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Research Article

High Baseline CD4 Count and Exclusive Breastfeeding Are Associated with Lower Rates of Mother to Child HIV Transmission in Northwestern Uganda: A Two-Year Retrospective Cohort Study

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Background. Under Option B plus, the transmission of Human Immunodeficiency Virus (HIV) along the Early Infant Diagnosis (EID) of HIV cascade remains unknown. We described HIV transmission along the EID cascade and determined associated factors at Arua Regional Referral Hospital, Northwestern Uganda. *Methods*. Data on 295 mother-baby pairs in EID care (January 2014 and April 2015) was extracted, cleaned, and analysed in STATA. Univariate, bivariate, and multivariate analyses were performed. Independently associated factors were stated in adjusted odds ratio (AOR), 95% confidence interval (CI), and p-values. *Results*. 233 (89.0%) mothers were above 30 years, 251 (85.1%) were in World Health Organization (WHO) clinical stages I/II at enrolment, 170 (57.6%) attended antenatal care (ANC) visits during recent pregnancy, and 204 (69.1%) delivered in a health facility. Meanwhile, 257 (87.1%) HIV Exposed Infants (HEIs) received Nevirapine prophylaxis from birth up to 6 weeks and 245 (83.0%) were exclusively breastfed during the first 6 months. Of 295 mother-baby pairs, 25 (8.5%) HEIs turned HIV-positive along the EID cascade. Baseline maternal CD4 count of more than 500 cells/ul compared to less than 500 cells/ul (adjusted odds ratio (AOR) = 0.29; 95% Confidence Interval (CI): 0.10–0.85; $p = 0.024$) and exclusive breastfeeding (EBF) in the first 6 months of delivery in contrast to not EBF in the first 6 months (AOR = 0.17; 95% CI: 0.52–0.55; $p = 0.003$) reduced HIV transmission. Meanwhile, ANC visits, place of delivery, time of Nevirapine initiation, and maternal antiretroviral therapy use were not significantly associated with infant HIV transmission. *Conclusion*. HIV transmission was high. High baseline CD4 count and exclusive breastfeeding reduced HIV transmission.

1. Introduction

Ninety percent of children acquire Human Immunodeficiency Virus (HIV) from their mothers during pregnancy, labor and delivery, and breastfeeding [1]; this is known as MTCT (Mother to Child Transmission of HIV). Without antiretroviral therapy (ART), about 15–45% of infants born to HIV-positive mothers will get HIV infected. However, with ART and other effective Prevention of Mother to Child Transmission of HIV (PMTCT) interventions, this transmission can reduce to below five percent [2, 3].

In Uganda, the Ministry of Health adopted Option B plus, a strategy for elimination of MTCT (EMTCT) in 2012 [1]. Elsewhere [4], the implementation of Option B plus in Uganda was described. Briefly, under Option B plus, the diagnosis of HIV in infants born to HIV-positive mothers is through the collection of Dry Blood Spot (DBS) samples at 6–8 weeks and at 6 weeks after cessation of breastfeeding for HIV testing using Polymerase Chain Reaction (DNA-PCR), and at 18 months using fresh whole blood with HIV antibody test [5]. Infants confirmed as HIV-positive at any of these testing time points are immediately started on lifelong

ART regardless of the age, immunological status, and World Health Organization (WHO) clinical stage. However, at 18 months, HIV Exposed Infants (HEIs) that test negative are discharged as HIV uninfected.

The effectiveness of an EMTCT program is measured by the proportion of HEIs that turn positive along the EID cascade. Good performing EID programs have less than 5% MTCT, and the routine monitoring of this indicator assures the provision of high quality maternal and infant HIV care.

