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Research Article

Assessing the Effectiveness of the Strategy for the Prevention of Mother to Child Transmission of HIV at the 37 Military Hospital, Accra

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Abstract

Background: The World Health Organization (WHO) has been recommending strategies to combat mother-to-child transmission (MTCT) of the Human immunodeficiency Virus (HIV), and Ghana is one of the countries in the forefront of implementing these guidelines in their health institutions. Accordingly, the 37 Military Hospital, a prominent hospital in Ghana, has adopted the 2015 Option B+ strategy.

Context and purpose: This study seeks to determine the success rate of the Prevention of Mother to Child Transmission (PMTCT) strategy at the Military hospital and to ascertain whether demographic parameters and interventions like maternal adherence to antiretroviral therapy (ART), trimester of initiation of antiretrovirals (ARVs), delivery and feeding options play a role in the determination of the retroviral status of her baby as determined by Polymerase Chain Reaction (PCR) test at 6 weeks postnatal.

Methods and results: Purposive sampling was employed in the retrieval of retrospective data of HIV pregnant women from 2011 to 2015 from the antenatal, public health and paediatric clinics. The main variables collected and analysed included demographic details, trimester of initiation of ARVs, feeding and delivery options. The reviewed and cleaned data was then analysed using Excel and SPSS® (Version 21).We find that the average prevalence rate of HIV was 1.56% at the antenatal clinic (ANC). Interestingly, of the 114 exposed babies born to the 109 women analyzed, only 3 (2.6%) (Representing prevalence among children born to infected mothers) tested positive indicating a success rate of 97.4%. Demographic details, trimester of initiation of ARVs, delivery and feeding options appear to have no effect on the HIV status of a baby born to a woman on ARVs.

Conclusions: The success rate of 97.4% at the Military hospital, though impressive, falls short of the targeted elimination of vertical transmission at the end of 2015 by the National AIDS Control program (NACP). This study posits that measures including the prompt enrolment of HIV infected pregnant women identified at ANC into care, improving adherence counselling and adequate supply of ARVs will help in achieving a zero transmission rate.

ABBREVIATIONS

AIDS: Acquired Immune Deficiency Syndrome; ANC: Ante Natal Clinic; ART: Antiretroviral Therapy; ARV: Anti Retro Viral; AZT: Zidovudine; CD4: Cluster Differentiation 4 cells/ T4 helper cells; DNA: Deoxyribonucleic Acid; eMTCT: elimination of Mother to Child Transmission; HAART: Highly Active Antiretroviral Therapy; HIV: Human Immunodeficiency Virus; IATT: Inter Agency Task Team; NVP: Nevirapine; MOH: Ministry of Health; MTCT: Mother To Child Transmission; NACP: National AIDS/STI Control Programme; PCR: Polymerase Chain Reaction; PLHIV: Persons Living with HIV; RCH: Reproduction and Child Health; PMTCT: Prevention of Mother to Child Transmission; WHO: World Health Organization; TB: Tuberculosis; UNICEF: United Nations Children's Education Fund

INTRODUCTION

Prevention of Mother-to-Child Transmission (PMTCT)

Research shows that about 90% of all children who get the HIV infection acquire it from their retroviral positive mothers (vertical transmission) either *in utero*, during labour and delivery or through breastfeeding [1]. Research by Kourtis et al., (2006) further indicated that about a 50% transmission rate occur just before labour and during delivery in non-breastfeeding populations compared to about 40% transmission rate seen in exposed babies who actually breastfeed [2]. However other studies incorporating statistical modelling analysis concluded that there is a higher rate of transmission between 28-36 weeks of pregnancy [3]. Various studies have also highlighted the fact

Coleman-Sarfo et al. (2016)
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that without any form of intervention, vertical transmission is between 15-40%. (www.avert.org).An earlier study conducted in the United States and France; ACTG protocol 076 in 1993 [4] had paved the way for further studies that has buttressed the possibility of significant decreases in vertical transmission. Other landmark studies which contributed to the adoption of the PMTCT strategy included the ACTG 082 [5], HIV Net 052 [6], ACTG 049 [7], the Thai [8], Ditrame [9] and Swiss [10] studies. In 2010, WHO launched a global comprehensive strategy for PMTCT and encouraged all nations to adopt the practice. This intervention if initiated timeously, drastically decreases the risk of vertical transmission to levels below 2%-5% [11]. To achieve this, PMTCT strategies must be implemented by health institutions of nations worldwide. Some of these programs would include encouraging all pregnant women to attend ANC and then counselling and testing them for HIV. Those testing positive should receive ARVs, undergo appropriate delivery and infant feeding options as well as be offered other post-natal healthcare services including testing the infants 6 weeks post-partum [12]. Studies have shown that factors influencing MTCT may be classified under maternal, gynaecological, fetal and infant factors [13]. Important among these are decreased maternal cluster differentiation 4 cells(CD4) count, elevated maternal viral load, advanced clinical disease, primary infection, first born twins, type of delivery and breast feeding.

The comprehensive PMTCT strategic vision promoted by the WHO between 2010 and 2013 for member nations included a four- prong approach:

a) Preventing new retroviral infections in women of reproductive age group.

b) Prevention of accidental pregnancies in women living with the virus.

c) Prevention of virus from mother to child.

d) Providing suitable treatment, care and support to mothers living with the virus and their families [14].

This was followed in 2015 by the recommendations of new strategies which advocated the provision of lifelong ARVs for all retroviral positive pregnant and lactating women regardless of CD4 count or clinical staging [15].

