

ORIGINAL RESEARCH ARTICLE

The Prevalence of Human Immunodeficiency Virus Infection among Pregnant Women in Labour with Unknown Status and those with Negative status early in the Index Pregnancy in a Tertiary Hospital in Nigeria.

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Abstract

Rapid HIV test in labour provide an opportunity for the identification of HIV positive pregnant women who should benefit from interventions to reduce the risk of mother-to-child transmission (MTCT) of HIV. Between November 2013 and June 2014 we conducted rapid HIV testing of pregnant women in labour at the National Hospital Abuja to determine the HIV seroconversion rate in pregnancy and the prevalence of HIV in pregnant women in labour with previously unknown status. HIV testing and counseling (HTC) was acceptable to 224 (99.6%) of the pregnant women who met the study criteria. The mean 'turnaround' time for test result was 288 minutes and 16.2 minutes for tests performed in the hospital laboratory and those performed at the point-of-care (labour ward) respectively. HIV seroconversion was detected in 2(1.2%) of the 165 parturients with initial HIV negative result early in the index pregnancy. HIV infection was detected in four (2.7%) of the 59 parturients with unknown HIV status. Secondary school level education was significantly associated with HIV seroconversion in pregnancy $P < 0.001$. HTC in labour using rapid testing strategy is feasible and acceptable in our setting. The introduction of HCT will lead to the diagnosis of HIV positive women in labour, appropriate interventions and prevention of MTCT of HIV. (*Afr J Reprod Health* 2015; 19[3]: 137-143).

Keywords: Human Immunodeficiency Virus, mother-to-child transmission, rapid HIV testing, prevention of mother-to-child transmission of HIV, seroconversion, HIV prevalence

Résumé

Les analyses rapides pour détecter le VIH pendant le travail fournit une opportunité pour l'identification des femmes enceintes séropositives qui devraient bénéficier des interventions visant à réduire le risque de transmission du VIH de la mère à l'enfant (TME). Entre novembre 2013 et juin 2014, nous avons mené un dépistage rapide du VIH auprès des femmes enceintes en travail à l'Hôpital National d'Abuja pour déterminer le taux de séroconversion du VIH pendant la grossesse et la prévalence du VIH chez les femmes enceintes dans le travail avec l'état de santé jusque-là inconnue. Le Dépistage et les Conseils à propos du VIH (DCV) étaient acceptables à 224 femmes enceintes (99,6%) qui répondaient aux critères de l'étude. Le temps moyen de «redressement» pour le résultat de l'analyse était de 288 minutes et 16,2 minutes pour les analyses effectuées dans le laboratoire de l'hôpital et celles effectuées au point des soins (salle d'accouchement) respectivement. La séroconversion du VIH a été détectée chez 2 (1,2%) des 165 parturientes initiales qui avaient des résultats négatifs du VIH au début de la grossesse index. Infection par le VIH a été détectée dans quatre (2,7%) des 59 parturientes dont l'état d santé par rapport au VIH était inconnu. La scolarité de niveau secondaire était significativement associée à la séroconversion du VIH pendant la grossesse $P < 0,001$. Le DCV pendant le travail en utilisant la stratégie de dépistage rapide est possible et acceptable dans notre milieu. L'introduction du DCV mènera au diagnostic des femmes séropositives dans le travail, aux interventions appropriées et à la prévention de la TME du VIH. (*Afr J Reprod Health* 2015; 19[3]: 137-143).

Mots-clés: Virus de l'immunodéficience humaine, transmission de la mère à l'enfant, dépistage rapide du VIH, prévention de la transmission de la mère à l'enfant, séroconversion, prévalence du VIH

Introduction

The National HIV/AIDS and Reproductive Health Survey done in 2012 showed that the HIV sero-prevalence in Nigeria was 3.4%¹. In the absence of effective intervention there is a 25-40% risk of the mother transmitting the infection to the baby during

pregnancy, labour and delivery, and through breastfeeding². Mother-to-child transmission (MTCT) of HIV accounts for over 90% of all paediatrics (children less than 15 years) infections. The Joint United Nations Programme on HIV/AIDS (UNAIDS) 2011 report showed that Nigeria with 69,000 new paediatrics infections was the highest

contributor accounting for 20.9% of global new paediatrics HIV infections³. South Africa followed with 29,000 (8.8%) and Mozambique 27,000 (8.2%). The morbidity and mortality associated with paediatrics HIV infection in sub-Saharan Africa has virtually eroded most of the previous gains in improvement in child survival in the continent. About one third of HIV infected children in Africa and other developing countries die within their first year of life⁴.

Prevention of mother-to-child transmission (PMTCT) of HIV strategy has been successfully employed in developed nations and has resulted in virtual elimination of paediatrics HIV in these countries⁵. HIV testing and counseling (HTC) during the antenatal period has served as the main source of identifying HIV positive pregnant women who should benefit from PMTCT interventions. However, pregnant women who do not attend antenatal clinic would not benefit from this practice. The 2013 Nigerian demographic and health survey (NDHS) showed that only 61% of pregnant women access antenatal care⁶.