However, in our setting (Arua Regional Referral Hospital, ARRH), the level of MTCT under Option B plus implementation has never been evaluated. Consequently, contextual maternal and infant factors associated with MTCT along the EID cascade remain unknown. Without such evidence, designing site-specific and evidence-driven interventions for improving the current EID program and subsequently contributing to the national and global efforts in EMTCT is far from being reached. The objective of this study is hence to describe the level of MTCT along a 2-year EID cascade and to establish associated maternal and infant factors at ARRH, Northwestern Uganda. The reporting of this study is in accordance with Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines, a standard for reporting cross-sectional, case-control, and cohort studies [6, 7].

2. Methods and Materials

This was a retrospective cohort study design that used existing EID data at ARRH, Northwestern Uganda. ARRH is located in Arua District, bordered in the North by Maracha District, in the East by Yumbe and Amuru Districts, in the South by Nebbi and Zombo Districts, and the Democratic Republic of Congo (DRC) in the West. Arua District has 73 health facilities (five hospitals with one being ARRH, four Health Center (HC) IVs, 33 subcounty HC IIIs, and 31 Parish level HC IIs). Initially, ARRH was established as a District Hospital in 1932; in 1994, it received a Regional Referral Hospital status. With a limited bed capacity of 372, the average outpatient attendance is between 250 and 300 patients per day, while the in-patient admission is about 30 patients per day.

ARRH offers a wide range of comprehensive specialized curative, preventive, and maternal health services including tertiary training and continuous professional development [8]. In addition, it offers supervision to lower health facilities in the district and conduct research and capacity building. Other than being the regional focal point for epidemic and infectious disease surveillance response, ARRH is also the coordinating center for reproductive health, blood banking, malaria and tuberculosis control, and comprehensive HIV/AIDS care (including ART). Currently, it serves all the seven districts in West Nile region: Adjumani, Moyo, Yumbe, Maracha, Koboko, Nebbi, and Zombo.

Recent estimates placed the district total population at 785,177 people, with total fertility rate of 3.2%. With the influx of refugees, the population has become multiethnic: Lubgara (the majority), Ma'di, Alur, Kakwa, Aringa and refugees from South Sudan, and the DRC. Of the total population, 8,487 are HIV infected women. Subsistence farming is the major economic activity that employs more than 79% of the population. Although only 9% of the population has formal employment, 3.3% are employed in cottage business. Because of the proximity of Arua District to the borders of the Sudan and the DRC, the population trades a lot with its neighbors. Elsewhere [9], the setting of ARRH was further described.

Our study population consisted of HIV-positive mother-baby pairs enrolled in the EID program between January 2014 and April 2015. Because Option B plus was rolled out in the hospital in December 2013, the stated period was selected to ensure that the final EID cascade evaluated only mother-baby pairs enrolled under Option B plus, with the last HEI observed for a minimum period of 18 months. We excluded mother-baby pairs with missing outcome data in the Open Medical Records System (OpenMRS), an efficient electronic medical records (EMR) data storage and retrieval system.

From the OpenMRS, we retrieved and reviewed HEI data: age at enrolment in months, feeding options in the first 6 months (exclusive breastfeeding, replacement, or mixed feeding), history of Nevairapine (NVP) prophylaxis initiation (never at all, started after 6 weeks, or started between birth and 6 weeks), DNA-PCR test results at 6 weeks and at 1 year (measured as HIV-positive, or HIV-negative), and HIV antibody test result at 18 months (measured as positive and negative). To verify these HIV test results, the dispatch form was used to double-check the time at which the tests were done and to confirm the reported test result. However, maternal data retrieved and reviewed included the age in absolute years (later categorized as equals or less than 30 years versus above 30 years), parity (one child versus more than one child), antenatal care (ANC) use (ever attended ANC during recent pregnancy, or none, and the frequency of ANC use), place of HEI delivery (health facility versus nonhealth facility), mode of delivery of the HEI (spontaneous vaginal delivery, or caesarean section), maternal ARVs (antiretroviral drugs) use (never used, used during ANC and labor only, or on lifelong ART), and the baseline WHO clinical stage (stages I/II versus III/IV).