Ghana's HIV statistics

The 2013 HIV sentinel survey reported that, the national HIV prevalence was 1.3% in 2013 with HIV type 1 remaining dominant at 97.1%. HIV type 11 was 0.8% and type 1&11, 2.1%. The estimated number of persons living with HIV (PLHIV) consisted of 189,931 adults and 34,557 children, totalling 224,488. There were 7,812 reported new infections, comprising of 5,405 adults and 2,407 children under 14 years. The survey further reported that 7,826 adults and 2,248 children died from HIV/AIDS related illnesses that year. An estimated number of PLHIV needing ART for 2013 was pegged at 129,396. About 11,682 mothers also needed PMTCT services. The prevalence of HIV among pregnant women who attended antenatal clinic in 2013 dropped from 2.1% in 2012 to 1, 9%. The survey highlighted the varied prevalence rates in different parts of the country. Both urban and rural sites reported average prevalence of 2.4% and 0.2% respectively [16].

Ghana's PMTCT strategy

In Ghana, vertical transmission will account for up to about 30% of PLHIV without any intervention. Fortunately the comprehensive guidelines adopted by the nation have been able to drive the figures down substantially over the period. Strategies for mitigating MTCT was initiated in Ghana by the Ghana Health Service (GHS) and Ministry of Health (MOH) with support from Ghana's Development partners. The strategy has evolved from just prevention of vertical transmission to the four- prong approach proposed by WHO [16]. Though HIV counselling and testing services were patronized by 53% of all pregnant women nationwide, by the end of 2009 only 74% of those tested had their status revealed to them out of which 55% were put on ARVs. The prevalence rate among those tested was 1.7% [17].

According to National AIDS Control Program/Ghana Health Service (NACP/GHS) reports, there has been a drop in prevalence since 2010. The HIV Sentinel Survey also noted that the median HIV prevalence among pregnant women attending ANC had decreased from 3.6% in 2003 to 1.9% in 2013, with that in the general population declining to 1.3% in 2013 from 1.5% in 2011 [18]. Indeed the years 2009- 2014 recorded prevalence rates of 2.9%, 2%, 2.1%, 2.1%, 1.9% and 1.6% respectively among pregnant women [19].

PMTCT of HIV strategy in Ghana has gone through various stages from2006 (when it was first instituted) where a combination of two ARVs was used for PMTCT. This was later superseded by the use of triple ARVs in 2010. Although the PMTCT strategy had commenced throughout Ghana, access and utilization of facilities and services were not optimal creating a wide variation in uptake in different regions with the capacity to provide early diagnosis of HIV among infants remaining a huge challenge. Thus in 2013, Ghana adopted the WHO revised guidelines, "Option B" which entails the routine offer of HV testing and Counselling to all pregnant women, provision of a triple fixed combination ARVs to those found positive regardless of their CD4 count for as long as they breastfeed,6 week supply of Zidovudine (AZT) syrup for their new born babies and testing by PCR for the exposed baby at 6 week post-natal. Under the Option B, ARVs are continued after the breastfeeding period only if the mother was eligible for treatment for her own health [20].

The number of healthcare facilities providing PMTCT services in Ghana as at December 2013 was 1,656 representing 44% of all healthcare facilities in the country. With the implementation of the adopted "Option B^+ " guidelines at all levels of healthcare, Ghana expects to completely eliminate MTCT (eMTCT) of HIV by the end of 2015 [20].

Rationale for study, aims and objectives

Although Ghana was operating under the Option A strategy in 2006, the early adoption of the comprehensive PMTCT strategy under the Option B in 2009 led to Ghana being among the seven countries in Sub Saharan Africa that has reduced vertical infections by over 50% since2009 [21]. In spite of Ghana's achievements, transmission (or success) rate under the PMTCT strategies was 6% (or 94%) 7% (or 93%) and 7.9% (or 92.1%) respectively in 2012, 2013 and 2014 [22]. Comparatively the rate

Coleman-Sarfo et al. (2016)
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in developed countries was less than 2% (or 98%) within the period. To further improve outcomes, Ghana has duly adopted all the revised WHO recommendations at all levels of healthcare delivery, including private hospitals and maternity homes, with the aim of eliminating MTCT (eMTCT) of HIV by 2015 [20].

Although the 37 Military Hospital in Ghana implemented the PMTCT strategy in 2011 and has greatly increased case detection of HIV among pregnant women attending ANC through the "opt out" strategy, an exact success rate has not been documented. Success rates in ART centres globally show very encouraging results with average rates well over 70%. Given that, in Ghana, the success of the strategy has been lauded as a means of encouraging the adoption, it will be informative to analyse how the success rate at the Military Hospital compares with the rates especially in Sub Saharan Africa. Furthermore, it will be highly informative for Ghana's public health officials and policy makers to know whether demographic factors, the trimester of initiation of the ARVs , breastfeeding and delivery options has any effect on the retroviral status of the new born baby as determined by DNA PCR test at 6 weeks.

The main aim of the study is to determine the exact success rate of the PMTCT of HIV at the 37 Military Hospital and to ascertain if demographic parameters of the HIV positive pregnant woman who has taken ARVs play a role in the retroviral status of her baby. Specific objectives include establishing a constant supply of ARVs and a 6-week supply of AZT syrup to the HIV positive woman from initiation to 6 weeks post-partum and to determine whether the trimester of initiation of ARVs, as well as the delivery and breastfeeding options has any influence on the status of the baby at 6 weeks.

