VALIDITY OF DATA FROM PREVENTION OF MOTHER TO CHILD HIV TRANSMISSION PROGRAMME IN ESTIMATING GENERAL POPULATION HIV PREVALENCE IN MBEYA REGION, TANZANIA 2003-2008

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VALIDITY OF DATA FROM PREVENTION OF MOTHER TO CHILD HIV TRANSMISSION PROGRAMME IN ESTIMATING GENERAL POPULATION HIV PREVALENCE IN MBEYA REGION OF TANZANIA 2003-2008

By

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A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Applied Epidemiology of Muhimbili University of Health and Allied Sciences

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for examination of the Dissertation titled "***Validity of Data from Prevention of Mother to Child Transmission (PMTCT) programme in Estimating General Population HIV Prevalence in Mbeya, Tanzania 2003-2008***" in fulfilment of the requirement for the degree of Master of Science in Applied Epidemiology of the Muhimbili University of Health and Allied Sciences.

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DECLARATION AND COPYRIGHT

I, **Azma Ayoub Mwinyimvua Simba**, declare that this dissertation is my original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award

Signature..... Date 19-10-2010

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DEDICATION

I dedicate this work to my beloved son, Edwin Kalinjuma Lugazia

ABSTRACT

Background: Monitoring trends in HIV-1 infection is crucial for planning and evaluation of intervention measures. ANC sentinel surveillance data have been used for that purpose; however, they require significant resources to operate and are biased. Recent literature shows that data from Prevention of Mother to Child HIV Transmission (PMTCT) programmes could be a cheaper and comparable source of data for monitoring HIV-1 trends. However, its validity as compared to ANC sentinel surveillance data has not been well examined.

Objective: The objective of this study was to assess the validity of PMTCT programme data as a proxy measure of the general population HIV-1 prevalence estimates compared to the ANC sentinel surveillance data.

Materials and Methods: This was a cross-sectional study which involved a review of facility-based data from ANC PMTCT registers. Comparison of age-adjusted HIV-1 prevalence estimates were made between ANC sentinel surveillance, PMTCT programme and the Tanzania HIV Indicator survey of 2003-2004 together with the Tanzania HIV and Malaria Indicator survey of 2007-2008. Comparison was made for the same geographical area and time period, i.e 2003-2008. Overall and age-specific HIV-1 prevalence estimates were compared between women in the ANC sentinel surveillance and those who participated in the PMTCT programme, both for the overall study period and separately for each year.

Results: In total, 6390 records were retrieved from ANC PMTCT registers in nine PMTCT sites during the study period 2003-2008. Most women in the study population were in the age group 15-24 years (Mean age 25 years, SD: 5.7). Overall HIV-1 PMTCT-based prevalence estimates from 2003-2006 were comparable to HIV-1 prevalence estimates based on ANC sentinel surveillance ($p=0.89$ and $p=0.43$ for the year 2003/2004 and 2005/2006 respectively). For 2007/2008, the HIV-1 prevalence estimate from PMTCT programme and that from the ANC sentinel surveillance were significantly higher than the estimate from the population-based survey ($p=0.00$ for both PMTCT and ANC sentinel surveillance). Women attending clinics at urban and border areas were more likely to be HIV-1 infected than those who attended clinics located at rural areas (OR=1.35, $p=0.00$, OR=1.99, $p=0.04$ respectively). HIV-1 testing uptake was more than 99%. There was a notable varying data quality across the sites.

Conclusions and Recommendations: HIV-1 prevalence estimates from PMTCT programme were comparable to those from the ANC sentinel surveillance as well as to estimates from the general population. However, for the period 2007/2008, estimates from PMTCT programme and the ANC sentinel surveillance significantly overestimated the estimates in the general population. The HIV testing uptake in the PMTCT environment was very high. PMTCT data was of moderate data quality, Behavioral change HIV programmes in Mbeya region should target urban and border areas and male participation in PMTCT programmes should be encouraged. Improvement of data can be done by standardizing data collection tools, regular training and supervision. PMTCT programme has a potential to replace ANC sentinel surveillance for monitoring of HIV epidemic trends in Mbeya region.

TABLE OF CONTENTS

ABBREVIATIONS

AIDS	Acquired Immuno-Deficiency Syndrome
ANC	Antenatal Care
ANOVA	Analysis of Variance
ART	Antiretroviral Therapy
CDC	US Centers for Disease Control and Prevention
CI	Confidence Interval
COSTECH	Tanzania Commission for Science and Technology
DBS	Dried Blood Spot
ELISA	Enzyme-linked Immunosorbent Assay
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
MOHSW	Ministry of Health and Social Welfare
MUHAS	Muhimbili University of Health and Allied Sciences
NACP	National AIDS Control Programme
NIMR	National Institute for Medical Research
OR	Odds Ratio
PMTCT	Prevention of Mother to Child Transmission of HIV
RCHS	Reproductive and Child Health Services
THMIS	Tanzania HIV and Malaria Indicator Survey
UAT	Unlinked Anonymous Testing
VCT	Voluntary Counselling and Testing

DEFINITION OF TERMS

HIV testing uptake: number of ANC attendees tested for HIV out of those who were pre-test counseled at their first visit during the ANC sentinel surveillance period

"Opt in" strategy: Individual pre-test counseling with patients actively choosing whether to be tested or not to be tested

"Opt out" strategy: The routine non-compulsory approach to prenatal HIV testing, whereby health staff hold group education sessions during which pregnant women are informed that they will be routinely screened for HIV and other diseases, and that they have the right to refuse testing. Women may accept or refuse testing HIV testing for PMTCT at any visit

Quality of data: Availability of data and ease at which access can be made to general ANC and PMTCT registers, clear handwriting and uniformity of logbook with a standard format (number, type, and order of variables recorded) within the same site, across sites and over time

Surveillance: Ongoing systematic collection, analysis, interpretation and dissemination of data regarding a health-related event for use in public health action

Unlinked Anonymous Testing: The procedure in which the link between the specimen and the personal identifying information such as the clinic card number or name is removed prior to HIV testing and the individual's test result cannot be identified

Validity: An indication of the extent to which a test or other measure does the job for which it was intended.

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

1.0 INTRODUCTION

1.1Background

1.1.1 HIV/AIDS situation

HIV/AIDS is a major global public health problem. By the end of 2007, an estimated 33.2 million people worldwide were living with HIV and AIDS, Sub-Saharan Africa being the most severely affected region. With only 10% of the world's population, this region has about two-thirds of the global number of people living with HIV and AIDS (UNAIDS 2008). Tanzania has a generalized HIV epidemic, with HIV-1 as the predominant sub-type (NACP 2008). The first case of AIDS in the country was reported in 1983 in the northwest region of Kagera and by 1986 all regions had reported AIDS cases. The epidemic has rapidly spread such that in 2007, about 2 million people were estimated to be living with HIV and AIDS in Tanzania. The Tanzania HIV/AIDS and Malaria Indicator Survey (THMIS) conducted in 2007-2008 shows that 5.7% of adults aged 15-49 years were infected with HIV (6.6% of adult women and 4.6% of adult men). Prevalence was higher in urban than rural areas (8.7% vs. 4.7%) (Tanzania HIV/AIDS and Malaria Indicator Survey, 2007-2008).

Since the late 1980s, HIV prevalence estimates in countries with generalized epidemics have been derived primarily from data collected through Antenatal Care (ANC) sentinel surveys (WHO/UNAIDS, 2003, UNAIDS/WHO 2001, Hladik *et al*, 2005). These surveys are conducted at regular intervals, usually annually, at selected sentinel sites, which are clinics providing antenatal care for pregnant women. Pregnant women are considered to be a good proxy for the general population, and this population is accessible through routine ANC visits, where blood is generally collected for other tests. The ANC sentinel surveillance testing is unlinked and anonymous. It requires frequent data collection, having the appropriate populations under surveillance, consistency over time, and representative sampling (Grulich *et al*, 2002).

1.1.2 Operation of the ANC Sentinel Surveillance System and the Prevention of Mother to Child Transmission of HIV (PMTCT) programme in Tanzania

In the late 1980s sentinel surveillance activities in ANC clinics were initiated in the Kagera region. Subsequently, in the early 1990s, the National AIDS Control Programme (NACP) developed a protocol for ANC HIV and syphilis sero-surveillance, and expanded activities to 11 of the then 20 regions of mainland Tanzania. This protocol was implemented until 1999, when the NACP undertook a comprehensive review that resulted in improved methods for HIV and syphilis surveillance.

The NACP revised the protocol for ANC surveillance and developed new methods to conduct sentinel surveillance that included: (1) the introduction of a 3-month data collection period to replace the previous system of continuous data collection; (2) use of dried blood spots (DBS) technique for blood storage; and (3) the standardization of HIV testing strategies and quality assurance systems.

The first round of ANC sentinel surveillance using the new algorithm was conducted in 2001/2002 at 24 ANC sites in 6 regions: Dar es Salaam, Dodoma, Kagera, Kilimanjaro, Mbeya and Mtwara. The second round was conducted between October 2003 and January 2004 at 57 ANC sites located in ten regions, with an addition of four regions: Kigoma, Lindi, Morogoro and Tanga. The third round was conducted between November 2005 and February 2006 at 92 ANC sites in fifteen regions. The five newly introduced regions were Arusha, Iringa, Shinyanga, Mara and Tabora. The fourth round was conducted between July and October 2008, whereby all 21 regions of Tanzania mainland were included, with a total number of 134 ANC sentinel surveillance sites. The information generated from these surveys is considered vital for determining the epidemiology of HIV and syphilis in Tanzania. These surveys are meant to continue over time in an attempt to monitor HIV and syphilis infection trends in the general population.

In September 2000, the National PMTCT programme was started with five pilot sites. Gradual scaling of PMTCT services, which started in 2003, has led to the coverage of 3029 out of 4647 (65%) of health facilities offering RCH services in the country as of December 2008 (NACP, 2009). Over the years, there has been an increase in the number of clients reached by PMTCT service at ANC facilities from 255, 913 in 2005 to 958,103 in 2008. Between 2005 and 2008, there was an increase in the proportion of HIV infected pregnant women reached by PMTCT services from 11% to 80% respectively.

In summary, HIV testing in the PMTCT programme is voluntary; with all ANC clients routinely recommended HIV testing with a right to refuse testing ("opt-out"). Ideally, the HIV test is offered at the first ANC visit. Health staff holds group education sessions and recommend HIV testing as part of routine ANC services. In PMTCT programmes, HIV testing is linked to therapy to prevent transmission of HIV from pregnant women to their infants.

The HIV test is usually performed within the PMTCT clinic or a related laboratory. Women who accept testing have an opportunity to receive their results and benefit from PMTCT interventions, including antiretrovirals for PMTCT and prevention, treatment, care, and support services for themselves and their families. The PMTCT programme enter individual data into ANC registers, which are aggregated as a monthly or quarterly report and sent to the Ministry of Health and Social Welfare.

In contrast, ANC sentinel surveillance consecutively samples leftover blood routinely collected for various pregnancy tests on all new ANC attendees until the target sample size is reached. Unique identifiers, such as name and hospital number, are removed before the HIV test is done. HIV testing is usually performed outside the clinic, usually in a central reference laboratory, with strong quality assurance measures. For each sampled ANC surveillance client, individual data, such as age, parity, and gravidity, are abstracted or transcribed into individual data forms without identifiers, entered electronically, and analyzed. Figure 1 shows the flow chart for conducting ANC surveillance within a PMTCT service site.