Under certain instances, we used the EID data tools (register, clinical charts, and dispatch forms) to verify data accuracy.

The retrieved data was cleaned and exported to STATA version 12 (StataCorp, College Station, TX, USA) for statistical analysis at three levels: univariate, bivariate, and multivariate. Univariate analysis consisted of descriptive statistics of frequencies and percentages for categorical variables and means with standard deviations or median with interquartile ranges for numerical variables. The outcome variable was level of MTCT, measured as the percentage of HEIs that tested HIV-positive along the 18 months EID cascade (at 6 weeks, or 12 months, or 18 months). The numerator was the number of HEIs that turned HIV-positive at 6 weeks, 12 months, or 18 months, while the denominator was the number of HEIs at the specific time points. The overall level of MTCT was computed as the percentage of the total number of HEIs that

turned HIV-positive along the 18-month EID continuum of care, with the total number of HEIs in care at 18 months as the denominator.

In bivariate analysis, we used the Chi-squared test to establish statistically significant association between categorical independent variables and the outcome variable whenever the cell count was large (typically equal and above five). In instances where the cell count was small (less than five), Fisher's exact test was used. Conversely, we used Student's t-test to test for statistically significant differences in the means of numerical independent variables with the outcome. The level of statistical significance was less than 5%.

Finally, we performed a multivariate analysis using logistic regression since the outcome variable was binary. First, we performed a univariable logistic regression analysis to assess the strength of association for all statistically significant variables at bivariate analysis without adjusting for potential confounders, and the result was stated in unadjusted odds ratio (UOR), corresponding 95% confidence interval (CI) and probability values (p-values). We then performed a multivariable logistic regression analysis involving all statistically significant variables at bivariate analysis to determine factors independently associated with MTCT. We stated the output in adjusted odds ratio (AOR), 95% CI, and p-values. Notably, before multivariable logistic regression analysis, we performed a multicollinearity test in order to determine collinear variables, defined by Variance Inflation Factor (VIF) greater than 10. Nevertheless, there was no collinearity. This study was approved by the Research Ethics Committees of Mbarara University of Science and Technology and ARRH.

3. Results

3.1. Sociodemographic Characteristics of Participants. Of 295 mother-baby pairs, 233 (89.0%) mothers were above 30 years of age, 251 (85.1%) were in WHO clinical stages I and II at the time of enrolment into EID care, 170 (57.6%) had attended ANC visits during the last pregnancy, 204 (69.1%) delivered in a health facility, 251 (85.1%) had spontaneous vaginal delivery, 257 (87.1%) of the HEIs received NVP syrup for prophylaxis from birth up to 6 weeks, and 245 (83.0%) of the HEIs were exclusively breastfed during the first 6 months of delivery (Table 1).

3.2. Outcomes of MTCT along the EID Cascade. Of 368 HEIs enrolled in care at ARRH between January 2014 and April 2015, 352 were enrolled onsite while 16 were transferred in from other health facilities. Between enrolment and 6 weeks, two HEIs died, three got lost and 18 turned HIV-positive on first DNA-PCR test at 6 weeks and were started on ART. Between 6 weeks and 12 months, 13 HEIs died, 33 got lost, 11 transferred to other health facilities, and four turned HIV-positive on the second DNA-PCR test. Between 12 and 18 months, two HEIs got lost, and three turned HIV-positive at 18 months on HIV antibody testing. Between 18 and 24 months, nine HEIs transferred out. At the end of 2 years, 295 HEIs remained in care, of which 25 (8.5%) tested HIV-positive (Figure 1).

Table 1: Mother-baby pair sociodemographic and clinical characteristics at ARRH, Northwestern Uganda.

