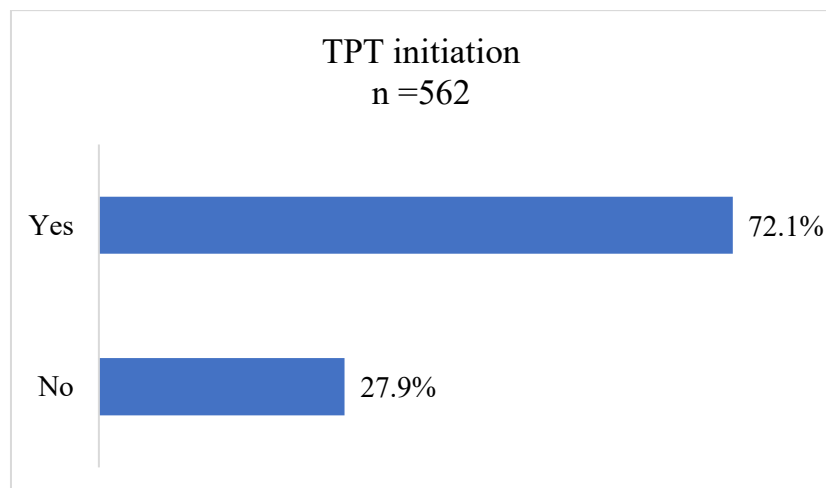


Figure.1: TPT uptake

As presented in table 3, stock out at the facility was the most common reason for non-initiation, affecting 23% of cases. This was followed by distance to the facility (22%), and decline by caregiver (20%). Lack of knowledge was the least common at 10% while for another 10%, the reason was not recorded. This was in congruence with the county TB coordinator’s statement that:

“Long distance to facility due to tough economic times. Those who are supposed to be initiated, having presented with symptoms fail to come back for initiation” -TB coordinator.

Table.3: Reasons for TPT non-initiation

Factor	Response	Frequency	Percent
Reason non-initiation	Lack of knowledge	16	10.2
	None given	16	10.2
	Pill burden	24	15.3
	Decline by caregiver	31	19.7
	Distance to facility	34	21.7
	Stock out at facility	36	22.9

Among the children initiated on TPT, the 3-month isoniazid plus rifampicin regimen dose was the most common (51%), however, there were significant differences in the preferred regimen between children living with HIV, and those in contact with BCTB cases ($\chi^2 = 67.72$, $p < .01$). Isoniazid was preferred for those living with HIV (56%) whereas 3RH was preferred for BCTB contacts. Table 4 details the results.

Table 4: TPT regimen differences between case types

	TPT regimen			
Eligibility	Isoniazid	3HP	3RH	chi (p val)
Living with HIV	55.5%	20.5%	24.0%	67.72(0.000)
BCTB contact	22.0%	12.0%	66.0%	
Overall	34.1%	15.1%	50.9%	

As presented in table 5, among the children in close contact with cases of TB, all the cases' type of contact was in the households n=356. All the index cases were bacteriologically confirmed, with 98.6% being drug sensitive and less than 2% drug resistant. The vast majority of the index cases completed their treatment n=290; n=200 was confirmed cured, while 9.8% were lost to follow up.

Table 5: Index cases profile BCT contacts

Factor	Frequency	Percentage
Type of contact to index case		
Household	356	100.0
Type of TB for index case		
Drug sensitive	354	98.6
Drug resistant	5	1.4
Index case complete TB treatment		
No	54	15.7
Yes	290	84.3
Treatment outcome for index		
Cured	200	57.5
Completed treatment	85	24.4
Lost to follow up	34	9.8
On treatment	29	8.3

The majority of cases living with HIV had no history of contact with a confirmed case of TB. Of those who had a history of contact, 78% (n=7) were bacteriologically confirmed, while 22% were clinically diagnosed. Further, almost all, 95%, of the cases had no comorbid condition nor opportunistic infections. Additionally, three quarter of the children living with HIV/AIDS were clinically stable at initiation of ART their treatments. Table 6 shows the results.

Table 6: TB Profile of children living with HIV

Factor	Frequency	Percent
History of contact with a case of TB		
No	144	75.0
Yes	9	4.7
Unknown	39	20.3
Type of TB of contact		
Clinically diagnosed	2	22.2
Bact. Confirmed	7	77.8
Presence of comorbid condition		
Yes	9	4.6
No	187	95.4
Opportunistic infection		
No	162	95.9
Yes	7	4.1
Condition at baseline		
Clinically stable	147	75.0
Clinically unstable	49	25.0

The TPT uptake rate was not significantly different between those with HIV and the BCTB contacts ($\chi^2=0.88$, $p=0.35$). Among the children living with HIV, there was found a 74.5% level of TPT uptake, while those in close contact with BCTB cases had a 70.8% uptake rate of TPT. Table 7 details the findings.

Table 7: Chi square test of uptake differences by case type

	TPT initiated		
Eligibility	No n(%)	Yes n(%)	Chi (p val) value)
Living with HIV	50(25.5)	146(74.5)	0.88(0.35)
BCTB contact	107(29.2)	259(70.8)	

Factors associated with TPT initiation

Different factors were found to affect TPT uptake between the two groups of children. Among children with contact to bacteriologically confirmed cases of TB, the treatment outcome of the index case was found to influence TPT initiation, with those whose index case completed treatment being 10 times as likely to be initiated

on TPT compared to those whose index cases were still on treatment (AOR = 10.73, 95% ci = 1.10-19.45). This finding is supported by the feedback of the HCWs who said,

“Yeah like us here, every index case which turns negative, we usually do contact tracing, we look for the eligible children, and we put them on TPT and we ensure that they complete because when the index is coming for their drugs, they also come for the children” -Nurse

Among those living with HIV, none of the measured factors was found to significantly influence TPT uptake. Table 8 shows the results.