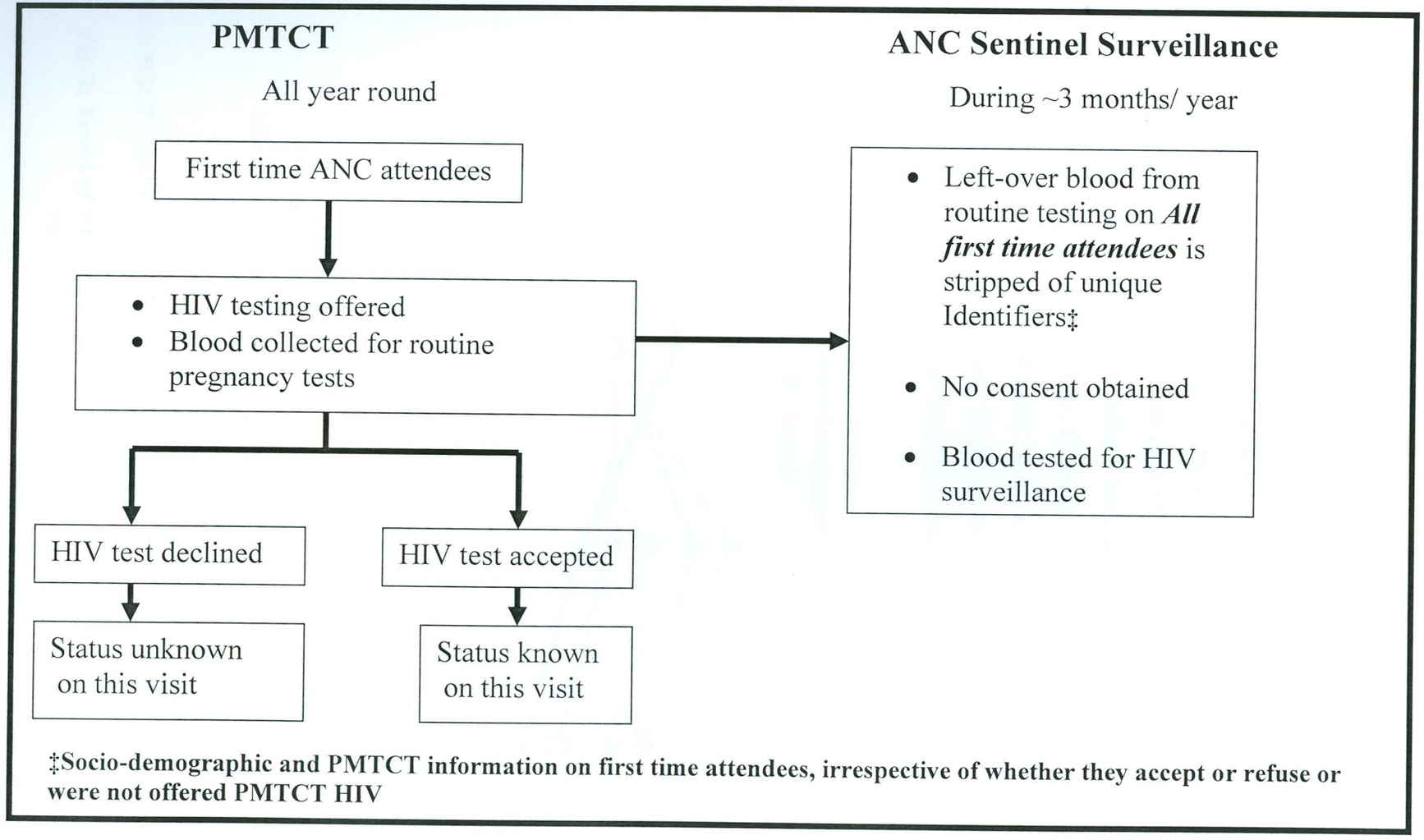
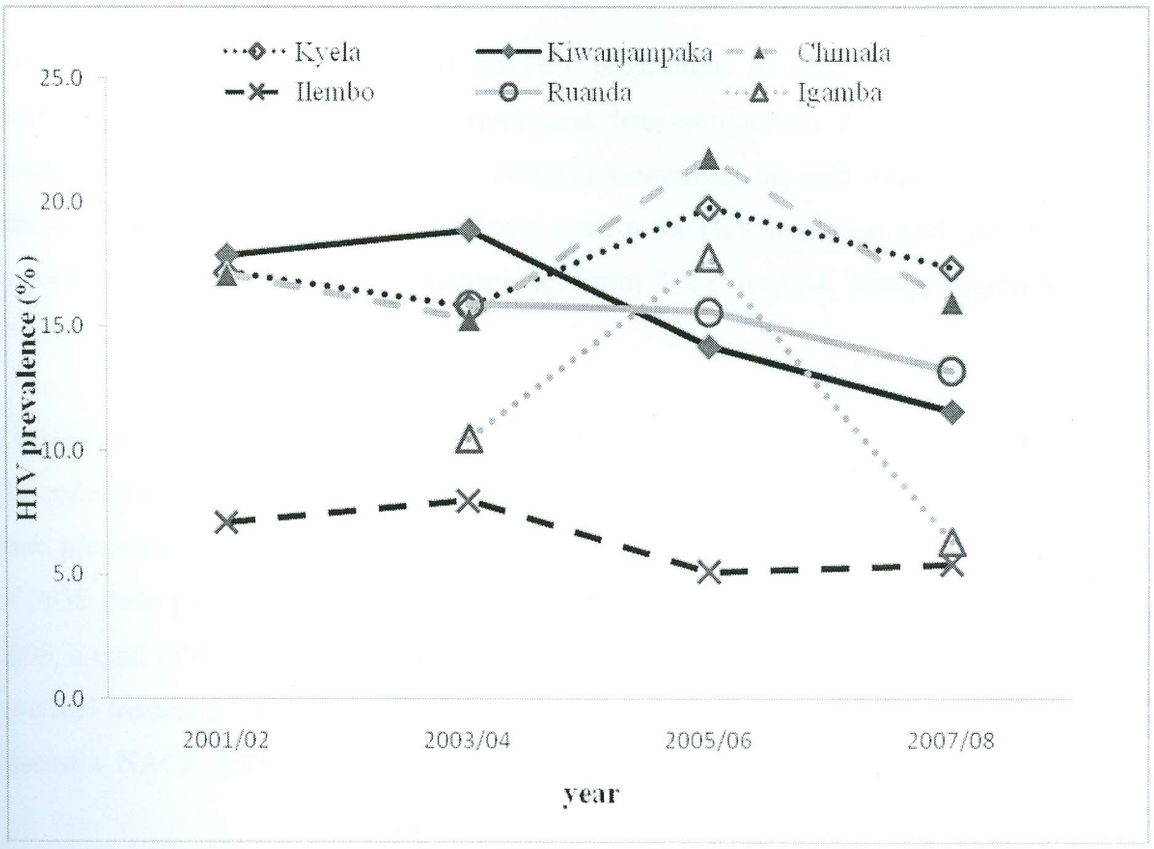


Figure 1. Flow chart for PMTCT programme and ANC sentinel surveillance at sites with both PMTCT and ANC sentinel surveillance

1.1.3 ANC sentinel surveillance and PMTCT services in Mbeya Region

Mbeya was one of the six regions that were involved in the first round of the ANC sentinel HIV sero-surveys conducted in 2001/2002 in 24 ANC sentinel surveillance sites in Tanzania. Kyela, Kiwanjampaka, Chimala and Ilembo were the four sites in Mbeya region which took part in the first round of the serosurveys. Mbeya has continued to participate in these surveys in the subsequent years to-date. Currently, there are six ANC sentinel surveillance sites in Mbeya, which are Kiwanjampaka, Ruanda, Ilembo, Kyela, Igamba and Chimala (Fig.2). Mbeya region had HIV prevalence among the ANC attendees of 15.7% (95% CI 13.9-16.8) in 2003/2004, 15.8% (95% CI 13.9-17.7) in 2005/2006 and 12.36% in 2007/2008.



Source: NACP Database, Tanzania, 2010

Fig. 2: Trend of HIV prevalence among pregnant women in six ANC sentinel surveillance sites, Mbeya region, 2001-2008

Since 2001, a comprehensive nevirapine-based PMTCT programme has been operating in Mbeya Region (Theuring *et al.* 2009). The intervention procedure of this PMTCT programme envisages that women are offered voluntary counseling and HIV-testing at first encounter with the PMTCT-offering ANC services.

HIV tests are performed using a serial testing algorithm according to the National Guidelines for HIV testing (Ministry of Health and Social Welfare, Tanzania; NACP, 2008). Positive-tested women may then enroll in a single-dosed nevirapine prophylaxis programme, receiving a maternal drug dose in gestational week 28 with the instruction to take it at the onset of labor. Newborns receive a drug dose within 72 hours after birth in the health facilities.

Women first-time encountering the PMTCT programme at delivery are offered intra- or postpartum counselling, testing and subsequent drug administration in case of a positive test result. The programme also involves postnatal counseling on safe infant feeding and other relevant health issues, as well as a referral system for HIV treatment and care. Partners are encouraged to participate in the programme. From 2002 to 2004, Mbeya region had only 4 PMTCT sites.

Later on, scale up of PMTCT sites had taken place reaching 121 PMTCT sites in the region by the end of December 2008 whereby, among 44380 new attendees in antenatal clinics, 37, 855 were pre-test counseled, 37784 were post test counseled and 3929 were HIV positive. A total of 3938 male partners were tested for HIV, of these, 495 were HIV positive. Up to March 2009, a total of 49,401 people living with HIV/AIDS in Mbeya region have been enrolled in care and treatment. Of these, 24,801 were on ART (Ministry of Health and Social Welfare, Tanzania, NACP, 2009).

1.2 Problem Statement

The ANC sentinel surveillance is unlinked and anonymous, thus, the health staff cannot identify an individual's test result and the women cannot be informed of their HIV test results. Positive cases therefore miss the opportunity for care and prevention of mother to child transmission of HIV. Additionally, ANC sentinel surveillance require significant resources to operate. Furthermore, lack of male participation in ANC sentinel surveillance has played an important role in distorting ANC HIV estimates which has necessitated the use of robust statistical adjustments.

There are potential biases in ANC-based surveillance data which include the differences in socio-demographic and economical structure between women attending ANCs and the rest of the population. HIV infection has been reported to directly and indirectly affect fertility, therefore HIV infected women have reduced fertility and are less likely to attend ANC (UNAIDS 2008). These limitations associated with ANC sentinel surveillance data have led to concerns in considering other sources for HIV surveillance.

Since PMTCT shares the same target population and sometimes the same sampling points as ANC sentinel surveillance, it is likely to inherit these biases. However, PMTCT has the potential of complementing or replacing ANC data since it has got more advantages associated with it. Given that African countries are moving toward universal access to HIV/AIDS prevention, treatment, and care over the next few years, they are expected to increase the coverage of PMTCT programmes greatly (Fabiani *et al*, 2005). In this light, whether or not to continue with UAT-based ANC surveillance has become a topic of debate.

Tanzania seems to have limited information on the comparability of PMTCT programme results with the ANC sentinel surveillance in estimating HIV prevalence in the general population. This study therefore seeks to validate PMTCT- HIV prevalence estimates by comparing with those of ANC sentinel survey using a population-based survey as a standard.

1.3 Research question

The research question in this study was posed as follows:
Can HIV prevalence estimates obtained from PMTCT programme be used as an alternative to prevalence estimates from the ANC sentinel surveillance in estimating HIV prevalence in the general population of Mbeya region in Tanzania?

1.4 Rationale of the study

Results of HIV tests conducted as part of PMTCT programmes could be used as a data source to obtain reliable national estimates of HIV prevalence. Expansion of PMTCT services increasingly includes clinics at which ANC sentinel surveillance is conducted, resulting in increased availability of HIV testing data from both PMTCT programmes and ANC sentinel surveillance in the same clinic population.

Using data from PMTCT programmes to estimate HIV prevalence has several advantages, including: (1) reduced costs and workload in antenatal clinics; (2) increased geographic coverage of the surveillance system; (3) increased precision of the prevalence estimates as a consequence of the increased number of tested women; (4) the potential to overcome ethical concerns related to the fact that when performing UAT at sites with no PMTCT programme, women are not informed of the test result, and thus do not receive appropriate care (5) male participation, which plays a crucial role in enabling women to take on the required serial decisions and adhere to the course of the intervention. Male partners, who are key decision makers in questions of sexual and reproductive health in many societies, are attributed to a high potential of impact on pregnant women's behavior and their participation in PMTCT reduces selection biases (Theuring *et al,* 2009).