Variables	Number (No. = 295)	Percentage (% = 100.0)
Maternal age (years)		
Less or equal 30	62	21.0
More than 30	233	89.0
Parity (children ever born)		
Equals one	142	48.1
More than one	153	51.9
History of ANC visit		
No	125	42.4
Yes	170	57.6
Baseline WHO clinical stage		
I & II	251	85.1
III & IV	44	14.9
Place of delivery		
Health facility	204	69.1
Home	91	30.9
Mode delivery		
Spontaneous vaginal delivery	251	85.1
Caesarean section	44	14.9
NVP initiation after delivery		
Never at all	35	11.9
After 6-weeks	3	1.0
From birth up to 6-weeks	257	87.1
Infant feeding option		
Replacement feeding	5	1.7
Mixed feeding	45	15.3
Exclusive breast feeding	245	83.0

Note. ANC: antenatal care; WHO: World Health Organization.

3.3. Factors Associated with MTCT. In bivariate analysis (Table 2), maternal ANC attendance during recent pregnancy ($p = 0.002$), baseline CD4 cell count ($p = 0.015$), delivery in a health facility ($p = 0.017$), infant NVP prophylaxis use postdelivery ($p < 0.001$), infant exclusive breastfeeding within the first 6 months of life ($p < 0.001$), and maternal use of ART ($p < 0.001$) were statistically significantly associated with MTCT. Conversely, maternal age ($p = 0.055$), parity (number of children ever born) ($p = 0.666$), baseline WHO clinical stage ($p = 0.183$), and mode of delivery ($p = 0.055$) were not statistically significantly associated with MTCT.

In unadjusted analysis (Table 2), mothers above 30 years were not significantly less likely to transmit HIV to their infants compared to those below or equals 30 years (unadjusted odds ratio (UOR) = 0.43; 95% CI: 0.18–1.04; $p = 0.06$). Mothers who had delivered more than a child (multiparous women) were not significantly less likely to transmit HIV to their infants compared to mothers who had delivered only a child (primiparous women) (UOR = 0.20; 95% CI: 0.52–2.74; $p = 0.666$). Mothers who attended ANC visits during the recent pregnancy were significantly less likely to

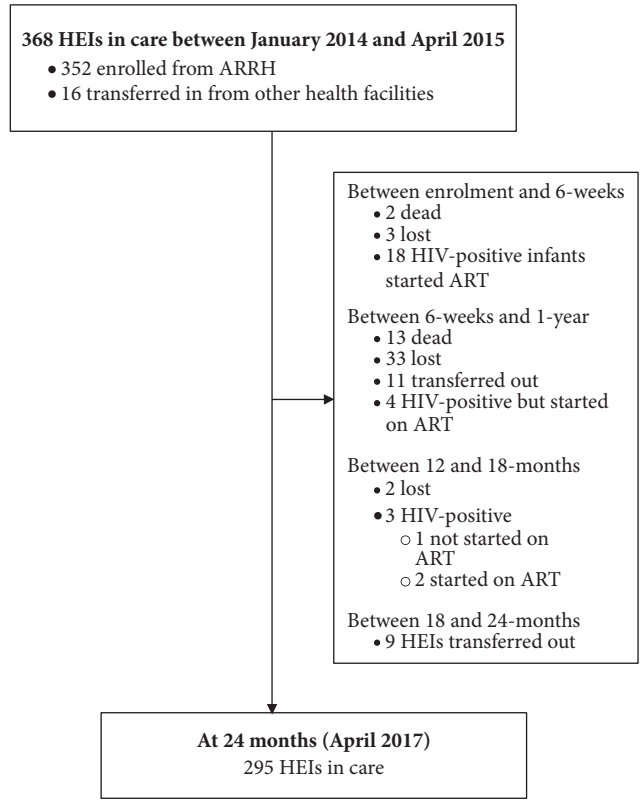

Figure 1: Outcomes of HEIs in 24-month EID continuum of care at ARRH, Northwestern Uganda.