METHODS

The 37 Military Hospital is situated in Accra the capital city of Ghana. It was initially set up in 1941 to cater for Military Personnel and their families. It is a 500 bedded hospital currently opened to the general public. It is also a referral centre for other smaller medical facilities in Accra. It caters to over a thousand patients daily on outpatient basis [23].The ART center was established at the Military Hospital in December 2006, and currently manages about 2,000 adult clients and 100 paediatric patients. The HIV Counselling and Testing (HCT) unit is opened to the general public and is well-attended. The prevalence rates noted at the ANC in 2014 and 2015 was 1.82% and 1.57% respectively, with the average prevalence rate recorded at 1.56% between the study periods 2011-2015 (Table 1). An urban center Agomanya recorded prevalence rates of 8.5% and 6.2% in 2014 and 2015, whilst a rural center Wenchi recorded rates of 1.5% and 0.6% respectively, both indicating a decrease in trends [19].

Study participants

The study sample included positively diagnosed HIV pregnant women between June 2011 and December 2015 who had subsequently been referred to the ART clinic for care. These women must have honoured (documented visits in folder) all adherence counselling appointments and must have been supplied with ARVs from the time they were enrolled into the program. The pregnant women irrespective of breastfeeding and delivery options must have been provided with the 6 weeks supply of AZT syrup for her baby. The enrolled women should also have tested their babies at the facility at age 6 weeks by DNA PCR. Those excluded from the study are pregnant women who tested positive at the ANC but chose not to get enrolled into the PMTCT program. Excluded also are those who failed to come in for the Zidovudine syrup for their babies and mothers who though did not enrol into care at the facility came in only to test their 6 weeks old babies.

Data collection technique and procedure

Retrospective data from ANC, PMTCT, early infant diagnosis (EID) registers and patients' medical records between June 2011 and December 2015 was extracted and entered into Excel. Variables collected included mothers' age and test date, educational level, religion, marital status, trimester of initiation of ART, mode of delivery, infant feeding option and new born baby's retroviral status. Data collection started in June 2011 because that was when the PMTCT strategy was implemented at the hospital a total of 453 records of HIV positive mothers who had attended ANC, public health or paediatric clinic were reviewed (Figure 1).

Table 1: HIV Testing at the Antenatal Clinic from 2012-2015.

	HIV Testing			PMTCT	
Year of Diagnosis	**No. Tested**	**No. Positive**	**Prevalence (%)**	**No. Enrolled**	**(%) Enrolled**
2011	.	.	.	9	.
2012	3,505	43	**(1.23)**	25	(58.14)
2013	2,478	43	**(1.74)**	24	(55.81)
2014	2,796	51	**(1.82)**	33	(64.71)
2015	2,810	44	**(1.57)**	27	(61.36)
Total	11,589	181	**(1.56)**	109*	(60.22)

* 2012-2015

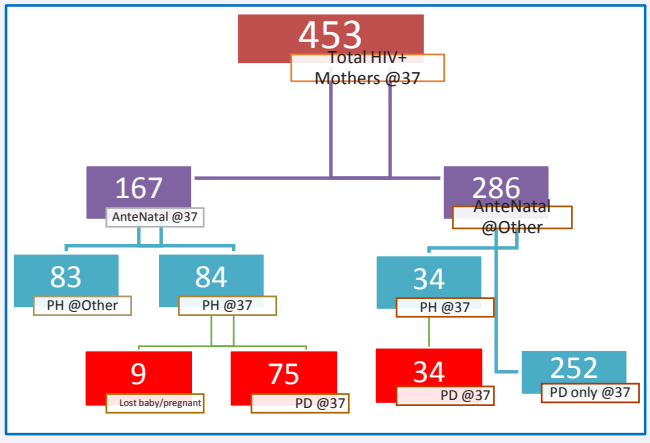

Figure 1 HIV Positive Mothers Attending Clinics from 2011-2015 (Reviewed records).
Notes: '@37' refers to attendance at 37Military hospital, whereas' @other 'denotes attendance at other facilities. PH refers to Public health clinic, PD refers to Paediatric clinic, and AnteNatal refers to Antenatal clinic." Enrolled patients" in the 3 red boxes (9+75+34 = 118), "Analysis patients" in 2 red boxes (75+34= 109)

Initially 118 women were enrolled into the study but only 109 qualified to be analysed (Table 2). Since the study period was up to December 2015, pregnant women who had tested positive within the period were included and subsequently followed up at the paediatric department to get the status of their babies. The other nine were disqualified at the time of data cleaning and analysis because they either missed appointments or lost their babies before the 6 week PCR test. Out of a total of 367 babies tested at 6 weeks within the study period only 114 babies could be matched to the 109 mothers included in the study.

Data management and statistical analysis

The reviewed sets of data (prenatal, public health and paediatric data) were then entered into Excel spreadsheets and exported into SPSS® (version 21). The datasets were then merged and computer-based integrity checks and corrections were performed for completeness and consistencies. In addition, patient follow-up telephone calls as well as consultations with hospital personnel were conducted to further clean and bolster the integrity of the data. All summary tabulations of counts and percentages were performed using SPSS® (version 21). Statistical tests however were conducted and *p*-values computed using SAS® (version 9.4). Graphical presentations were also generated using SAS® ODS Graphics procedures SGPLOT).

The significances of associations, if any, between these characteristics and the trimester of initiation of ARV therapy were determined using Mantel Haenszel Chi-square tests [24], where attributes were ordinal in nature, e.g., age category. All statistical tests were to be conducted as two-sided, and declared significant for *p*-value < 0.05.

Success Rates for the Strategy

The incidences of negative ("success") and positive retro-viral status in the newly-born babies were to be summarized and frequency counts and percentages tabulated by year of diagnosis of the retro-positive mothers (i.e., 2011 to 2015). The yearly success rates (number of negative status, relative to total number of babies tested at six weeks) and the overall success rate were also presented along with the estimated Walden asymptotic confidence intervals (based on normal approximation), adjusted for continuity [25,26].