There have been recent evaluations of the utility of PMTCT programme data for the purpose of surveillance, because of ethical concerns about the inability to provide UAT-based test

results and services to ANC clients; the introduction of rapid syphilis testing with limited access to leftover blood; and the larger number of PMTCT sites and sample sizes, compared to ANC surveillance (Bolu *et al* 2007). However, the limited published results to date suggest that whereas PMTCT programme data often include large numbers of women, their data quality, availability, and the uptake of PMTCT HIV testing must be considered when using them for surveillance.Some countries have added PMTCT variables into their ANC sentinel survey data forms. These data can provide information on whether the HIV prevalence among women who participate in PMTCT or accept HIV testing is comparable to HIV prevalence in women who do not participate in PMTCT or refuse HIV testing as part of PMTCT services, i.e., refusers. These data are not available from routine PMTCT records and can help countries estimate the number of HIV-positive women not identified by the PMTCT programme and the related lost impact. This information can be useful for planning and setting PMTCT service targets. However, the experiences in using these data have not been documented. The National AIDS Control Programme (NACP) could use these results to make appropriate evidence-based recommendations for calibrating surveillance data and appropriate planning.

1.5 Objectives

Broad Objective

To assess the validity of PMTCT programme data as a proxy measure of the general population HIV estimates compared to the ANC sentinel surveillance data

Specific objectives

1. To compare HIV prevalence estimates from PMTCT programme with ANC sentinel surveillance data in Mbeya region, with reference to a population-based estimate
2. To examine factors associated with HIV sero-status among PMTCT clients during the ANC sentinel surveillance period
3. To determine the HIV testing uptake among pregnant women and their partners in the PMTCT environment in Mbeya region
4. To assess the quality of data generated by the PMTCT services in Mbeya region

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1. Biases associated with estimates from antenatal clinics and PMTCT

A study in Mwanza, Tanzania, which compared HIV infection in randomly sampled women from the general population with a sample of women attending ANC clinics found that, the prevalence of HIV infection was higher in the general population sample (Kigadye *et al.*, 1993). Overall HIV 1 seroprevalence was 11.5%. The population serosurvey revealed an HIV seroprevalence of 15.1% among the general adult female population, suggesting that the sentinel surveillance among pregnant women could have underestimated population HIV seroprevalence for women under 35 years old.

HIV infection is associated with a low risk of pregnancy for at least two reasons. Firstly, bacterial Sexually Transmitted Diseases (STDs), which are more common in those with HIV infection, cause tubal occlusion and hence infertility. Secondly, the pathology associated with HIV may include a reduction in fertility, either through spontaneous abortion or other less well-defined means.

Moreover, HIV infected women are less likely to become pregnant as a result of reduced sexual activity resulting from recurrent sickness and or spouse/partner death. These factors further affect the validity of antenatal clinics as sentinel sites for HIV surveillance activities. The accuracy of HIV sentinel surveillance in reflecting population incidence has been challenged, because it includes only those women who attend antenatal clinics and because HIV infection is known to be associated with lower fertility. It has been estimated that the prevalence of HIV infection in pregnant women underestimates the prevalence in the general population prevalence by 35–65% in populations with low use of contraception (Grulich *et al*, 2002).

Previous studies on the use of PMTCT-based data for HIV surveillance have led to different conclusions. Non-participation bias attributable to possible differences testing uptake between HIV-positive and HIV-negative women is the key factor that influences the comparability of UAT-based and PMTCT-based estimates, especially in settings with low HIV prevalence (Fabiani *et al*, 2005).

A study was done to compare prevalence estimates in a setting where UAT based in ANC may be biased by the introduction of PMTCT services (Mpairwe *et* al, 2005). Comparing women who accept counseling and testing in the context of a PMTCT programme to those who refuse these services showed that those who accepted testing during the first month of PMTCT services were significantly more likely to be HIV positive than those who refused testing. It was concluded that the introduction of PMTCT may result in biased estimates of seroprevalence measured through sentinel surveillance in the short term, as women who perceive themselves to be at high risk for HIV and are willing to be tested seek care at ANC clinics with PMTCT services, which may bias results from the UAT method if women choose a facility with PMTCT instead of the ANC surveillance facility.

The potential bias of using data that is routinely reported in PMTCT programmes to estimate HIV prevalence among ANC attendees and the general population has been reported in a study which compared UAT based estimates from ANC with that from PMTCT programme in Botswana, Kenya Thailand and Uganda and assessed whether or not routine data reported from PMTCT programmes should replace the UAT method (Hladik *et al,* 2005). In countries such as Thailand, where ANC and PMTCT coverage is exceptionally high and routinely reported PMTCT data are complete and accurate, results indicated that PMTCT data can be used instead of UAT based from ANC to track HIV prevalence in the general population. However, in settings where routinely reported PMTCT data are of poor quality and prevalence ratios between those who accept and those who do not accept testing are not known, UAT was recommended as the most valid and reliable method for estimating HIV prevalence.

PMTCT-based HIV prevalence estimates are likely to inherit the limitations of the ANC sentinel surveillance. These limitations include the fact that HIV prevalence in pregnant women overestimates HIV prevalence among younger women (<20 years of age), as these sexulally active young women do not reflect most young women (Boisson et al, 1996, Hladik *et al,* 2005, Seguy et al, 2006). HIV prevalence from these surveys underestimates HIV prevalence in older women (>40 years of age), as HIV infection decreases fertility.

2.2. Comparison studies between PMTCT, ANC sentinel surveillance and population-based estimates

A study in Kenya, to evaluate the utility of PMTCT data for HIV surveillance in 2006 (Seguy *et al,* 2006), compared the prevalence estimates from PMTCT programmes with those of ANC sentinel surveillance and found that the median UAT-based HIV prevalence to be 12.8% compared with 14.4% in PMTCT. HIV testing acceptance for PMTCT ranged from 48% to 69% across clinics, and was more likely among primigravidae than multigravidae.

Another study has examined the utility of antenatal HIV surveillance data to evaluate prevention of mother-to-child HIV transmission programmes in resource-limited settings (Bolu *et al* 2007). The study analyzed data from Ethiopia, Zimbabwe and Kenya, where information on PMTCT test acceptance was collected from the 2005 ANC sentinel surveillance forms. For Zimbabwe, they compared the 2005 ANC sentinel surveillance data to that of PMTCT programme data.

ANC surveillance data allowed the researchers to calculate the number of HIV-positive women not participating in the PMTCT programme. The percentage of HIV-positive women missed by the PMTCT programme was 17% in Kenya, 57% Ethiopia, and 59% Zimbabwe. The HIV prevalence among women participating in PMTCT differed from women who did not.

Another study conducted in Uganda (Fabiani *et al,* 2005), found that the crude PMTCT-based prevalence were different from that based on UAT data. It was also found that by adjusting the PMTCT-based prevalence data for non-participation bias, it resulted in the reduction of the difference between PMTCT-based and UAT-based prevalence estimates by approximately 70% and this yielded PMTCT-based prevalence estimates that were similar to those of UAT.

A cross-sectional population survey was conducted between 1991 and 1992 to compare the prevalence of HIV infection among women in the general population and antenatal clinic attendees in rural Mwanza, Tanzania, and to validate a method for adjusting HIV prevalence in ANC attendees to estimate the prevalence in the general female population aged 15-44 years (Changalucha *et al*, 2002).

In the study, the HIV prevalence in women in the general population was compared with unadjusted and adjusted in ANC attendees. Parity-adjusted prevalences were obtained by applying correction factors to the observed prevalences in parous and nulliparous ANC attendees. Unadjusted HIV prevalence was significantly lower in ANC attendees (3.6%) than in women from the general population (4.7%), but after adjustment there was no significant difference between the two groups. In this rural population, the HIV prevalence in ANC attendees underestimated the prevalence among women in the general population, but this difference was eliminated by applying parity-based correction factors.

2.3 Population-based studies on HIV prevalence

A study conducted in Bukoba, Tanzania, compared ANC sentinel surveillance with general population prevalence to assess validity of ANC data (Kwesigabo *et al*, 1996). This study involved a comparison of the results of a sentinel surveillance study on HIV-1 infection in 1292 pregnant women aged between 15 and 47 years attending prenatal care and in 454 blood donors with those from a cross sectional population-based study on HIV-1 infection among 553 people aged between 15 and 54 years also conducted in Bukoba during August 1987 to

April 1988 to determine which sentinel populations most closely represented the HIV-1 infection rate of the general population. The HIV-1 prevalence rate was found to be 24.4% for the population-based sample, 22.4% for the pregnant women, and 11.6% for the blood donors. The general population females were found to have the highest HIV-1 prevalence rate, while the male blood donors had the lowest rate (29.4% compared to 10.5%).

Pregnant women had a significantly lower rate than general population females (22.4% compared to. 29.4%; $p = 0.016$). The 25-34 years old age group had the highest prevalence of HIV-1 infection in all three populations, suggesting that this group faces the highest risk of HIV infection and that the three populations have a similar trend of age-specific prevalence. There were no significant differences between the HIV-1 prevalence rates among general population females and those among female blood donors, suggesting that female blood donors more closely represent the HIV-1 seroprevalence rate of general population females than pregnant women attending prenatal care or male blood donors.

Another population-based HIV study done to identify risk factors and validate the representativeness of ANC-based estimates from December 2003 to May 2004 within the rural areas of Manyara and Singida regions in Tanzania (Malima *et al*, 2007) found the prevalence of HIV in the general population to be 1.8%, which was comparable to that of pregnant women attending antenatal clinics. The female to male prevalence ratio was 0.8 (95% CI 0.4–1.7).

HIV was associated with being a resident in a fishing community, and having recently moved into the area. Multiple sexual partners increased likelihood of HIV infection by 4.2 times (95% CI; 1.2–15.4) for men. In women, use of contraceptives other than condoms was associated with HIV infection (OR 6.5, 95% CI; 1.7–25.5), while most of the population (78%) had never used condoms.

Population-based surveys are always prone to different types of biases (Y.-Malima *et al*, 2007). Non-response bias, particularly due to refusal, might be of particular concern in HIV surveys. The close match between the local ANC-based surveillance and the population-based survey from the same areas suggests of the representativeness of pregnant women in estimating the local general adult HIV prevalence albeit the inherent biases. A cohort study done in Mbeya Tanzania between 2002 and 2003 (Aroyo *et al,* 2005) found that an overall prevalence of HIV-1 infection to be 16.6% (95% CI, 15.3–17.9). It also revealed that the prevalence of HIV-1 infection in Mbeya differs considerably from one geographic area to another, despite their close proximity. (Aroyo *et al,* 2005).

2.4 Male partner participation in antenatal HIV counseling and testing

A study that was conducted by Msuya et al, 2008, aimed to describe the prevalence and predictors for male partner participation in HIV voluntary counselling and testing (VCT) at two primary healthcare clinics in Moshi urban, Tanzania as well as the effect of partner participation on uptake of HIV perinatal interventions. Three-hundred-and-thirty-two male partners (12.5%) came for HIV-VCT. A high proportion (131; 40%) came after the woman had delivered. Women were more likely to bring their partner for VCT if they collected their own test results, were living with their partner, had a high monthly income and had expressed at enrolment the intention to share HIV results with their partner. Although PMTCT programmes are presumably a good entry point for male involvement in prevention of sexual and perinatal HIV transmission, this traditional clinic-based approach reaches few men. Given the positive influence male participation has on the acceptance of perinatal interventions, a different approach for promoting male participation in VCT is urgently required. Within PMTCT programme, counseling should emphasize the advantages of partner participation to encourage women to inform and convince male partners to come for VCT. Also, promotion of couple VCT outside antenatal settings in male friendly and accessible settings should be given priority.

CHAPTER 3

3.0 METHODOLOGY

3.1 Study area

The study was conducted in Mbeya region, which is situated in the South-western highlands of Tanzania, bordering two neighboring countries of Zambia and Malawi. The region covers about 6,400 square kilometers with most settlements situated in the South-western part of the region at an altitude between 400 and 1,700 metres. According to the 2002 population census, the region was estimated to have 2.07 million people, 52.1% of whom were women. The region has eight administrative districts: Chunya, Mbarali, Mbozi, Rungwe, Kyela, Ileje, Mbeya Urban and Mbeya rural.

Mbeya region is among Tanzania's most heavily HIV-1 affected regions. It has major roads coming from Dar es Salaam to Zambia and Malawi, continuing to Zimbabwe, Botswana and South Africa. The local community of the region is accessible to the Trans-African highway, which connects Tanzania with neighboring countries and provides an epidemiological route for HIV-1 infection. Communities along the highway are known to engage in social interactions and casual sexual contacts between travelers and local inhabitants.