transmit HIV to their infants compared to those who never attended ANC visits (UOR = 0.25; 9% CI: 0.10–0.63; p = 0.003). Mothers who were in WHO clinical stages III/IV were not significantly more likely to transmit HIV to their infants compared to those in WHO clinical stages I/II (UOR = 1.93; 95% CI: 0.72–5.14; p = 0.189). Compared to mothers with baseline CD4 count less than 350 cells/ul, mothers with baseline CD4 counts between 350 and 500 cells/ul (UOR = 0.22; 95% CI: 0.05–1.03; p = 0.055) and with baseline CD4 count above 500 cells/ul (UOR = 0.31; 95% CI: 0.13–0.75; p = 0.009) were less likely to transmit HIV to their infants. Mothers who never delivered in a health facility were significantly more likely to transmit HIV to their infants compared to those who delivered in a health facility (UOR = 2.67; 95% CI: 1.16–6.10; p = 0.02). Mothers who delivered by caesarean section were not significantly more likely to transmit HIV to their infants compared to those who delivered vaginally (UOR = 2.45; 95% CI: 0.96–6.26; p = 0.062). HEIs who never received NVP syrup for HIV prophylaxis after 6 weeks had similar rates of HIV transmission in contrast to those who received NVP syrup after 6 weeks. However, MTCT was significantly lower in HEIs who received NVP syrup for HIV prophylaxis from birth until 6 weeks of age (UOR = 0.08; 95% CI: 0.03–0.20; $p < 0.001$).

Besides this, mothers who exclusively breastfed their infants during the first 6 months of life were significantly less likely to transmit HIV compared to those who never exclusively breastfed their infants during the first 6 months of life (UOR = 0.06; 95% CI: 0.03–0.16; $p < 0.001$). Mothers who were started on ART during labor and delivery were not significantly more likely to transmit HIV to their infants compared to those who were not on ART (UOR = 1.39; 95% CI: 0.22–8.92; p = 0.729). Conversely, mothers who were on lifelong ART were significantly less likely to transmit HIV to their infants compared to those who were not on ART (UOR = 0.11; 95% CI: 0.02–0.50; p = 0.004).

After adjusting for all statistically significant variables at bivariate analysis (Table 3), mothers with baseline CD4 counts of more than 500 cells/ul were significantly less likely to transmit HIV compared to those with baseline CD4 counts below 350 cells/ul (adjusted odds ratio (AOR) = 0.29; 95% CI: 0.10–0.85; p = 0.024). However, mothers with baseline CD4 counts between 350 and 500 cells/ul were not significantly less likely to transmit HIV to their infants compared to those with CD4 count below 350 cells/ul (AOR = 0.30; 95%CI: 0.05–1.65; p = 0.167).

Mothers who exclusively breastfed their infants in the first 6 months of life were significantly less likely to transmit HIV to their infants compared to those who never exclusively breast their infants in the first 6 months of life (AOR = 0.17; 95% CI: 0.52–0.55; p = 0.003).

However, certain factors were not significantly associated with MTCT. Our results indicated that mothers who attended ANC visits during pregnancy were less likely to transmit HIV to their infants compared to those who never attended ANC visits (AOR = 0.55; 95% CI: 0.18–1.70; p = 0.298). Mothers who

Table 2: Bivariate analysis of factors associated with MTCT at ARRH, Northwestern Uganda.