Equality tests were to be conducted on each yearly success rates as well as the overall success rate compared with the most currently available figures for Ghana to determine whether the implementation of strategy at 37 Military Hospital produces statistically different results from the national ones. Similar tests were to be conducted comparing 37 Military Hospital success rates with available figures for the sub region.

RESULTS

HIV Testing at the Antenatal Clinic

Table (1) illustrates the results of antenatal HIV tests conducted at the hospital between 2011 and 2015 along with the prevalence rates. This has been juxtaposed along the 'analysis' women in the study. Of the 11,589 pregnant women who tested at the ANC during this period, only 181 were found to be retroviral positive, representing an average prevalence rate of 1.56%.

Table 2: HIV-Positive Mothers Attending Clinics from 2011-2015.

Clinics Attended	n	(%)
1. Antenatal Only	83	(18.3)
2. Antenatal & Public Health Care Only	9	(2.0)
3. Antenatal, Public Health & Paediatric Care	75	(16.6)
4. Public Health Care Only	0	(0.0)
5. Public Health & Paediatric Care Only	34	(7.5)
6. Paediatric Care Only	252	(55.6)
Total	453	(100)

Disposition of HIV positive pregnant mothers

Table (2) describes the disposition of the women who were considered for the study. These were made up of 453 records of HIV-positive mothers who had attended ANC, public health or paediatric clinics from 2011 – 2015.Eighty- three 83 (18.3%) pregnant women who tested HIV-positive were lost to follow-up after ANC. Nine (2.0%) were initially enrolled to the strategy, but were excluded during the analysis because they either lost their pregnancies/ babies, or were lost to follow-up after going through public health care. Seventy-five (16.6%) of the women were enrolled to the strategy after ANC, public health clinic and paediatric care for their babies at the hospital. Thirty-four (7.5%) of these pregnant women had ANC elsewhere, but were enrolled to the PMTCT strategy for public health care and paediatric care for their babies. Two hundred and fifty-two (55.6%) of the women attended other clinics elsewhere but only brought their babies to be tested at 6 weeks at the paediatric clinic and were thus excluded.

HIV testing at the paediatric Clinic

Although the study enrolled retroviral positive pregnant women from 2011 to 2015, there were 4 of such patients who gave birth in 2016, and therefore required a waiting period to determine the babies' status.

Only 3 out of the 114 (or 2.6%) analysis babies tested positive to the HIV tests, with 2 recorded in 2015 and 1 recorded in 2016 (Table 4).

In all 118 patients were enrolled and 109 (or 92.4%) patients were deemed qualified for analysis as illustrated in table 5 above. Majority of the 109 analysis patients (44 or 40.4%) initiated ARV therapy in the second trimester and delivered 47 or 41.2% of the new born babies. This is followed by 33 or 30.3% analysis patients who initiated therapy in the first trimester of pregnancy and who accounted for 35 or 30.7% of the babies. Only 14 or 12.8% of these patients initiated therapy during the third trimester, accounting for 14 or 12.3% of the 114 new born babies.

Most of the babies (77 or 67.5%) were breastfed, with the remaining 37 or 32.5% fed artificially. The mode of delivery of the new born babies was almost equally balanced between vaginal (50.9%) and caesarean (49.1%).

Eighteen (18 or 16.5%) of the 109 analysis patients were already on ARV therapy before their latest pregnancies, and accounted for 18 or 15.8% of the newly born babies. Ten (10) or 13.0% of the 77 breastfed babies were delivered by this group

Table 3: Inclusion Criteria.	
1	Enrolled into Strategy (ANC,PH,PC)&(PH,PC) at 37 Military Hospital
2	Adhered to counseling appointments and were supplied with ARVs
3	Received six-week supply of Zidovudine syrup for babies
4	Satisfied Inclusions 1, 2, and chose to breastfeed/artificially feed babies
5	Satisfied Inclusions 1,2,3,4 and delivered by either vaginal or caesarean
ANC: Antenatal; PH: Public Health; PC: Pediatric Clinic	

Table 4: HIV Testing at the Paediatric Clinic, from 2011-2016.

	Babies of all Patients						Babies of Analysis Patients					
	All Tests		Positive		Negative		All Tests		Positive		Negative	
Babies' Year of Diagnosis	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
2011	42	(11.4)	3	(0.8)	39	(10.6)	6	(5.3)	0	(0.0)	6	(5.3)
2012	60	(16.3)	6	(1.6)	54	(14.7)	16	(14.0)	0	(0.0)	16	(14.0)
2013	96	(26.2)	9	(2.5)	87	(23.7)	24	(21.1)	0	(0.0)	24	(21.1)
2014	97	(26.4)	7	(1.9)	90	(24.6)	35	(30.7)	0	(0.0)	35	(30.7)
2015	66	(18.0)	12	(3.3)	54	(14.7)	29	(25.4)	2	(1.8)	27	(23.7)
2016	4	(1.1)	1	(0.3)	3	(0.8)	4	(3.5)	1	(0.9)	3	(2.6)
(Missing Date)	2	(0.5)	0	(0.0)	2	(0.5)	.	.	.	.	.	.
Total	367	(100)	38	(10.4)	329	(89.6)	114	(100)	3	(2.6)	111	(97.4)

Table 5: Disposition of Patients, by Trimester of Initiation of Therapy.