Mbeya region has 15 hospitals (1 referral hospital, 1 regional hospital, 5 district hospitals, 5 mission hospitals and 3 private hospitals), 29 health centres and 271 dispensaries. The main hospital, Mbeya Referral Hospital is located in Mbeya urban and serves as a referral hospital for 6 million people in four regions of the southern zone (Mbeya, Iringa, Rukwa and Ruvuma).

3.2 Study design

This was a cross-sectional study which involved desk review of 2003-2008 PMTCT facility-based data from ANC registers in health facilities conducting PMTCT services. For comparison, the ANC based HIV sentinel surveillance records of 2003-2008 available in the electronic database at the NACP were used. Comparison of HIV-1 prevalence estimates were made between ANC sentinel surveillance, PMTCT and the Tanzania HIV Indicator survey of 2003-2004 together with the Tanzania HIV and Malaria Indicator survey of 2007-2008 .

3.3. Data management at the Regional level

In this study, data collected from the ANC sentinel surveillance and PMTCT in Mbeya region in the years 2003-2008 were retrieved and compared. Population-based studies (THIS 2003/04 and THMIS 2007/08) were used as standard estimates and compared with the estimates from ANC sentinel surveillance and PMTCT for the period 2003-2008 for the same region.

Data from ANC sentinel surveillance that were used for comparison were those from the ANC sentinel surveillance sites that took part in ANC sentinel surveillance of 2003-2008 which were Chimala, Ilembo, Kiwanjampaka, Kyela, and Ruanda, which also carry out PMTCT services in their premises.

For PMTCT, data from district hospitals of Tukuyu, Rungwe, Kyela, Mbozi and Mbarali for the year 2003-2008 were used. Other health facilities that also provided PMTCT data were Ilembo health centre in Mbeya rural district, Ruanda, Kiwanjampaka and Igawilo health centres in Mbeya municipality and Mbeya referral hospital in Mbeya Town.

3.4 Data management at the National level (NACP)

Available analyzed data at NACP were collected during the second, third and fourth rounds of ANC sentinel surveillance (Swai *et al*, 2006). The antenatal-clinic-based population data were obtained by consecutively recruiting of ANC attendees coming for the first time during a given pregnancy.

Data from ANC sentinel surveillance were analyzed by a team of researchers from NACP, MUHAS, NIMR, COSTECH and CDC. ANC HIV and syphilis prevalence rates were calculated according to age, marital status, parity, educational level, and distance to ANC and duration of stay in residence. Data collected in the year 2003-2008 in Mbeya region were extracted from the electronic database. Available information from this database included variations in HIV prevalence by site, age-specific HIV prevalence by sex, age, marital status, and educational level and variation of prevalence by location of the clinic (Urban versus rural) and by duration of residence. Information on Syphilis infection, which is out of the scope of this study, was not used.

3.5 Size of the study population

All available PMTCT data during the 3-months corresponding to the ANC sentinel surveillance period in the nine selected sites in Mbeya were eligible for the purpose of this study. For the year 2003/2004, all available PMTCT records between 20th October 2003 and 21st January 2004 were retrieved from registers in the facilities that had data. For the year 2005/2006, all available PMTCT records between November 14, 2005 and February 10 2006 were retrieved from registers in the facilities that had data. For 2007/2008 data, since the ANC sentinel surveillance took place in 2008, all available PMTCT records between July 15, 2008 and October 15, 2008 were retrieved from registers in the facilities that had data.

3.6 Variables

For the 2003-2004 PMTCT data, independent variables were: age of woman, gestation age, gravidity, marital status, educational level, parity, and location of site. The dependent variable was HIV status of woman (positive or negative). Starting from 2005, the PMTCT programme had omitted some variables from the ANC logbook. The programme also added results of partner test for HIV in the PMTCT register. Therefore for 2005/06 PMTCT data, independent variables were age of woman, gestation age, gravidity, and residence. The dependent variable was HIV status of woman (positive or negative). For 2007/8 data, Independent variables were: age of woman, gestation age, gravidity, and residence. Dependent variables were HIV status of woman (positive or negative), Partner HIV test (tested or not tested) and Partner HIV status (positive or negative). Two of these variables (age of woman and parity) were obtained from the HMIS (MTUHA) book number 6.

3.7 Site selection

The nine sites that participated in this study were located in five of the eight districts of Mbeya region, i.e. Mbarali, Mbozi, Rungwe, Kyela, Mbeya Urban and Mbeya Rural. Of the six ANC clinics used as ANC sentinel sites for surveillance, five had PMTCT data, but four of them had started PMTCT programme after the 2003-2004 ANC surveillance sampling period (October 2003- January 2004).

For this study, all the five sites that had both ANC sentinel surveillance data and PMTCT data were selected, namely, Kiwanjampaka, Ruanda, Ilembo, Kyela, and Chimala. These sites were selected based on the same criteria as that used for ANC sentinel surveillance that is, based on the records of number of women attending ANC for the first time during a particular pregnancy. The sites were categorized according to their geographical location. Urban sites were clinics located within the city and in the regional headquarter town while semi-urban sites were clinics located in towns other than the regional headquarter towns. These are towns

situated along major roads, district headquarter towns or border towns. Rural sites are ANC clinics which are located in the remote areas where communities either farm or keep livestock and these ANCs are not usually housed in hospital settings but in rural health centres, rural dispensaries or stand alone clinics. In this study, two sites (Kiwanjampaka and Ruanda) were urban, one (Ilembo) was rural, one (Kyela) was along the border, and one (Chimala) was located on the "roadside".

Additionally, four sites which had only PMTCT services were included in the study. Three of these sites had started to implement PMTCT services since 2001. These were Vwawa hospital in Mbozi district, Igawilo health centre in Mbeya Municipality, Meta RCH clinic of Mbeya referral hospital. Tukuyu district hospital in Rungwe district was also included in the study.

3.8 Data collection procedures

Firstly, ANC surveillance data for Mbeya region available in the electronic database (previously analyzed) were obtained from NACP. Since these data were in electronic form, they were directly transferred into the computer for further analysis and comparison with PMTCT data from the field. These data included HIV variation in prevalence rates by age, marital status, parity and educational level for Mbeya region for 2003/04, 2005/06 and 2007/08 by sites. In addition, the median HIV prevalence in five ANC surveillance sites: Chimala, Ilembo, Kiwanjampaka, Kyela, and Ruanda for the same period were obtained.

Secondly, individual information of ANC attendees at their first visit were manually retrieved from the general ANC PMTCT registers at the sites into data collection forms designed in an Excel data sheet. These individual-level PMTCT data are usually recorded in the general ANC PMTCT register that includes all women attending the antenatal clinic, age, gravidity, parity, date of pre-test counseling, date of test, date of post test counseling and the HIV test results. No interview was done to any woman. PMTCT data available at the sites were also assessed in terms of availability and quality. The criteria which were used to assess the availability and

quality of PMTCT programme data were the accessibility, accuracy and consistency of data recorded, and the ease of entering data into an electronic database.

Inclusion criteria:

For each site, PMTCT data collection were restricted to the ANC surveillance sampling period which were October 2003- January 2004, November 2005-February 2006 and July 2008-October 2008 whereby all data available were included.

Exclusion criteria:

PMTCT data which were recorded in the ANC registers before October 2003 and between January 2004 and November 2005, between February 2006 and July 2008 and after October 2008 were excluded from the study.

Data collection and entry

The 2003-2008 ANC surveillance data (electronic database) were provided by NACP. All individual-level PMTCT data were collected at all the nine sites. These individual-level PMTCT data were typically recorded in the PMTCT ANC register. Some variables (such as age and parity) were obtained from the HMIS book number 6. These data were directly recorded into an excel sheet using a laptop computer. To protect confidentiality, no names from the registers were recorded. For each site, PMTCT data collection was restricted to the ANC surveillance sampling period.

3.9 Data analysis

Data entry from PMTCT programme was directly done at the site into the excel spreadsheet using a laptop computer. Variables collected were as age of the woman, marital status, parity, education level, residence and gestation age, date of pre-test counselling and HIV test results. Data cleaning was done and initial data analysis was done by using EPI Info version 3.5.1 statistical software. To ensure comparability with ANC sentinel surveillance data previously

analyzed by the NACP, further analysis was done using STATA version 8.0 statistical software. Frequencies were generated from PMTCT data. Socio-demographic characteristics and reproductive history were examined within the PMTCT data. Comparison of HIV prevalence was done within and between PMTCT and the ANC sentinel surveillance. Chi-square test was used to test for difference between proportion. Student t-test and /or Analysis of Variance (ANOVA) were used to test the difference between means.

Logistic regression models were used to examine independent association between HIV infection and various sociodemographic and reproductive variables. Variables with p-values < 0.05 on univariate analysis and after assessment of co-linearity were included in the multivariable model. Variables included in the full multivariable model that were not significant were dropped after assessment of interaction. Odds ratios (OR), and 95% confidence interval (CI) were presented for factors associated with HIV infection. Significance level was set at 0.05.

3.10 Ethical considerations

Ethical approval to conduct the study was obtained from the Muhimbili University of Health and Allied Sciences (MUHAS) ethics board. Permission to use ANC sentinel surveillance data was obtained from the National AIDS Control Programme of the Ministry of Health and Social Welfare, Tanzania and the Mbeya Regional Medical Officer. All the information from the ANC registers was kept under strict confidentiality. No names were recorded from the ANC PMTCT registers.

CHAPTER FOUR

4.0 RESULTS

Of the nine sites that took part in this study, five had both PMTCT and ANC sentinel surveillance data while four sites had only PMTCT data. This study retrieved 6390 records from PMTCT registers, of which, 703 (11.00%) were from year 2003/2004, 1344(21.03%) were from year 2005/2006 and 4343 (67.97%) were from year 2007/2008.

Availability of records

In the period 2003/2004, there were only four sites which were operational for PMTCT services. Of these, Mbeya referral hospital had no data available because the ANC PMTCT register was missing (Table 1). Two sites had no data for the period 2005/2006, while all sites had data for the period 2007/2008.

Table 1. Availability of data at the PMTCT sites visited, Mbeya region

	PMTCT Data Available			
Name of site	**2003/2004**	**2005/2006**	**2007/2008**	**Remarks**
1.Tukuyu		Available	Available	missing HMIS book 6 for 2007/2008
2. Kyela		Available	Available	
3. Chimala			Available	PMTCT services started in 2007
4. Ilembo		Not available	Available	missing PMTCT register 2005/2006
5. Ruanda	Available	Not available	Available	missing PMTCT register 2005/2006
6. Kiwanjampaka		Available	Available	missing HMIS book 6 for 2007/2008
7. Igawilo	Available	Available	Available	
8. Vwawa	Available	Available	Available	
9. Mbeya	Not available	Available	Available	missing PMTCT Register 2003/2004

Note: Four facilities had PMTCT services only, and five facilities had both PMTCT and ANC Sentinel surveillance. Shading indicates areas not operational during that period

Summary measures and reproductive parameters of the study population across the years are given in Table 2. The mean age of the overall study population was 25 years (SD: 5.7) and the age ranged from 11 to 52 years. The mean age significantly increased from 23.68 (SD: 3.3) in year 2003/2004, to 24.66 (SD: 5.91) and 25.43 (SD: 5.75) in year 2005/2006 and 2007/2008, respectively (p=0.000). The overall mean number of pregnancies was 2.6 (SD: 1.7), and it ranged from gravida 1 to gravida 10. The overall mean gestation age was 22.6 weeks (SD 6.55), ranging from 2 to 40 weeks.