Table 8: Factors associated with TPT uptake

Factor	Category	AOR (95% ci)	p value
Children in contact with BCTB cases			
Childs care taker	Both parents	0.91(0.35-2.36)	0.84
	Mother	1.17(0.42-3.27)	0.76
	Father	1.93(0.65-5.74)	0.23
	Extended family	Ref	
Treatment outcome for index	Cured	8.85(0.91-86.16)	0.06
	Completed	10.73(1.1-19.45)	0.04
	Lost to follow up	3.53(0.64-19.46)	0.15
	On treatment	Ref	
Type of TB index case	Drug sensitive	0.53(0.08-3.43)	0.51
	Drug resistant	Ref	
Index case complete TB treatment	No	4.35(0.81-23.41)	0.09
	Yes	Ref	
Children living with HIV			
CD4	CD4	1(0.98-1.01)	0.76
Viral Load	VL	1(0.99-1)	0.71
Age	Age	0.96(0.87-1.05)	0.38
BMI	Underweight	2.95(0.32-27.4)	0.34
	Normal weight	4.45(0.47-41.71)	0.19
	Overweight	Ref	
Gender	Female	0.62(0.31-1.25)	0.18

	Male	Ref	
Condition at baseline	Clinically unstable	1.79(0.72-4.41)	0.21
	Clinically stable	Ref	
Childs care taker	Both parents	0.62(0.13-2.89)	0.55
	Mother	0.95(0.34-2.66)	0.93
	Father	0.27(0.05-1.54)	0.14
	Extended family	Ref	

DISCUSSION

In children who were in contact with bacteriologically confirmed TB cases, the treatment outcomes of the index cases emerged as the only significant predictor of the onset of TPT. Children whose index case had completed treatment were approximately ten times more likely to initiate TPT than those whose index case was still in treatment (AOR = 10.73, 95% CI = 1.10-19.45, $p = 0.04$). This finding is supported by the health worker's observation: *"For every index case that turns negative, we usually do contact tracing, look for eligible children and put them on TPT."* The strong association between index treatment completion and child TPT initiation highlights the importance of the index patient's commitment to the health care system as a driver in the study of family contacts and the adoption of TPT.

This finding is consistent with evidence from Ethiopia, which found that index and child characteristics play important roles in TPT adherence²⁶. When index cases actively participate in care, attend regular appointments and complete treatment, they provide a bridge to the health system for their household contacts. The nurse's observation that when the index comes for their medication, they also come for the child, is illustrative of the mechanism by which the index patient's regular clinic visits create opportunities for contact tracing, eligibility screening, and initiation of TPT that might not otherwise occur. Conversely, the lower uptake among contacts of index cases still on treatment may also reflect healthcare provider prioritization of the index patient's care, with less attention devoted to household contact investigation during the acute phase of treatment.

In HIV-infected children, no measured factors, including CD4 count, viral load, age, BMI, sex, clinical presentation, or caregiver type, were found to significantly influence TPT uptake. This may reflect several underlying dynamics. First, the TPTs in this group are protocol driven⁷. HIV-infected children are typically initiated on TPT as part of a standardized HIV care regimen, regardless of individual clinical characteristics, and TPT is integrated into routine ART services, in line with World Health Organization recommendations for all HIV-infected children over 12 months of age 6 months before an HIV testing course. Care options^{7,10}.

Second, the lack of a significant association may reflect the relatively high baseline uptake of TPT among HIV-infected children in this setting. The overall TPT uptake rate among HIV-positive children was 74.5%, which was higher than the 68% found in a similar study at Kenyatta National Hospital²⁷ and much higher than the 53.2% found in Nairobi County²⁸. Due to the relatively large sample size, differences may exist in identifying associations with individual factors.

Third, barriers to TPT among HIV-infected children may be more system and health system related than individual related. A mixed-methods study in Kenya found that health education and counseling about IPT were key facilitators of IPT uptake and completion, while fear of adverse drug reactions, drug burden, and lack of comprehensive monitoring and evaluation systems were major barriers²⁷. These systemic and psychosocial barriers may have a greater impact on TPT uptake than the individual clinical or demographic factors assessed in this study.

CONCLUSION

TPT uptake among eligible children at the referral hospital in Kakamega County was moderate but did not meet universal coverage targets. Although the facility is performing better than the national average, ongoing barriers to the health system, particularly supply shortages, accessibility challenges, and caregiver reluctance continue to hinder efforts towards universal coverage. Comparable uptake rates between people living with HIV and BCTB contacts suggest that facility-level contact tracing programs are working, but the gap between current coverage and ideal universal coverage highlights the need to strengthen interventions.

Among BCTB contacts, the index case's health system connection emerged as a key driver of paediatric TPT initiation, highlighting the importance of leveraging the index patient's treatment journey to facilitate investigation of family connection. The lack of significant individual-level predictors among HIV-infected children suggests that a program-driven approach to HIV programming is effective in overcoming individual barriers, but also indicates missed opportunities to address systemic and psychosocial barriers that may still impact uptake and completion.

ACKNOWLEDGEMENTS

"We thank research assistants; Ben Otieno, Florence Wangu, Nety Otieno and Ivy for their helpful contributions on data collection and Eugene Ohanga for assistance with statistical analysis."

Declarations

Funding: No external funding was received for this study

Conflict of interest: The authors declare no conflict of interest

Ethical approval: Ethical approval was granted by the Institutional Scientific Ethics Review Committee of University of Eastern Africa, Baraton (Approval No. B2726062024), The National Commission for Science, Technology and Innovation (NACOSTI) (Approval No.497134), as well as the Kakamega County Referral Hospital.

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