Variable	MTCT along the EID cascade?		Total	Univariable logistic regression analysis	p-value
	No (No., %)	Yes (No., %)		UOR (95% CI)	
Overall	270 (91.5)	25 (8.5)	295		
Maternal age (years)					
Less or equals 30	53 (85.5)	9 (14.5)	62	Ref	
More than 30	217 (93.1)	16 (6.9)	233	0.43 (0.18–1.04)	0.060
Parity (children ever born)					
One	131 (92.2)	11 (7.8)	142	Ref	
More than one	139 (90.8)	14 (9.2)	153	0.20 (0.52–2.74)	0.666
Attended ANC during pregnancy					
No	107 (85.6)	18 (14.4)	125	Ref	
Yes	163 (95.9)	7 (4.1)	170	0.25 (0.10–0.63)	0.003
Baseline WHO Clinical staging					
I & II	232 (92.4)	19 (7.6)	251	Ref	
III & IV	38 (86.4)	6 (13.6)	44	1.93 (0.72–5.14)	0.189
Baseline CD4 count (cells/ml)					
<350	65 (83.3)	13 (16.7)	78	Ref	
350–500	45 (95.7)	2 (4.3)	47	0.22 (0.05–1.03)	0.055
>500	160 (94.1)	10 (5.9)	170	0.312 (0.13–0.75)	0.009
Place of delivery					
Health facility	192 (94.1)	12 (5.9)	204	Ref	
Home	78 (85.7)	13 (14.3)	91	2.67 (1.16–6.10)	0.02
Mode delivery					
SVD	233 (92.8)	18 (7.2)	251	Ref	
Caesarean section	37 (84.1)	7 (15.9)	44	2.45 (0.96–6.26)	0.062
Nevirapine initiation after delivery					
Never at all	22 (62.9)	13 (37.1)	35	Ref	
After 6-weeks	3 (100.0)	0 (0.0)	3	1	
From birth up to 6-weeks	245 (95.3)	12 (4.7)	257	0.08 (0.03–0.20)	<0.001
Exclusive breastfeeding in first 6-months					
No	33 (66.0)	17 (34.0)	50	Ref	
Yes	237 (96.7)	8 (3.3)	245	0.06 (0.03–0.16)	<0.001
Maternal use of ART					
ART naïve	5 (62.5)	3 (37.5)	8	Ref	
Received ART during labor and delivery	6 (54.6)	5 (45.4)	11	1.39 (0.22–8.92)	0.729
On life-long ART	259 (93.8)	17 (6.2)	276	0.11 (0.02–0.50)	0.004

Note. Percentages calculated as row percentages (n/N); ANC: antenatal care; AOR: adjusted odds ratio; ART: antiretroviral therapy; MTCT: mother to child transmission of HIV; NVP: Nevirapine; UOR: unadjusted odds ratio; Ref: reference category.

delivered at home were more likely to transmit HIV to their infants compared to those who delivered in a health facility (AOR = 1.56; 95% CI: 0.57–4.30; $p = 0.389$).

HEIs who received NVP syrup for HIV prophylaxis after 6 weeks of birth had equal chances of HIV transmission compared to those who never received NVP syrup for HIV prophylaxis (AOR = 1). Nonetheless, HEIs who were started on NVP syrup for HIV prophylaxis from birth until 6 weeks of age were more likely to be HIV-positive compared to those who were never started on NVP syrup for HIV prophylaxis (AOR = 2.50; 95% CI: 0.75–8.30; $p = 0.133$).

Compared to mothers who were not on ART, mothers who were started on ART during labor and delivery were more likely to transmit HIV to their infants (AOR = 2.01; 95% CI: 0.21–19.5; $p = 0.545$), while those who were on lifelong ART were less likely to transmit HIV to their infants (AOR = 0.72; 95% CI: 0.10–5.12; $p = 0.72$; 0.10–5.12; $p = 0.742$).

4. Discussion

The objective of this study was to describe MTCT along a 2-year EID continuum of care and to establish maternal and infant factors associated with overall MTCT at ARRH, Northwestern, Uganda.

We found a higher rate of MTCT (8.5%) at the end of 24 months, slightly higher than the national MTCT rate of 7.0%, and significantly higher than 5% MTCT rate recommended for EMTCT by 2020. The rate of MTCT declined with time:

Table 3: Multivariate logistic regression analysis of factors associated with MTCT at ARRH, Northwestern Uganda.