Table 2. Summary measures of the study population and some reproductive parameters by year, Mbeya region 2003-2008 (N=6390)

	2003/04	2005/06	2007/08	Overall
Age of woman				
N	703	1305	3363	*5371
Mean(SD)	23.7 (3.3)	24.7 (5.9)	25.4 (5.7)	25.0 (5.7)
Median	23	24	25	24
Min	11	12	12	11
Max	42	45	52	52
Gravidity				
N	695	1305	3362	*5362
Mean (SD)	2.4 (1.6)	2.7 (1.7)	2.6 (1.7)	2.6 (1.7)
Median	2	2	2	2
Min	1	1	1	1
Max	10	10	12	12
Gestation age				
N	624	1328	4238	*6190
Mean(SD)	24.5 (6.6)	23.3 (6.7)	22.2 (6.4)	22.6 (6.5)
Median	24	24	22	23
Min	2	6	4	2
Max	38	39	40	40

***N varies due to missing information on age of woman, gravidity or gestation age**

4.1 Socio-demographic and reproductive characteristics of the study population

The socio-demographic and reproductive characteristics of the study population are shown in Table 3. The age group 15-24 years had the largest proportion of women in all the years, however, this proportion decreased significantly over time (p=0.000). On the contrary, the proportion of pregnant women in the age groups 25-34 and 35+ years increased significantly over the years (p=0.000). The distribution of marital status and occupation for the year 2003/2004 when these data were being recorded are presented. The largest proportion of women reported to be married or cohabiting (92.4%), with almost half of them reporting to be housewives (48.4%).

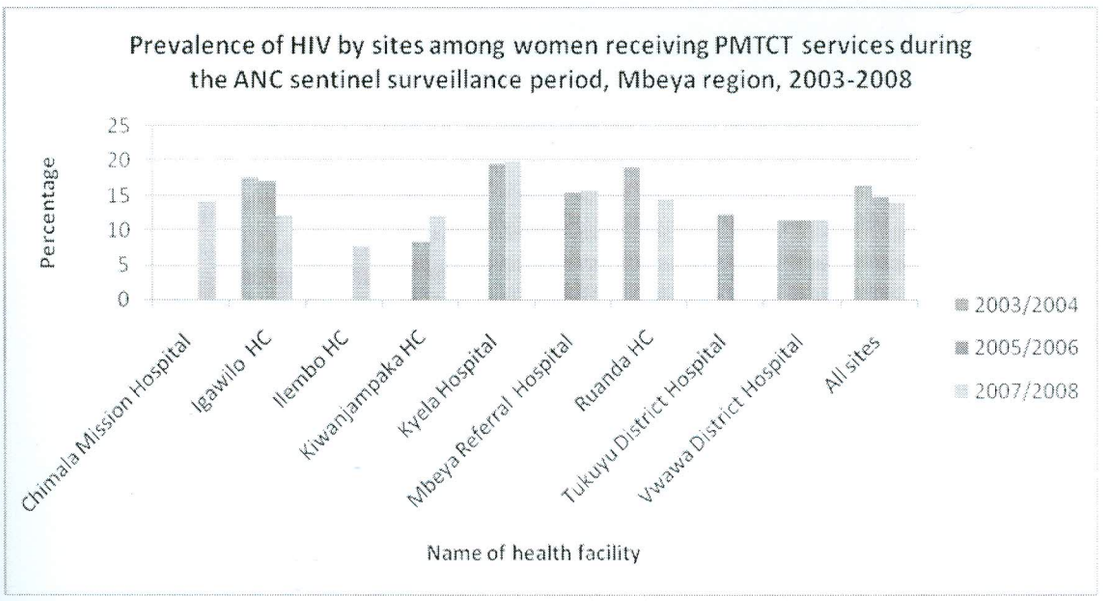
Table 3: Socio-demographic and reproductive characteristics of women receiving PMTCT services during the ANC sentinel surveillance period, Mbeya region 2003-2008

Category	2003/2004 n (%)	2005/2006 n (%)	2007/2008 n (%)
Age group			
15-24 years	435 (62.8)	720 (55.2)	1612 (47.9)
25-34 years	223 (32.2)	484 (37.1)	1456 (43.3)
35+ years	35 (5.0)	101 (7.7)	295 (8.8)
#N	693 (100)	1305 (100)	3363 (100)
Gravidity			
1 & 2	421 (60.6)	733 (56.2)	1853 (55.1)
3 & 4	188 (27.0)	365 (27.9)	1146 (34.1)
5+	86 (12.4)	207 (15.9)	363 (10.8)
#N	695 (100)	1,305 (100)	3,362 (100)
Marital status			
Married/Cohabiting	647 (92.4)		
Single	53 (7.6)		
#N	700 (100)		
Occupation			
Business/Formal employment	87 (12.4)		
Farmer	274 (39.2)		
House wife	338 (48.4)		
#N	699 (100)		

Marital status and occupation were among variables removed from the PMTCT registers after 2003/2004
#N varies due to missing data in the respective categories

4.2 Attendance and Prevalence of HIV in the PMTCT group by sites

In the years 2003/2004 and 2005/2006, Igawilo Health centre had a higher proportion of women attending PMTCT sites than other health centres. Among hospitals in 2005/2006, of the four hospitals which had data, Vwawa hospital and Mbeya referral hospital had a higher proportion of women (21% and 20% respectively). In year 2007/2008, Ilembo health centre had the lowest proportion (only 3%), of all four health centres which had above 10% of women receiving PMTCT services. For the year 2007/2008, of the four district hospitals that had data available, Vwawa hospital had the highest proportion (16.9%), followed by Kyela distict hospital 616 (14.2%), while Mbeya referral hospital had the lowest proportion 386 (8.9%). In 2003/2004 Ruanda health centre had the highest prevalence of HIV among women attending PMTCT services (19.1%) of all sites (Fig. 3). In year 2005/2006, Kyela had the highest prevalence (19.5%), while Kiwanjampaka Health centre had the lowest prevalence (8.3%) of all the sites. In the year 2007/2008, Kyela district hospital had the highest prevalence of HIV (19.8%), followed by Mbeya referral hospital (15.8%).



Note: For the period 2003-2004, of the four health facilities that had started PMTCT services, three had data

Figure 3. Prevalence of HIV by sites

4.2.1 Prevalence of HIV by location of PMTCT sites

In year 2003/2004, the prevalence of HIV among women receiving PMTCT services in sites located in urban areas (Table 4) was the highest 19.12% compared to all other locations. But in both years 2005/2006 and 2007/2008, the prevalence of HIV was consistently highest in border areas (19.51% and 19.81% respectively) compared to other locations. Generally the prevalence was lowest in sites located in semi-urban areas in all the three years 2003/2004, 2005/2006 and 2007/2008 and their prevalence was 11.41%, 12.81%, and 11.43% respectively.

Over the years, HIV prevalence in sites located at border areas has remained the same, while it has been decreasing in sites located at rural areas. A statistically significant difference was found between the HIV prevalence estimates among sites located in the rural areas in the year 2005/2006 and that of the year 2007/2008 (17 .1% CI 12.8-22.2, vs 11.0%,CI 8.7-13.64, p=0.01).

Table 4: Prevalence of HIV by location of site among women receiving PMTCT services during the ANC sentinel surveillance period, Mbeya region, 2003-2008

Location	2003/2004 **			2005/2006*			2007/2008***		
	Total (%)	HIV +	Prevalence (95%CI)	Total	HIV+	Prevalence (95%CI)	Total	HIV+	Prevalence (95%CI)
Border				205(15.43)	40	19.5% (14.3-25.6)	616(14.2)	122	19.8% (16.7-23.2)
Semi-urban	184(26.2)	21	11.4% (7.0-16.9)	445 (33.48)	57	12.8% (9.8-16.3)	735(17.0)	84	11.4% (9.2-14.0)
Urban	204(29.1)	39	19.1% (14.7-25.2)	416(31.30)	54	13.0% (9.9-16.6)	1765(40.8)	245	13.9% (12.3-15.6)
Roadside	-	-	-	-	-	-	561(12.9)	79	14.1% (11.3-17.2)
Rural	314(44.7)	55	17.52% (13.5-22.2)	263(19.79)	45	17.1% (12.8-22.2)	655(15.1)	72	11.0% (8.7-13.64)
Overall	702(100)	115	16.4% (13.7-19.3)	1,329(100)	196	14.8% (12.9-16.8)	4,335(100)	602	13.9% (12.9-15.0)

Note: *** =p<0.01, ** p<0.05 and * p<0.1, HIV + - Number of HIV positive, Data do not add up to N due to missing data on HIV test results
CI= Confidence Interval

4.2.2 Prevalence of HIV by gravidity

Table 5 shows the prevalence of HIV by number of pregnancies (gravidity) among women receiving PMTCT services during the ANC sentinel surveillance period in Mbeya region for the whole study period, 2003-2008. The prevalence of HIV differed by number of pregnancies for women in the study population.

In year 2003/2004 the prevalence was the highest (21.81%, CI 16.1-28.4) among women in their third and fourth pregnancies, p=0.05. However, in the year 2005/2006 there was no significant difference of prevalence of HIV for women by number of pregnancies but for the year 2007/2008 again the prevalence was the highest (16.6%, CI 14.5-18.9) among women in their third and fourth pregnancies p=0.04. Across the years, there was no definite pattern of HIV prevalence by gravidity.

Table 5: Prevalence of HIV by number of pregnancies (gravidity) among women receiving PMTCT services during the ANC sentinel surveillance period, Mbeya region, 2003-2008

	2003/2004 **			2005/2006			2007/2008**		
Gravidity	Total N	Positive n	Prevalence (95%CI)	Total N	Positive n	Prevalence (95%CI)	Total N	Positive n	Prevalence (95%CI)
1 & 2	421	58	13.8% (10.6-17.4)	728	110	15.1% (12.6-17.9)	1849	244	13.2% (11.7-14.8)
3&4	188	41	21.8% (16.1-28.4)	362	50	13.8% (10.4-17.8)	1144	190	16.6% (14.5-18.9)
5+	86	15	17.4% (10.1-27.1)	204	27	13.2% (8.9-18.7)	363	54	14.9% (11.4-19.0)
Overall[#]	695	114	16.4% (13.7-19.4)	1,294	187	14.4% (12.6-16.5)	3,356	488	14.5% (13.4-15.8)

Note: *** =p<0.01, ** p<0.05 and * p<0.1; [#] data do not add up to N=6390 due to missing data on gravidity

4.3 Comparison of HIV prevalence by age groups

Figure 4 compares the prevalence of HIV by age groups among women receiving PMTCT services and the ANC sentinel surveillance. When examining the difference in HIV prevalence across the age strata between the PMTCT programme and the ANC sentinel surveillance for the year 2003/2004 and 2005/2006, there was a statistical significant different in HIV prevalence estimates only in the age group of 35 and above (p=0.00 for both years). For the year 2007/2008, between the two data sources, there was a statistical significant difference in HIV prevalence estimates in the age group of 15-24 and 25-34 (p=0.00). Generally, between the PMTCT programme and the ANC sentinel surveillance for all study years, the results showed similar estimates of HIV prevalence across the age strata.