Patients' Disposition		Trimester of ARV Initiation									
		0++		1st		2nd		3rd		Total	
		n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
No. of Patients Enrolled:		18	(15.3)	37	(31.4)	47	(39.8)	16	(13.6)	118	(100)
No. of Analysis Patients		18	(16.5)	33	(30.3)	44	(40.4)	14	(12.8)	109	(92.4)
No. of New Born Babies		18	(15.8)	35	(30.7)	47	(41.2)	14	(12.3)	114	(100)
No. Babies Fed by	**Artificial**	8	(21.6)	12	(32.4)	12	(32.4)	5	(13.5)	37	(32.5)
	Breast	10	(13.0)	23	(29.9)	35	(45.5)	9	(11.7)	77	(67.5)
No. Babies Delivered by	**Vaginal**	7	(12.1)	18	(31.0)	27	(46.6)	6	(10.3)	58	(50.9)
	Caesarean	11	(19.6)	17	(30.4)	20	(35.7)	8	(14.3)	56	(49.1)

0++ : Already on ARV therapy prior to current pregnancy

of analysis patients who were already on medication. Also, 11 or nearly 20% of the 56 caesarean births came from this group.

Socio demographic characteristics by trimester of initiation of therapy

The summary of socio-demographic characteristics for the 118 patients who were enrolled in the study from 2011-2015 are presented in (Table 6) by trimester of initiation of ARV therapy and patients who were already on ARV therapy. The age group of the patient does not seem to have any significant bearing on the trimester of initiation of therapy (p = 0.285). The trimester of initiation of therapy does not seem to be influenced by the marital status of the patient (p = 0.912). There is no association (p = 0.351) between level of education (JHS or lower, SHS or higher) and trimester of initiation of ARV therapy. The trimester of initiation appear to be independent of religious affiliation.

Socio-Demographic characteristics of patients & retroviral status of baby

Interventions and retroviral status of baby: There were only 3 retroviral positive babies recorded as the outcome among the 114 babies within the study period (Table 8). These 3 babies were born to mothers who adhered to ARVs and were supplied with Zidovudine syrup. One of the babies was born to a woman already on ARVs prior to getting pregnant. Additionally

Table 6: Demographic Characteristics of Patients, by Trimester of Initiation of Therapy.

Characteristics of Patients		Trimester of ARV Initiation										
		0++		1st		2nd		3rd				
		n	(%)	n	(%)	n	(%)	n	(%)	Total	(%)	*p*-value
Age Group (yrs)	≤ 20	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0.285
	21 – 30	4	(3.4)	12	(10.2)	21	(17.8)	4	(3.4)	41	(34.7)	
	31 – 40	14	(11.9)	24	(20.3)	22	(18.6)	10	(8.5)	70	(59.3)	
	≥ 41	0	(0)	1	(0.8)	4	(3.4)	2	(1.7)	7	(5.9)	
	Total	18	(15.3)	37	(31.4)	47	(39.8)	16	(13.6)	118	(100)	
Marital Status	Single	2	(1.7)	6	(5.1)	8	(6.8)	2	(1.7)	18	(15.3)	0.912
	Married	11	(9.3)	29	(24.6)	34	(28.8)	14	(11.9)	88	(74.6)	
	Cohabiting	4	(3.4)	2	(1.7)	5	(4.2)	0	(0)	11	(9.3)	
	Divorced	1	(0.8)	0	(0)	0	(0)	0	(0)	1	(0.8)	
	Total	18	(15.3)	37	(31.4)	47	(39.8)	16	(13.6)	118	(100)	
Educational Level	No Education	3	(2.5)	1	(0.8)	8	(6.8)	0	(0)	12	(10.2)	0.351
	Primary	3	(2.5)	3	(2.5)	5	(4.2)	4	(3.4)	15	(12.7)	
	JHS	5	(4.2)	13	(11.0)	9	(7.6)	6	(5.1)	33	(28.0)	
	SHS	3	(2.5)	10	(8.5)	15	(12.7)	3	(2.5)	31	(26.3)	
	Tertiary	4	(3.4)	10	(8.5)	10	(8.5)	2	(1.7)	26	(22.0)	
	Unknown	0	(0)	0	(0)	0	(0)	1	(0.8)	1	(0.8)	
	Total	18	(15.3)	37	(31.4)	47	(39.8)	16	(13.6)	118	(100)	
Religion	Christian	14	(11.9)	33	(28.0)	38	(32.2)	14	(11.9)	99	(83.9)	0.543
	Muslim	4	(3.4)	4	(3.4)	9	(7.6)	2	(1.7)	19	(16.1)	
	Total	18	(15.3)	37	(31.4)	47	(39.8)	16	(13.6)	118	(100)	

0++ Already on ARV therapy prior to current pregnancy

Note: Category of patients already on medication excluded from tests. Unknown categories excluded from tests. Sparse categories combined meaningfully with next higher/lower ones for test purposes. *P*-values based on Mantel-Haenszel chi-square statistic.

Table 7: Socio-Demographic Characteristics of Patients& Retroviral Status of Baby.

Characteristics of Patients		Retroviral Status of Baby					
		Negative		Positive			
		n	(%)	n	(%)	Total	(%)
Age Group (yrs)	≤ 20	0	(0)	0	(0)	0	(0)
	21 – 30	38	(33.3)	2	(1.8)	40	(35.1)
	31 – 40	68	(59.6)	1	(0.9)	69	(60.5)
	≥ 41	5	(4.4)	0	(0)	5	(4.4)
	Total	111	(97.4)	3	(2.6)	114	(100)
Marital Status	Single	16	(14.0)	0	(0)	16	(14.0)
	Married	82	(71.9)	3	(2.6)	85	(74.6)
	Cohabiting	12	(10.5)	0	(0)	12	(10.5)
	Divorced	1	(0.9)	0	(0)	1	(0.9)
	Total	111	(97.4)	3	(2.6)	114	(100)

Table 7: Socio-Demographic Characteristics of Patients& Retroviral Status of Baby.