Variable	MTCT along the EID cascade?		Multivariable logistic regression analysis	p-value
	No (No., %)	Yes (No., %)	[X]AOR (95% CI)	
Overall	270 (91.5)	25 (8.5)		
Attended ANC during pregnancy				
No	107 (85.6)	18 (14.4)	Ref	
Yes	163 (95.9)	7 (4.1)	0.55 (0.18–1.70)	0.298
CD4 level (Cells/ml) at enrolment				
<350	65 (83.3)	13 (16.7)	Ref	
350–500	45 (95.7)	2 (4.3)	0.30 (0.05–1.65)	0.167
>500	160 (94.1)	10 (5.9)	0.29 (0.10–0.85)	0.024
Place of delivery				
Health facility	192 (94.1)	12 (5.9)	Ref	
Home	78 (85.7)	13 (14.3)	1.56 (0.57–4.30)	0.389
Nevirapine initiation after delivery				
Never at all	22 (62.9)	13 (37.1)	Ref	
After 6-weeks	3 (100.0)	0 (0.0)	1	
From birth up to 6-weeks	245 (95.3)	12 (4.7)	2.50 (0.75–8.30)	0.133
Exclusive breastfeeding in first 6-months				
No	33 (66.0)	17 (34.0)	Ref	
Yes	237 (96.7)	8 (3.3)	0.17 (0.52–0.55)	0.003
Maternal use of ART				
Never on ART	5 (62.5)	3 (37.5)	Ref	
Received ART during labor and delivery	6 (54.6)	5 (45.4)	2.01 (0.21–19.5)	0.545
On life-long ART	259 (93.8)	17 (6.2)	0.72 (0.10–5.12)	0.742

Note. Percentages calculated as row percentages (n/N); ANC: antenatal care; AOR: adjusted odds ratio; ART: antiretroviral therapy; HAART: highly active ART; MTCT: mother to child transmission; NVP: Nevirapine; UOR: unadjusted odds ratio; X: adjusted for all statistically significant variables at unadjusted analysis; Ref: reference category.

4.9% at 6 weeks, 1.1% at 1-year, and 0.98% at 18 months, similar to previous study conducted across four geographic regions in Uganda [10], Western Kenya [11], and Ethiopia [12]. Also, the overall rate of MTCT at the end of 18 months was higher than that reported previously in Ethiopia at 5.9% [13] although lower than 10.5% in Western Kenya [11]. Overall, the rate of MTCT was unacceptably high, suggesting the need for urgent amelioration interventions. In particular, further studies to understand sociocultural, economic, and health systems related challenges that impact on poor EID performance is worthy. Without reducing the rate of MTCT, the ultimate goal of EMTCT will remain far-fetched in Arua District. Our results challenges all HIV healthcare providers, program managers, and policy makers to pay critical attention in addressing gaps in EID care in order to improve the survival of HEIs and ensure a HIV free generation.

We found lower MTCT in HEIs born to mothers with baseline CD4 count above 500 cells/ul. A baseline CD4 count is a measure of immunosuppression caused by HIV and is useful in monitoring response to ART [14].

CD4 depletion (low CD4 count) is a huge risk factor for MTCT [15]. Our findings conform the importance of starting ART early, when the immune system is still strong: high CD4 cell count and low viral load.

Our finding supports a previous study that indicates people who start ART at lower CD4 cell count have high mortality, rapid HIV progression to advance stages, or even more aggressive nonopportunistic infections [14]. It is therefore likely that mothers with CD4 count more than 500 cells/ul at baseline had lower viral loads; this combined with immediate ART initiation upon HIV diagnosis presents a great opportunity for rapid virologic suppression and reduced risk of MTCT. This result has implication for the current nationwide implementation of the test and treat HIV policy, where all HIV-positive persons are started on ART irrespective of the CD4 cell count, WHO clinical stage and age, and the triple 90-90-90 HIV global targets. Our result emphasizes the importance of healthcare systems in diagnosing at least 90% of pregnant women with HIV as early as possible, initiating them on HIV treatment on same day, and retaining them in care. This will ensure optimal ART adherence and virologic suppression, thus preventing MTCT along the EID continuum of care.