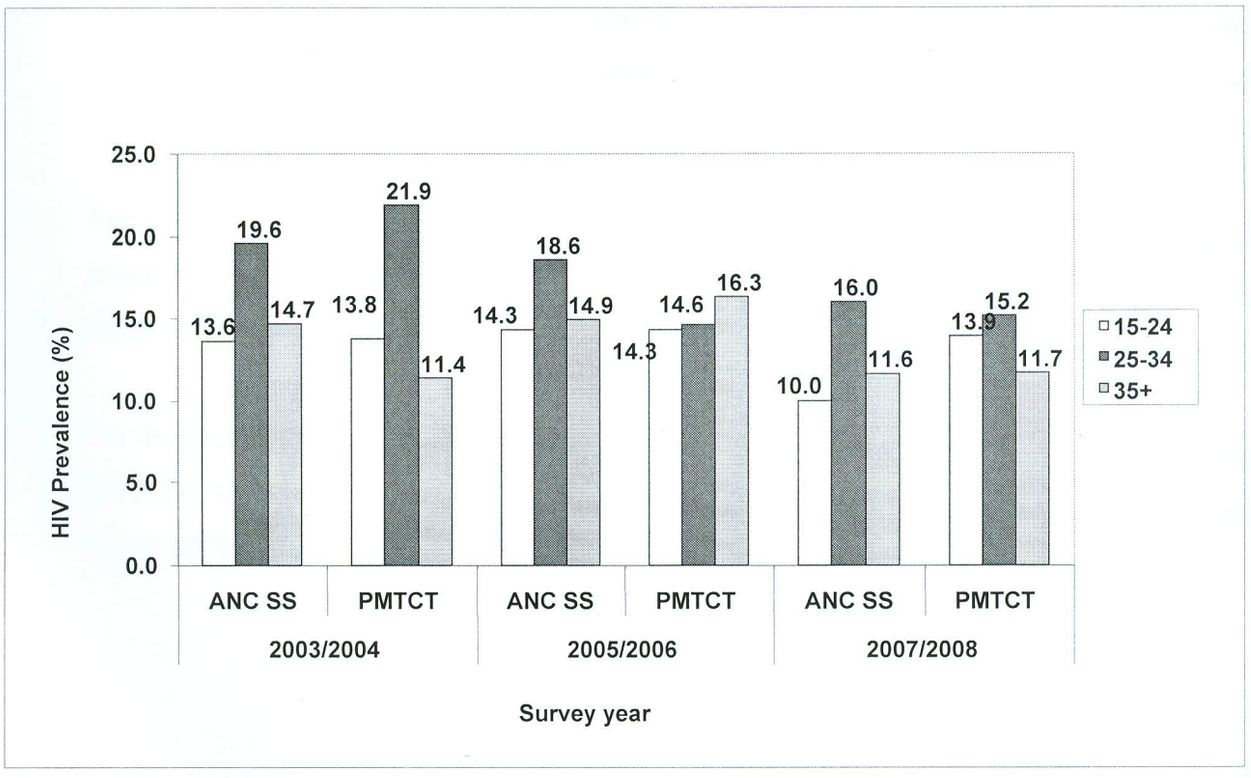


Figure 4. Comparison of HIV prevalence by age groups between ANC sentinel surveillance and PMTCT, Mbeya region 2003-2008

4.4 Comparison of age-adjusted HIV prevalence estimates from PMTCT programme with those from ANC sentinel surveillance

Table 6a compares the HIV prevalence estimates between the PMTCT programme and ANC sentinel surveillance for the period 2003/2004, 2005/2006 and 2007/2008, after adjusting for age. The results showed that there was no statistically significant difference in HIV prevalence estimates between PMTCT programme and ANC surveillance data for the period 2003-2004. However, for the year 2007/2008, the difference in the estimates were found to be statistically significant (p=0.00).

Table 6b compares the age-adjusted HIV prevalence estimates between PMTCT programme and a population-based survey, also between ANC sentinel surveillance and a population-based survey in Mbeya region for the period 2003-2008. Comparison is made separately with women and separately with all men and women in the population-based survey.

For the years 2003/2004 and 2005/2006, the HIV prevalence estimates from the PMTCT programme as well as that from the ANC sentinel surveillance did not significantly differ from the population-based survey.

For the year 2007/2008, the HIV prevalence estimates from the PMTCT programme and that from the ANC sentinel surveillance significantly differed from that of the population-based survey (p=0.00 for both PMTCT and ANC sentinel surveillance).

Table 6a. Comparison of age adjusted HIV prevalence estimates between PMTCT programme and ANC sentinel surveillance, Mbeya region, 2003-2008

	2003/2004			2005/2006			2007/2008		
	PMTCT	ANC SS	p value	PMTCT	ANC SS	p value	PMTCT	ANC SS	p value
Age-adjusted HIV-1 prevalence	15.85%	15.86%	p=0.89	14.89%	15.87%	p=0.43	14.36%	12.38%	p=0.00

PMTCT= prevention of Mother to Child HIV Transmission; ANC SS, Antenatal Care Sentinel Surveillance

Table 6b. Comparison of age-adjusted HIV prevalence estimates between PMTCT programme and a population-based survey and between ANC sentinel surveillance and a population-based survey

Year	Parameters	PMTCT	Population Survey		ANC SS	Population Survey	
			Women	All		Women	All
*2003/2004	Age-adjusted HIV prevalence	15.85%	15.2%	13.5%	15.86%	15.2%	13.5%
	p value		0.73	0.09		0.73	0.09
*2005/2006	Age-adjusted HIV prevalence	14.89%	15.2%	13.5%	15.87%	15.2%	13.5%
	p value		0.86	0.31		0.72	0.09
**2007/2008	Age-adjusted HIV prevalence	14.36%	9.3%	9.2%	12.38%	9.3%	9.2%
	p value		**0.00**	**0.00**		**0.03**	**0.00**

Note: Population-based surveys used were the:
***Tanzania HIV Indicator Survey (THIS) conducted in 2003/2004 and**
****Tanzania HIV and Malaria Indicator Survey (THMIS) conducted in 2007/2008**
PMTCT= prevention of Mother to Child Transmission; ANC SS, Antenatal Clinic Sentinel Surveillance

4.5 Factors associated with HIV sero-status among women receiving PMTCT services during the ANC sentinel surveillance period

Table 7 presents the results of univariate and multivariate logistic regression analyses of the factors associated with HIV sero-status among women receiving PMTCT services during the ANC sentinel surveillance period in Mbeya region for the period 2003/2004.

Univariate analysis showed that women who belonged to the age group 25-34 years were significantly 85% more likely to be HIV sero-positive than the younger women aged 15-24 years (OR: 1.85, 95% CI: 1.22-2.80, p=0.00). Association of HIV sero-status with gravidity showed that those women who were in their third and fourth pregnancies were 75% more likely to be HIV sero-positive than those in their first and second pregnancies (OR: 1.75, 95% CI: 1.09-2.78, p=0.01).

In addition, those women who were in gestation age of 21-32 weeks were 40% less likely to be HIV sero-positive than those women who were in a lower gestation age of less than 20 weeks(OR: 0.61, 95% CI: 0.38-0.98, p=0.04).

Attending an ANC clinic in a PMTCT site located in a semi –Urban areas was significaltly associated with HIV sero-status such that, the women in these sites were 43% less likely to be HIV sero- positive, than those women who attended clinics at PMTCT sites located in rural areas (OR: 0.57, 95% CI: 0.33-0.99, p=0.04). .

In the multivariate logistic regression analysis, HIV ser-status was significantly associated with older age (OR: 1.82, 95% CI: 1.05-3.15, p=0.03). Women in higher gestataion age were less likely to be HIV positive than those in a lower gestation age (OR: 0.60, 95% CI: 0.38-0.97), and women attending clinic in a site situated in an urban area were 45% less likely to be HIV infected than those attending clinics in sites located in rural areas. The significant association of HIV infection with number of pregnancies disappeared in the multivariate logistic regression analysis.

Table 7: Factors associated with HIV sero-status among women receiving PMTCT services during the ANC sentinel surveillance period, 2003/2004

Variable	n (%) Positive	Univariate logistic regression OR (95% CI)	p-value	Multivariate logistic regression AOR (95% CI)*	p-value
Age groups					
15-24 years	60 (52.2)	Ref		Ref	
25-34 years	51 (44.3)	1.85 (1.22-2.80)	0.00	1.82 (1.05-3.15)	0.03
35+ years	4 (3.5)	0.80 (0.27-2.36)	0.69	1.02 (0.29-3.60)	0.96
Gravidity					
1 & 2	363 (62.5)	Ref		Ref	
3& 4	147 (25.3)	1.75 (1.09-2.78)	0.01	1.48 (0.85-2.57)	0.16
5+	71 (12.2)	1.32 (0.68-2.56)	0.38	0.95 (0.40-2.26)	0.91
Gestation age					
< 20 weeks	147 (28.2)	Ref		Ref	
21-32 weeks	313 (59.9)	0.61 (0.38-0.98)	0.04	0.60 (0.38-0.97)	0.04
33-40 weeks	62 (11.9)	0.72 (0.34-1.51)	0.38	0.72 (0.34-1.52)	0.39
Location of clinic					
Rural	259 (44.1)	Ref		Ref	
Urban	165 (28.1)	1.06 (0.62-1.79)	0.83	0.55 (0.32-0.96)	0.03
Semi-urban	163 (27.8)	0.57 (0.33-0.99)	0.04	1.02 (0.60-1.73)	0.94

Ref –Reference group, CI= Confidence Interval, OR= Odds Ratio, AOR= Adjusted Odds Ratio
*** Each variable adjusted for other variables in the table**

Table 8 presents the results of univariate and multivariate logistic regression analyses of the factors associated with HIV sero-status among women receiving PMTCT services during the ANC sentinel surveillance period in Mbeya region for the period 2005/2006. Univariate analysis showed that there was no statistical significant difference between the strata of age groups, gravidity and gestation age and HIV prevalence.

When looking at the location of sites where PMTCT services were provided, for the period 2005/2006, the most influential factor for HIV sero positive condition was for women who attended PMTCT clinics that were located at border areas. These women were 65% more likely to be HIV sero- positive than those women who attended clinics located in in semi-Urban areas, and these results were statistically significant, p=0.03. In the multivariate logistic regression analysis, the significant association of HIV infection with location of PMTCT site disappeared.

Table 8: Factors associated with HIV sero-status among women receiving PMTCT services during the ANC sentinel surveillance period, 2005/2006

Variable	n (%) Positive	Univariate logistic regression OR (95% CI)	p-value	Multivariate logistic regression OR (95% CI)*	p-value
Age groups					
15-24 years	102 (54.3)	Ref		Ref	
25-34 years	70 (37.2)	0.97 (0.70-1.35)	0.87	1.34 (0.87-2.06)	0.18
35+ years	16 (8.5)	0.86 (0.49-1.53)	0.62	1.67 (0.77-3.63)	0.19
Gravidity					
1 & 2	110 (58.8)	Ref		Ref	
3& 4	50 (26.7)	0.90 (0.63-1.29)	0.57	0.74 (0.47-1.16)	0.19
5+	27 (14.4)	0.85 (0.54- 1.35)	0.50	0.62 (0.33-1.16)	0.13
Gestation age					
< 20 weeks	82 (42.3)	Ref		Ref	
21-32 weeks	99 (51.0)	0.98 (0.71-1.34)	0.88	0.99 (0.71-1.38)	0.96
33-40 weeks	13 (6.7)	0.83 (0.44-1.56)	0.56	0.89 (0.46-1.73)	0.73
Location of clinic					
Semi-Urban	57 (29.0)	Ref		Ref	
Urban	54 (27.6)	1.01 (0.68-1.51)	0.94		
Rural	45 (23.0)	1.41 (0.92-2.15)	0.12	0.73 (0.50-1.08)	0.11
Border	40 (20.4)	1.65 (1.06-2.58)	0.03	1.10 (0.66-1.84)	0.71

Ref –Reference group, CI= Confidence Interval, OR= Odds Ratio, AOR= Adjusted Odds Ratio
*** Each variable adjusted for other variables in the table**

Table 9 presents the results of univariate and multivariate logistic regression analyses of the factors associated with HIV sero-status among women receiving PMTCT services during the ANC sentinel surveillance period in Mbeya region for the period 2007/2008.

Univariate analysis showed that women in their third and fourth pregnancies were 1.3 times more likely to be HIV positive compared to those in their first and second pregnancies (OR: 1.31, 95% CI: 1.07-1.61, p=0.01). Women who attended clinic at border areas had a 1.91 times higher likelihood of being HIV infected compared to those who attended clinics located in other residences. (OR: 1.91, 95% CI: 1.41-2.59, p=0.00).

In the multivariate logistic regression analysis, HIV sero-status was significantly associated with women attending clinics located in urban areas (OR: 1.35, 95% CI: 1.00-1.80, p=0.04) and clinics located in areas along the border (OR: 1.99, 95% CI: 1.44-2.77, p=0.00). The significant association of HIV infection with number of pregnancies disappeared in the multivariate logistic regression analysis.