Characteristics of Patients		Retroviral Status of Baby					
		Negative		Positive			
		n	(%)	n	(%)	Total	(%)
Educational Level	No Education	13	(11.4)	0	(0)	13	(11.4)
	Primary	12	(10.5)	1	(0.9)	13	(11.4)
	JHS	31	(27.2)	1	(0.9)	32	(28.1)
	SHS	30	(26.3)	1	(0.9)	31	(27.2)
	Tertiary	24	(21.1)	0	(0)	24	(21.1)
	Unknown	1	(0.9)	0	(0)	1	(0.9)
	Total	111	(97.4)	3	(2.6)	114	(100)
Religion	Christian	93	(81.6)	3	(2.6)	96	(84.2)
	Muslim	18	(15.8)	0	(0)	18	(15.8)
	Total	111	(97.4)	3	(2.6)	114	(100)

Table 8: Interventions & Retroviral Status of Baby.

Intervention		Retroviral Status of Baby					
		Negative		Positive			
		n	(%)	n	(%)	Total	(%)
ADHERENCE TO ARV	No	0	(0)	0	(0)	0	(0)
	Yes	111	(97.4)	3	(2.6)	114	(100)
	Total	111	(97.4)	3	(2.6)	114	(100)
ZIDOVUDINE SUPPLY	No	0	(0)	0	(0)	0	(0)
	Yes	111	(97.4)	3	(2.6)	114	(100)
	Total	111	(97.4)	3	(2.6)	114	(100)
TRIMESTER OF ARV INITIATION	0++	17	(14.9)	1	(0.9)	18	(15.8)
	1st	34	(29.8)	1	(0.9)	35	(30.7)
	2nd	46	(40.4)	1	(0.9)	47	(41.2)
	3rd	14	(12.3)	0	(0.0)	14	(12.3)
	Total	111	(97.4)	3	(2.6)	114	(100)
FEEDING OPTIONS	Artificial	37	(32.5)	0	(0.0)	37	(32.5)
	Breast	74	(64.9)	3	(2.6)	77	(67.5)
	Total	111	(97.4)	3	(2.6)	114	(100)
MODE OF DELIVERY	Vaginal	55	(48.2)	3	(2.6)	58	(50.9)
	Caesarean	56	(49.1)	0	(0.0)	56	(49.1)
	Total	111	(97.4)	3	(2.6)	114	(100)

all the 3 babies were vaginally delivered and breastfed. The incidences however were too few to warrant any meaningful statistical analysis via binary logistic models that would capture the influences or the associations (and the degree) of socio-demographic characteristics and the strategy interventions with the retroviral status of the babies. The low positive outcome has to be attributed to the highly successful implementation of the strategy.

Success of the PMTCT program in Sub Saharan Africa

The (Table 9) reproduced above depicts the success rates / rankings for the year 2015 for twenty selected sub-Saharan countries (including Ghana) where PMTCT strategies have been implemented. The 2015 success rate for 37 Military Hospital is also included, in relation to these countries. It is noted that for 2015, the Hospital's success rate (95.0 %) is higher than the figures for eight of these countries, including the national success rate for Ghana (92.1 %), but lower than those for twelve other countries in the sub-region.

The prevalence of HIV in the 114 babies born to the 109 mothers diagnosed as retro-positive is summarized in (Table 10).

The success rates are presented by year of diagnosis of the mothers. Table (10) also presents the corrected Wald asymptotic 95% confidence intervals for the expected success rates based on the data analysed. The study resulted in only 3 retro-viral positive

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Table 9: Six-Week PMTCT Success Rates for 2015.

Country	2015 Success Rate (%)	Rank
UGANDA	98.7	1
SOUTH AFRICA	98.6	2
SWAZILAND	98.3	3
NAMIBIA	98.1	4
BOTSWANA	97.9	5
ZAMBIA	97.2	6
MOZAMBIQUE	97.0	7
BURUNDI	96.8	8
TANZANIA	96.4	9
ZIMBABWE	96.0	10
MALAWI	95.7	11
KENYA	95.2	12
37 MILITARY HOSPITAL	**95.0**	
CAMEROON	94.8	13
COTE D'IVOIRE	94.3	14
LESOTHO	93.8	15
DR CONGO	92.4	16
GHANA	92.1	17
CHAD	89.1	18
ANGOLA	88.9	19
NIGERIA	86.9	20
Average (Excl 37 Mil. Hosp)	**94.9**	

Source: UNAIDS ESTIMATES 2016

Table 10: Success Rates for Babies from Analysis Patients.

Patients' Year of Diagnosis	Success Rate (Neg. Tests)			95% Conf. Int. (%)		*P*-values for comparing 2015 rates	
	n	(%)	Total Babies			Ghana 92.1%	Sub-Reg 94.9%
2011	11	**(100)**	11	**(95.45,**	**100.00)**	**0.680**	**0.933**
2012	26	**(96.3)**	27	**(87.32,**	**100.00)**	**0.652**	**0.914**
2013	24	**(100)**	24	**(97.92,**	**100.00)**	**0.291**	**0.502**
2014	31	**(96.9)**	32	**(89.28,**	**100.00)**	**0.501**	**0.916**
2015	19	**(95.0)**	20	**(82.95,**	**100.00)**	**0.947**	**0.626**
Overall	111	**(97.4)**	114	**(93.99,**	**100.00)**	**0.056**	**0.325**

Wald asymptotic Confidence Intervals, with computed *p*-values using Normal approximations, corrected for continuity.

babies as outcomes, one occurrence each for 2012, 2014 and 2015, indicating that the interventions employed in the strategy were quite effective. Although the yearly PMTCT success rates at the Hospital were each higher than the 2015 National PMTCT strategy success rate of 92.1%, the differences were deemed not statistically significant ($p > 0.05$) in all cases. The overall success rate of 97.4% was however noted to differ marginally ($p = 0.056$, 2-sided), and *significantly higher* than the national success rate ($p = 0.028$, 1-sided).