We found exclusive breastfeeding in the first 6 months of life reduced MTCT. Even though formula (replacement) feeding offers the safest option for HIV prevention, in resource poor settings, it is impossible for families to afford formula feeds or access clean water for its use.

Consequently, the WHO recommended exclusive breastfeeding for infants born to HIV-positive mothers during the first 6 months of life provided such mothers are on lifelong ART [16]. However, breastfeeding HEIs remains a

challenge because of the difficulties in balancing the risk of HIV transmission against infant death from malnutrition, diarrhea and pneumonia. With ART intervention, evidence indicates that the risk of HIV transmission is substantially low [17]. Our finding confirms past study that found increased risk of MTCT at 6, 12, and 18 months in HEIs who were mixed fed compared to those who were exclusively breastfed [18]. Furthermore, it agrees with a study in South Africa that found low MTCT in HEIs who were exclusively breastfed in the first 3 months compared to those who were mixed fed [19]. Since a big proportion of the population in Arua District is poor to afford formula feeds, healthcare workers must continue to provide accurate information to HIV-positive mothers regarding infant feeding options. In particular, the importance of breastfeeding to the mother and the infant must be critically emphasized in addition to nutritional advice, counseling, and support.

Although our study highlighted important contextual factors associated with MTCT along the EID continuum of care, it has limitations that must be considered in its interpretation. First, we used secondary data collected primarily for routine clinical care; hence important sociodemographic factors (like wealth index, educational level, and access to transportation, among othersïż£) that are potential in influencing MTCT were not investigated.

In other words, the study variables were nonexhaustive, and a much better understanding would have been by using primary data. Second, this study did not consider HEIs who were transferred out of the EID program in its outcome measure. Third, the absence of qualitative data to explain the quantitative findings is another limitation. We propose that future research should use a mixed methods research approach to exhaustively study MTCT along the EID continuum of care. Despite these limitations, the overall MTCT at the end of 18 months was higher than recommended for EMTCT at ARRH. A pressing need therefore exists at ARRH in improving EID performance in order to eliminate MTCT, reduce HIV morbidity and mortality, and improve the overall HEI survival. In addition, as early enrolment of mothers (at a time when the immune system is strong) into the EID program and exclusive breastfeeding of HEIs in the first 6 months reduced MTCT, the healthcare system should address late and none ANC attendance among pregnant women and mixed infant feeding through targeted health education talks.

Abbreviations

AIDS: Acquired Immunodeficiency Syndrome
ART: Antiretroviral Therapy
ARRH: Arua Regional Referral Hospital
CD4: Cluster of differentiation four
EID: Early Infant Diagnosis
HEI: HIV Exposed Infant
HIV: Human Immunodeficiency Virus
EMTCT: Elimination of Mother to Child Transmission of HIV
PMTCT: Prevention of Mother to Child Transmission of HIV.

Data Availability

To protect participants anonymity, data will not be shared unless on reasonable request.

Ethical Approval

This study was approved by Research Ethics Committees of Mbarara University of Science and Arua Regional Referral Hospital.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Jonathan Izudi and Francis Bajunirwe contributed to study conception and design; Pontius Apangu contributed to acquisition of data; Jonathan Izudi and Francis Bajunirwe contributed to analysis and interpretation of data; Jonathan Izudi and Francis Bajunirwe contribute to drafting of manuscript; Jonathan Izudi, Pontius Apangu, Francis Bajunirwe, Edgar Mulogo, and Vincent Batwala contribute to critical revision. Jonathan Izudi, Pontius Apangu, Francis Bajunirwe, Edgar Mulogo, and Vincent Batwala are responsible for final approval of manuscript.

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