Table 9: Factors associated with HIV sero-status among women receiving PMTCT services during the ANC sentinel surveillance period, 2007/2008

Variable	n (%) Positive	Univariate logistic regression OR (95% CI)	p-value	Multivariate logistic regression OR (95% CI)*	p-value
Age groups					
15-24 years	223 (45.7)	Ref		Ref	
25-34 years	221 (45.3)	0.89 (0.73-1.09)	0.28	0.98 (0.76-1.28)	0.90
35+ years	42 (8.6)	0.92 (0.65-1.30)	0.63	0.95 (0.59-1.53)	0.84
Gravidity					
1 & 2	244 (50.0)	Ref		Ref	
3& 4	190 (38.9)	1.31 (1.07-1.61)	0.01	1.21 (0.92-1.58)	0.16
5+	54 (11.1)	1.15 (0.84-1.58)	0.39	1.13 (0.72-1.77)	0.59
Gestation age					
< 20 weeks	1661 (45.5)	Ref		Ref	
21-32 weeks	1807 (49.6)	0.98 (0.97-1.02)	0.90	1.11 (0.89-1.38)	0.34
33-40 weeks	179 (4.9)	0.96 (0.63-1.47)	0.78	1.72 (0.97-3.07)	0.06
Location of clinic					
Rural	72 (13.8)	Ref			Ref
Urban	329 (13.1)	1.22 (0.93-1.60)	0.14	1,35 (1.00-1.80)	0.04
Border	122 (23.3)	1.99 (1.46-2.74)	0.00	1.99 (1.44-2.77)	0.00

Ref –Reference group, CI= Confidence Interval, OR= Odds Ratio, AOR= Adjusted Odds Ratio
*** Each variable adjusted for other variables in the table**

4.6 HIV testing uptake among pregnant women and their partners in the PMTCT environment

Table 10 shows the HIV testing uptake among pregnant women receiving PMTCT services during the ANC sentinel surveillance period for the period 2003-2008. In general, the HIV testing uptake was above 99%.

Table 10. HIV testing uptake among pregnant women receiving PMTCT services during the ANC sentinel surveillance period, Mbeya region, 2003-2008, N=6390

Year	Number pretest-counseled	Number tested	% tested
2003/2004	703	702	99.9
2005/2006	1344	1329	98.9
2007/2008	4343	4335	99.8

Figure 5 shows the prevalence of HIV among male partners in the sites which had data on HIV testing among male partners for the year 2007/2008. In total there were 191 male partners tested in three sites providing PMTCT services (41 from Chimala, 25 from Kiwanjampaka and 125 from Kyela.

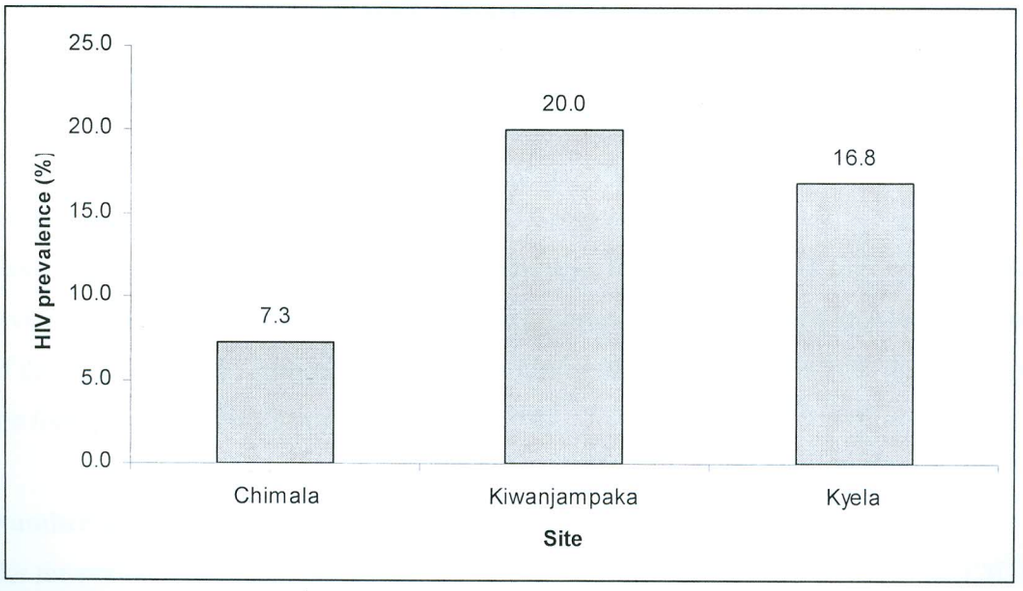


Figure 5. HIV testing among male partners of women in the study population, Mbeya region, 2007/2008

4.7 Quality of data generated by the PMTCT services in Mbeya region

Of the several PMTCT registers used for data collection in Mbeya, the ANC PMTCT register was the most useful for the purpose of this study. Other registers such as the National PMTCT care register, PMTCT mother and child follow up register and PMTCT labour and delivery register were not applicable in this study. The HMIS book number 6, which is available in all health facilities and which is a register for pregnant women attending ANC services, was used to trace information on age of woman and parity. This book was not found at the Tukuyu district hospital for the year 2007/2008.

Access to data

All available PMTCT ANC registers at all site were accessible. The health personnel at the RCH clinics were willing to share the information available in the registers with the investigator. By retrieving the information from registers, data could be entered electronically by entering into an excel sheet using a laptop computer.

Filling of registers and clarity of handwriting

Handwriting used in recording of data in the registers was clear at all the sites and registers were properly filed. However, a number of "unknown" or "blank" responses was observed. Of the total 6390 record retrieved, 1019 (15.9%) had missing information on age of woman, 1028 (16.1%) had missing information on gravidity, 200(3%) had missing information on gestation age and 24 (0.4%) had missing information on HIV test results.

Format and uniformity of the ANC PMTCT register

Since the start of the PMTCT programme in Mbeya, the ANC PMTCT register has been revised twice to meet the requirements of the programme and also to reduce the workload of the health workers. Although the logbook format was not uniform across the years, the the format used was the same for all sites.

Number and order of variables recorded

For the period 2003/2004, there were more than 16 variables recorded in the ANC PMTCT register. Later, from 2005 to 2008, some variables were excluded from the PMTCT

logbooks which resulted into only 13 variables recorded. The order of the variables has been changing in the ANC PMTCT register across the years. This is because the registers have been revised by removing some of the variables and adding others.

Type of variables recorded

Over time, some variables were removed form the ANC PMTCT register. Starting from the year 2005, in the ANC PMTCT register, the following variables were recorded: date started ANC, ANC card number, Gestation age, Known HIV positive status, Date of pretest-counseling, Date of HIV test, HIV test results, date of post-test counseling, ARV dispensed during ANC.

Some variables such as age of woman, parity, marital status and educational level were not available in the PMTCT ANC logbook starting from 2005. However, the investigator was able to trace the age either from the National PMTCT care register or from HMIS (MTUHA) book number 6. These variables were included in previous ANC PMTCT registers for the year 2003-2005. Results of partner test were initially included in the ANC PMTCT register for the year 2003/2004. For the year 2005/2006, a separate register was used for the male partners. Later, for the year 2007/2008, these results were again included in the ANC PMTCT register.

Storage of data

At Tukuyu district hospital, Ilembo health centre, Ruanda health centres and .Mbeya referral hospital, improper storage of data was observed. Mbeya referral hospital had the ANC PMTCT register for 2003/2004 missing. Tukuyu district hospital missed HMIS books where the ages of women attended at the RCH clinics were recorded. Ilembo health centre, Ruanda health centres had the ANC PMTCT logbooks for 2005/2006 missing.

CHAPTER FIVE

5.0 DISCUSSION

This study was able to compare HIV-1 prevalence estimates from PMTCT programme with those from ANC sentinel surveillance from the year 2003-2008 in Mbeya region.The results of this study showed that the HIV-1 prevalence estimates based on PMTCT data in Mbeya region were comparable to those based on ANC sentinel surveillance for the period 2003-2006. For the year 2007/2008 estimates from the two sources were found to have a statistically significant difference. The study also found that population-based estimates in HIV-1 prevalence among women as well as in the general population, did not differ significantly from those of PMTCT and ANC sentinel surveillance during the early years, i.e 2003/2004 and 2005/2006. However, the general population estimates were significantly lower than those from PMTCT or ANC sentinel surveillance for the period 2007/2008.

Within the PMTCT-based HIV-1 prevalence estimates, this study found that women attending clinics located in urban and border areas were more likely to be HIV-1 infected than those attending clinics located elsewhere. The HIV testing uptake among pregnant women in the PMTCT environment was very high. A notable varying PMTCT-based data quality was observed across sites and over the years.

Study population and participation

In this study, only 11.0% of the total records that were retrieved from ANC PMTCT registers were recorded for the year 2003-2004. This could be explained by the fact that, for that time period, only 4 facilities had been providing PMTCT services in Mbeya region, hence the low number of records provided for that year. PMTCT services were expanded in Mbeya from 2005 onwards, whereby more sites were included into the programme. Therefore, as more sites were being enrolled into the programme, pregnant women were increasingly receiving PMTCT services from the antenatal clinics. In this study, the proportion of pregnant women receiving PMTCT services who belong in the age group 15-24 years was the highest across all years, while this proportion has been significantly

decreasing across the years. On the other hand, the proportion of pregnant women in the age group 25-34 years has been significantly increasing over the years. Results from this study also showed that the mean age of women receiving PMTCT services has been increasing across the years, with younger women in the earlier years and older women in the recent years coming to the clinics to get the services This can be explained by the fact that, in the recent years, younger women are more involved in education and other activities before they start to engage themselves in child bearing, hence the age at which they become ready for reproduction has increased. Across all the years, the highest proportion of women in this study was those in their first and second pregnancies, majority of whom were married or cohabiting.

Comparison of HIV prevalence estimates from PMTCT programme with ANC sentinel surveillance data, with reference to a population-based survey

This study found that for the years 2003-2006, the age-adjusted HIV-1 prevalence estimates from the PMTCT programme and that from the ANC sentinel surveillance did not show any statistically significant difference. The result of this study are comparable with the study conducted in North Uganda (Fabiani *et al,* 2005), in which, although the crude PMTCT-based prevalence were different from that based on UAT data, the age-standardized HIV-1 prevalence among the women who underwent anonymous surveillance and those who underwent VCT was similar for the two groups. In that Ugandan study, the age-specific prevalence rates for the entire study period were also similar; the greatest difference was observed for women less than 20 years of age, among whom the prevalence was 1.18 times higher in the VCT group. In their conclusion, Fabiani *et al* suggested that the prevalence estimated based on the VCT data collected as part of the PMTCT programme could be used for HIV-1 surveillance in North Uganda. On the contrary, Seguy *et al,* 2006, in a study conducted in Kenya to compare the prevalence estimates from PMTCT programmes with those of ANC sentinel surveillance, found the median UAT-based HIV prevalence to be lower (12.8%) than the prevalence from PMTCT (14.4%).

The results of this study also showed that, for the years 2003-2006, the HIV prevalence estimates from PMTCT programme and ANC sentinel surveillance were comparable to the

estimates from the population based survey, however, they significantly overestimated the actual prevalence in the general population for the year 2007/2008. However, HIV-1 prevalence from ANC data has been reported by previous studies to be lower than that of women in the general population, especially those over 20 years (Mmbaga et al, 2009). A cross-sectional population survey conducted in rural Mwanza, Tanzania by Changalucha *et al*, 2002 showed that the unadjusted HIV prevalence was significantly lower in ANC attendees (3.6%) than in women from the general population (4.7%), but after adjustment there was no significant difference between the two groups. In this rural population, the HIV prevalence in ANC attendees underestimated the prevalence among women in the general population, but this difference was eliminated by applying parity-based correction factors.

The results obtained from this study were also different from the study conducted in Bukoba, Tanzania (Kwesigabo *et al*, 1996), where pregnant women had a significantly lower prevalence than general population females. Contrary to the above studies, this study found that PMTCT programme and ANC sentinel surveillance data overestimate general population prevalence estimates. Several explanations can be made for the overestimation of HIV prevalence in this study by the PMTCT-based and ANC sentinel surveillance data. Mbeya is among the regions in Tanzania that were early hit by the HIV epidemic. Following this, there is a high level of ARV roll out which translates into an increased survival among people who are HIV sero-positive. Studies indicate that people living with HIV/AIDS desire children equally to those uninfected, especially in the presence of ARVs. Hence, the number of HIV infected women seeking reproductive health services, hence PMTCT, could be higher in Mbeya as the region has the second largest population of infected individuals. The effect of the ARV roll out did not affect the general population because in the general population there is a mix of HIV negative and HIV positive people, which leads to a serious dilution of the prevalence. In addition, the presence of males in the general population, whose HIV prevalence is lower, also leads to a lower prevalence.