The yearly and overall success rates of the PMTCT strategy at the 37 Military Hospital were higher, compared with the 2015 average success rate for the sub-region (94.9%), although the differences were not significant($p > 0.05$ in all cases).

Additionally the yearly success rates are also presented graphically in (Figure 2), with the 2015 national PMTCT strategy success rate of 92.1%, and the 2015 average success rate for the sub-region (94.9%) as benchmarks. We observe that the yearly and the overall success rates for the PMTCT interventions at the Military Hospital are higher than the benchmarks, indicating a lot of successes from 2011 to date.

DISCUSSION

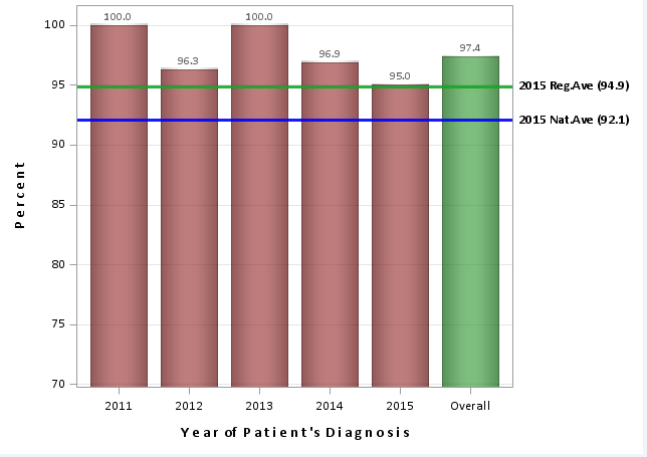

Figure 2 Success Rates for the PMTCT of HIV Strategy (2011-2015).

Although 453 records of retroviral positive women who attended either ANC, ART and Paediatric clinics between 2011 to 2015 were reviewed, only 109 (92.4%) out of 118 women initially enrolled met the inclusion criteria indicating that some of those who tested positive at the ANC opted not to attend ART clinic at the Military hospital. Exactly 83 (18.3%) of those who tested positive at the ANC discontinued care at the facility. Approximately 252 (55.5%) mothers had their ANC and ART clinics elsewhere but just brought their babies to be tested. Main reasons could be that of disclosure and perceived associated stigma. Several qualitative studies has illustrated that fear of being stigmatized after disclosure to family and friends has deterred a lot of women from seeking care at health facilities where they tested positive [27]. Again probably due to perceived stigma, 34 (7.5%) of those enrolled tested positive elsewhere but attended ART clinic at Military hospital, were supplied with Zidovudine syrup for their babies and followed through to the paediatric clinic for the DNA PCR test at 6 weeks.

Effect of Socio demographic characteristics

It appears most of the 'analysis 'patients were quite matured and as such adhered to their ARVs because 68 (59.6%) were aged between 31-40years, 38 (33.3%) between 21-30 and 5 (4.4%). This may well agree with findings in study undertaken by Gourley et al., (2013) which proposed that inadequate knowledge of HIV transmission, younger maternal age and lower educational level may lead to poor uptake of ART [27]. About 51% of the women in the study were either not educated or were educated up to the junior high school (JHS) level, whilst 48.2% have a senior high school (SHS) or tertiary level education. Another study conducted in China [28] concluded that HIV positive pregnant women aged between 20-30 years were more likely to start ARVs earlier than those below 20 years and above 35 years. Interestingly, the 3 (2.6%) retroviral positive babies identified in this study were born to women between 21-40 years with educational level of primary, JHS and SHS each. It may well be that the number of positive babies identified in the study is too low to draw any meaningful conclusions. This was similar to effect of marital status and religion on status of the baby. Separate Studies conducted in Nairobi [29], Nigeria [30] and South Africa [31], determined that the prevalence rate of HIV was two to three times higher in those divorced, separated, cohabiting and married as compared to women who had never married. The enrolled women in this study also exhibited similar trends with the number of married, cohabiting and divorced women almost quadruple the number of single infected ladies (100 versus 18).The proportion of Christians to Moslems in this study is 99 (83.9%) to 19 (16.1%) and is almost similar to Ghana's statistics on religion (75% to 18%). Studies conducted by Reynolds & Tanner in 1995 [32] as well as Ellison & Levin [33] in 1998, concluded that religious affiliations may influence disease transmission. Other studies pointed specifically to circumcision which is a common practice among Jews, Moslems and some Christians as a practice which helps to decrease HIV transmission [34,35].

Effect of interventions on status of babies

Interventions considered in this study include adherence to ARVs, 6 weeks administration of Zidovudine syrup to infant, mode of delivery and breastfeeding option. Since adherence to the ARVs was a prerequisite for inclusion into the study, 109 pregnant women out of the 118 were included. Although all the 109 women appeared to have adhered to therapy and administered Zidovudine syrup to their babies, 3 out of the 114 babies born to them tested positive for the retrovirus. A few studies conducted in Ethiopia [36] and Malawi [37] has underscored the importance of adherence counselling in maintaining the pregnant women in ARVs. Indeed integration of ANC and ART services has been adopted in a lot of sub Saharan countries, leading to the early initiation of ARVs [38]. Although all the 109 women appeared to have adhered to therapy, 3 out of the 114 babies did test positive for the retrovirus.