Although PMTCT programme and ANC sentinel surveillance data overestimated general population prevalence estimates probably for the reasons given above, they were more comparable with each other, indicating that both of them are good at estimating the general

population HIV-1 prevalence. The observation made for the year 2007/2008, whereby the difference in the estimates between PMTCT programme and ANC sentinel surveillance with the population-based survey was statistically significant, could be due to the fact that the has been a big drop in HIV prevalence in the general population, which was picked up by the population-based survey. Since estimates of HIV prevalence from ANC attendees have been previously shown not to be sensitive to changing in HIV prevalence in the general population the two data sources from pregnant women was not able to show this decrease in HIV-1 prevalence (Michelo et al, 2008).

The results of this study concurred with the population-based HIV study conducted within the rural areas of Manyara and Singida regions in Tanzania (Malima *et al*, 2007) found the prevalence of HIV in the general population to be 1.8%, which was comparable to that of pregnant women attending antenatal clinics.

Factors associated with HIV sero-status among women receiving PMTCT services during the ANC sentinel surveillance period

As shown in this study, women in younger gestation ages are more likely to have been HIV seropositive than women in older gestation ages. Gestation age by itself is not a risk factor for HIV infection, but women who perceive themselves as at risk of being infected may report to the RCH clinic as early as possible in their pregnancy with expectation of being tested and receiving appropriate care for their condition.

The results of this study have shown a high prevalence of HIV in sites located at urban areas as well as border areas compared to rural areas. Generally, in urban areas the proportions of women who are HIV positive have been increasing, while contrary to that, in rural areas the proportions have been falling throughout the years. This is in consistence with findings from a study conducted in three divisions of rural Manyara and Singida (Yahya-Malima *et al*, 2007), which showed a prevalence of 2.2%, which was very low compared to other rural areas of Tanzania. There might be some factors that limit the sources and spread of infection such as limited accessibility due to poor infrastructure, hence less traffic and reduced mobility (Yahya-Malima *et al*, 2007).

Urban/rural prevalence variations in HIV-1 prevalence has been shown by a study by Aroyo et al which showed that prevalence in HIV-1 infection in Mbeya differs considerably between rural and urban populations, despite their close proximity. The study showed that HIV-1 prevalence in Mbeya is high in Urban than in rural areas. The complexity observed in Mbeya Town may be explained in part by the accessibility of the local community to the Trans-African highway, which connects Tanzania with neighboring countries and provides an epidemiological route for HIV-1. Communities along the highway, which are known to engage in social interactions and casual sexual contact between travelers and local inhabitants, might also be contributing to the complex epidemiology observed. Geographical features such as mountainous terrain and a broad river, and the more limited availability of motorized transportation among villagers, are some of the factors that might be responsible for the lack of interaction between rural and urban populations, despite their close proximity (Aroyo et al, 2005). For areas along the border, high HIV prevalence may be associated with the sociocultural context of casual and commercial sex and profound mobility, as truckers, traders, soldiers, migrant miners and sex workers move through the towns along the border.

HIV testing uptake among pregnant women and their partners in the PMTCT environment

In this study, the HIV testing uptake was very high across all the years. This is in contrast with the study by Seguy *et al,* 2006 in which the HIV testing acceptance for PMTCT ranged from 48% to 69% across clinics. The higher the proportion of women accepting HIV testing for PMTCT, the more representative will be the HIV prevalence of the ANC population. Other studies (Wamsley 2003, MMWR 2004) have shown that service-related factors, including the HIV testing strategy ("opt-in" or "opt-out" strategy), the organization of services, human resources training, staff attitude, and availability of anti-retroviral medication at each facility may have a strong influence on HIV testing uptake. The opt-out strategy, for example, has proven to result in a better HIV testing uptake than the opt-in strategy (Wamsley 2003). For PMTCT data to be useful for surveillance, uptake of HIV testing for PMTCT must be significantly high. Data from other countries can provide some insight as to how HIV testing uptake may influence the utility of PMTCT

data for surveillance (Bolu *et al*, 2007). In 2003, Thailand replaced UAT serosurveys with a system of annually collecting individual PMTCT programme data over a one-month period. Although the overall HIV prevalence in Thailand is low (1.8%), 97% of ANC attendees accept HIV testing for PMTCT. Therefore, differences between PMTCT-based HIV prevalence rates and those obtained through ANC serosurveys should be negligible. In Botswana, where HIV prevalence was high (38%) and HIV testing uptake for PMTCT was only 42% at the time, the PMTCT-based HIV prevalence estimates were similar to those derived from the UAT survey and therefore seemed to be a good proxy for UAT-based HIV prevalence estimates.

In this study, the number of male partners that came to be tested in the PMTCT environment was very small to draw any tangible conclusions. The very low level of male partner HIV testing observed in this study is consistent with findings from other studies. For example, Kizito *et al,* 2008 showed that only 1.8% of women tested had partners who accepted an HIV test. It is possible that some male partners not tested in these sites were tested elsewhere, example to other centres in Mbeya region and that, others may have been aware of their status. These results highlight the challenge of promoting couple HIV-testing within a PMTCT programme. Previous research found that social support plays a crucial role in enabling women to take on the required serial decisions and adhere to the course of PMTCT intervention (Theuring *et al*, 2009). Especially male partners, key decision makers in questions of sexual and reproductive health in many societies, are attributed to a high potential of impact on pregnant women's behavior (Biratu and Lindstrom, 2006), and unsupportive partner attitudes are likely to create a barrier to women's programme participation. male partners need to be viewed and treated not only as a powerful influencing factor, but as a constituent part of reproductive health, and can no longer be excluded from any debate surrounding issues like pregnancy or HIV/AIDS (Theuring *et al*, 2009)..

In actually deciding whether or not data from a PMTCT programme can be used as a substitute for data from ANC sentinel surveillance, in estimating HIV-1 prevalence, potential biases should be taken into consideration. In this study, participation bias may not have a place because the HIV testing uptake was very high. The study by Fabiani *et al*,

2005 showed that participation bias may have been introduced by the fact that VCT uptake was low (48.3%) and that some of the factors associated with it (i.e., time of residence at current address, marital status and partner's occupation) were associated with being HIV-1 positive. However, the associations between these factors and VCT uptake, although statistically significant, were quite weak and probably did not greatly affect the prevalence estimates.

Quality of data generated by the PMTCT services in Mbeya region

For PMTCT data to be useful for surveillance, the data must be consistently and accurately collected, easily accessible, and provide either unbiased HIV prevalence estimates or have a consistent and measurable bias (Seguy et al, 2006). PMTCT data need to satisfy qualitative criteria such as the availability of individual data, data quality, representativeness, and sufficient knowledge about the magnitude and direction of bias as a result of self-selection or refusal for testing (Hladik et al, 2005). In this study, these conditions were partially met. Accessibility of data was not a problem wherever data was available. However, several challenges were associated with PMTCT data at the sites.

This study showed that availability of PMTCT records was a problem. Most of the records missing were those from the early years indicating poor institutional memory in ensuring that data were consistently available over the years. In general, the PMTCT –based data observed by this study was of moderate quality with a great opportunity for improvement.

It is important to note that there has been a general concern over whether or not the national-level prevalence estimates based on the HIV-1 sentinel surveillance system can be considered as representative, especially considering that rural sites are under-represented (Fabiani *et al*, 2005). In the ANC sentinel surveillance system in Mbeya region, only six sites are represented, whereas the PMTCT programme is currently implemented in 121 sites. By integrating the data provided by the ANC sentinel surveillance system with those from the PMTCT programme, most of the rural areas will be represented.

The strengths of the ANC SS include the fact that the data quality is good, since there is a centralized laboratory testing and also there is quality assurance ensured by supervision and training. On the other hand, PMTCT is likely to inherit the characteristics of a passive surveillance system whereby quality of data is usually compromised because of the routine nature of data collection as a service. However, if PMTCT data has to be adopted for surveillance, it will have a better external validity than ANC surveillance system because more women are involved and also because PMTCT will involve men. Steps to improve quality of data emanating from PMTCT can then be taken.

Limitations of the study

There are a number of limitations in this study that need to be addressed. Firstly, the number of variables recorded in PMTCT programme was limited and not consistent across the years, thereby preventing an assessment of the influence of important factors such as marital status and education on HIV serostatus. Data were missing for different years and categories, and this affected comparison. Changes in data collection strategies with omission of parameters rendered description of risk factors incomplete for some years. In addition, data that was collected in this study is of routine nature, not purposely designed for research. Therefore, the quality of data was compromised due to data being outdated and not in good order, with important variables missing. There was also limited opportunity to find missing data because of the retrospective design of the study. The fact that some information needed to be obtained from different registers which most of the time are not stored in one place and are managed by different staff at the site, made it difficult to be consistent in collecting all information needed.

Another limitation in this study was the lack of time and location matched population based data for comparison. For comparison in the year 2005/2006, the investigator had to use the population-based survey conducted in 2003/2004.

CHAPTER SIX

6.0 CONCLUSION AND RECOMENDATIONS

6.1 Conclusion

In conclusion, the PMTCT based HIV-1 prevalence estimates and the estimates from the ANC sentinel surveillance in Mbeya region have been shown by this study to be comparable. The estimates from the two sources are also comparable to those from the general population. However, in the recent years, the PMTCT based HIV-1 prevalence estimates and the estimates from the ANC sentinel surveillance in Mbeya region tend to overestimate HIV prevalence in the general population.

This study also concludes that, women attending PMTCT sites located in urban and border areas had a high prevalence of HIV than those women attending PMTCT sites located in rural areas. The HIV testing uptake among women in the PMTCT environment was found by this study to be very high. Therefore, this study concludes that, since the HIV-1 testing uptake for PMTCT in Mbeya region is sufficiently high, and estimates from both PMTCT and ANC sentinel surveillance are comparable to each other as well as to those in the general population, the HIV-1 prevalence estimates from PMTCT could be used instead of the estimates from the ANC sentinel surveillance to estimate prevalence in the general population.

ANC sentinel surveillance data can be replaced by PMTCT data for surveillance in Mbeya region because PMTCT services are available in a sufficient number of rural clinics to allow a good representation of rural areas. The study concludes that, PMTCT data was of moderate quality with a potential for improvement in the future, therefore consideration should be taken for improvement of individual PMTCT data quality.

Therefore, this study concludes that, currently, PMTCT has the potential to complement or even replace ANC Sentinel Surveillance in Mbeya region.

6.2 Recommendations

Despite a number of significant challenges in the PMTCT programme identified in this study, it is recommended that PMTCT services be improved and maintained so as to achieve the best in prevention of Mother to Child Transmission of HIV and providing estimates of HIV prevalence. It will be better for PMTCT services to be offered in the rest of the sentinel sites conducting ANC sentinel surveillance to allow trend analysis over time. Adjustments will need to be made in the PMTCT programme so that modeled prevalence curves that are based on PMTCT data can be compared to those provided for the current estimates based on ANC surveillance data. PMTCT data quality needs to be substantially improved by standardization of register format and by supervision of ANC staff. The laboratory and quality assurance with PMTCT system will need to be improved to ensure that if this system is proposed to be the main one from which data will be relied upon, data obtained is reliable and accurate.

It is also recommended that HIV Behavioral Change and Communication programmes in Mbeya region should target urban and border areas. Male participation into PMTCT programmes should also be encouraged. The operational aspects of PMTCT programme may differ within the same country, hence, additional studies involving national representative data are needed to evaluate whether data from PMTCT programme could replace, or instead be combined with, the data provided by ANC sentinel surveillance, especially in settings where HIV testing uptake among pregnant women is low and, as a consequence, the potential risk of participation bias is high.

Currently, PMTCT has the potential to complement or replace ANC sentinel surveillance in Mbeya region. This could be possible because, in Mbeya region PMTCT services are available in a sufficient number of rural clinics to allow a good representation of rural areas. In light of the results of this study, specifically in Mbeya region, the prevalence of HIV-1 infection could be estimated based on data provided by the PMTCT programme instead of using data from ANC sentinel surveillance. This would reduce costs and the workload in the ANC, and the additional available resources could be used elsewhere. The results of this study may be region-specific; therefore such comparisons need to be conducted in other regions of Tanzania.

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