Trimester of initiation and status of baby

Although studies from France [39], South Africa [40] and Zambia [41] all indicate that the earlier a pregnant woman starts ARVs, the better her baby is protected from acquiring the virus, the study at the Military Hospital did not show any correlation between the trimester of initiation of ARVs by the pregnant woman and the status of her baby. Out of the 18 (16, 5%) women already on ART prior to conception, one woman from that group had a positive baby, indicating that other factors like adherence, mode of delivery and feeding options may play a major role here.

Breastfeeding and delivery options

Earlier prospective studies has estimated that breastfed babies of HIV positive mothers are more likely to be infected with the virus than those who are formula fed with infection rates between 25-30% without intervention [42-45]. The DITRAME study carried out in Ivory Coast [46-48] all corroborated this assertion. Breastfeeding is generally accepted in Sub Saharan Africa as part of the cultural practices of the African [49] and the study at the Military hospital proved this, because the babies breastfed (77 0r 67.5%) was a little more than twice the number fed artificially (37 or 32.5%). Since the study ended with the status of the babies at 6 weeks, the added risk of breastfeeding cannot be clearly noted. One of the babies was however born to a woman already on ARVs, had a vaginal delivery and chose to

breastfeed. There have been conflicting assertions about delivery options of HIV infected pregnant woman, Studies published in *International Journal of Gynaecology and Obstetrics* advocates vaginal delivery for HIV positive women with viral loads below 1000copies/ml and on highly- active- antiretroviral- therapy (HAART) [50], Other studies reported in AIDS info (2015) concluded that although a caesarean section is the safest way for an HIV positive pregnant woman to deliver her baby, vaginal delivery is the preferred mode of delivery for safety of both mother and infant if the mother's viral load is low [51]. This study recorded 3 positive babies who were all delivered vaginally, but again the low positive outcome made it difficult to draw any meaningful conclusions.

Retroviral status of babies/Success rate of PMTCT strategy

The Military Hospital within the study period has recorded a total of 367 DNA PCR results, with 114 being from the 'analysis' mothers. Three babies (2.6%) out of 114 tested positive over the period 2011 to 2015, indicating a success rate of 97.4%. There was a 100% success rate in 2011 and 2013, whilst 2012, 2014 and 2015 recorded success rates of 96.3%, 96.9% and 95% respectively. The average success rate over the period compares favourably to the national 2013 and 2015 PMTCT records as shown in (Figure 2).

LIMITATIONS

1. Although the 'analysis ' women appeared to have honoured all their appointments according to records, one cannot be sure if they really did take the ARVS as directed.
2. Though supplied with the 6 weeks Zidovudine syrup, it cannot be ascertained if the mothers administered the syrup as directed.
3. The effect of continuous breastfeeding beyond the 6 week period cannot be concluded here since the study ended with the PCR test at 6 weeks.
4. Inability to link some mother infant pairs due to poor documentation.
5. The planned statistical analysis could not be meaningfully performed due to the low number of positive babies (A high success rate of the PMTCT strategy) observed.
6. The methods employed in the determination of success rates of the countries in Table 9 to which the success rate of the study was compared are not known and as such may not necessarily correspond to that used in our current study.

CONCLUSIONS AND RECOMMENDATIONS

Since the adoption and implementation of the guidelines on PMTCT in Ghana, significant strides have been made towards the elimination of the HIV. According to this study, demographic characteristics like age, educational level, religion and marital status as well as the mode of delivery and feeding option, appear not to have any significant effect on the retroviral status of the babies whose mothers adhered to ARVs during pregnancy, delivery and the first 6 weeks of breastfeeding. The trimester of initiation of therapy also appear not to have any notably effect on baby's status so long as the mother is adhering to the ARVs, clearly underscoring the importance of putting all pregnant and nursing mothers on ARVs. Although other sub Saharan nations have managed to bring transmission rates to under 2%, (Table 5) Ghana has achieved approximately a 93% success rate. The average success rate at the 37 Military Hospitals between 2011 and 2015 according to this study however pegged the average success rate at 97.4%.

In order to improve outcomes, the staff involved in the PMTCT program must be adequately trained and updated on current guidelines. Documentation and update of medical records of patients should be encouraged and the pediatric EID register should have a column for mothers name or Identification number in order for easy identification of mother-infant pairs for logistics and research purposes. The NACP in close collaboration with the WHO and Global Fund has proposed the introduction of the 'Treat all Policy' in Ghana tentatively from 1st October 2016. This policy advocates for the treatment of all PLHIV regardless of their CD4 count. Under the 'Treat all Policy', the 90-90-90 strategy is to be adopted in the fight towards the elimination of HIV by 2030 to such an extent that it would no longer be a public health issue. The strategy aims at getting 90% of PLHIV to know their status, 90% of those identified to be put on or have access to ART and finally to achieve 90% viral suppression within the first year of being put on ART. The 90-90-90 strategy under the 'Treat all Policy' if implemented properly across Ghana will definitely achieve the aim of drastically decreasing the HIV transmission rate to almost zero. As an extension to this study, the author proposes to conduct a more in depth research tracking the pregnant woman's CD4 counts and viral loads with her adherence status during the course of pregnancy as well as capturing the retroviral status of the babies beyond the breastfeeding period in order to capture the true effect of breastfeeding on the status of the infant.

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AUTHOR CONTRIBUTION

Kate Coleman-Sarfo worked on the conception, study design and data collection and discussion of results. Kate Coleman-Sarfo and Pasmor Kuranchie worked the methods, results and analyses.

COMPLIANCE WITH ETHICAL STANDARDS

Ethical approval

Ethical approval for the study was obtained from the Institutional Review Board of the 37 Military Hospital. Reference {IRB/37/MH/93/15}.

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