Many studies have reported high rates of primary HIV infections during pregnancy⁷⁻¹⁰. Newly infected women who are in the window period would test negative to HIV in early pregnancy. Repeat HIV testing in late pregnancy or labour provides an opportunity to detect those that seroconverted in the course of pregnancy. Efforts to improve detection rates have led to recent recommendation of repeat testing in late pregnancy or during labour for previously HIV negative pregnant women and testing of women in labour with unknown HIV status^{11,12}. The main obstacle to this recommendation is the added cost of repeat testing in labour. Several cost benefit analysis studies has however, confirmed its relevance in societies with high HIV prevalence^{13,14}.

The introduction of rapid HIV testing which is simple, fast and cheap, with high sensitivity and specificity has improved access to HIV testing especially during labour when the result is expected within a short period of time in order to initiate PMTCT interventions^{15,16}. Many facilities in Nigeria have not yet adopted this practice. We report on the study to determine the feasibility of introduction of this service at the National Hospital Abuja. We also determined the prevalence of HIV seroconversion in pregnancy and the prevalence of HIV in parturient with previously unknown status.

Subjects and Methods

This was a cross-sectional study carried out at the National Hospital Abuja, Nigeria over a period of 6 months (November 2012-May 2013). It is a federal government owned tertiary health institution that serves the Federal Capital Territory (FCT) and most of the North-Central geo-political zone of the country. Ethical clearance and approval was obtained from the Health Research and Ethics Committee of National Hospital, Abuja. Informed consent was obtained from the subjects before recruitment into the study.

The subjects were pregnant women in labour who had an initial HIV negative test during antenatal care and those admitted into labour ward (unbooked) with unknown HIV serostatus. Parturients who declined consent, with serious medical or obstetrics complications, HIV positive, unconscious or had severe mental health problems were excluded from the study. Parturients who met the inclusion criteria were recruited consecutively.

Provider-initiated, opt-out HIV testing and counseling approach was used. The rapid HIV testing serial algorithm as recommended in the Nigerian National PMTCT guidelines¹¹ was employed. The rapid test was performed at the beginning of the study in the hospital main laboratory by the medical laboratory scientist, but subsequently undertaken in the labour ward side laboratory by resident doctors trained on the test procedures. The test was conducted for each subject with finger stick whole blood sample and general safety precautions were observed. The first test (screening) was with DetermineTMHIV-1/2 (Alere Medical Co., Japan) test kits. The second (confirmatory) test was with UnigoldTM HIV-1/2 (Trinity Biotech plc, Ireland) test kits, undertaken when the first test is positive. StatpakTM (Chembio Diagnostic Systems, New York, USA) was used as tie breaker when the second test is negative.

Quality control to ensure proper performance of the test kit for the reagents, methodology and personnel was ensured through the internal procedural control included in the test and an external control. A pink/purple/red line appearing in the control region is an internal positive procedural control. It confirms sufficient specimen volume and correct procedural technique. External quality control samples included in some kits like the Stat-Pak and the control samples in the hospital

laboratory was used to certify the kit performance before use. Other quality control measures were ensured by procuring sufficient supplies of unexpired test kits, adhering to manufacturer's temperature ranges (2-30 °C) for storage and testing areas, doctors on duty were trained and step-by-step written instructions were made available to all personnel performing HIV test and accurate recording of results were ensured. Personal safety was ensured with application of universal precaution including the use of laboratory coats, gloves and safe disposal of lancets, syringes and needles into biohazard waste boxes.

Antiretroviral drug prophylaxis was given to women who tested positive to HIV as soon as the result is known. The HIV positive women were given single dose Nevirapine (sdNVP) 200mg tablet followed by twelve hourly Lamivudine (3TC) 150mg tablet and Zidovudine (ZDV) 300mg tablet for one week (the latter two drugs to prevent Nevirapine resistant development). Infant feeding counseling, psychological and social support was also provided to the women. Post test counseling was continued in the post partum period. Syrup Nevirapine (NVP) 4mg/kg was administered to HIV-exposed babies within 72 hours of delivery and continued daily for 6 weeks when the HIV status of the baby is determined. The CD4 count of the women is assessed in the post partum period and appropriately co-managed with the Adult antiretroviral treatment team.

Data Collection and Analysis

Individual subject data including socio-demographic characteristics and test result was collected with structured data collection form designed for the study. Statistical analysis of the result was done using Statistical Package for Social Sciences (SPSS) Version 19. Descriptive statistics The level of statistical significance used was $P < 0.05$ at 95% confidence interval.

Results

A total of 224 parturients with age ranging from 19 to 45 years and mean age of 32.0 ± 5.06 years were tested. Two hundred and five (91.52%) of the subjects were admitted in early labour while 19

(8.48%) were admitted in advanced labour. Uptake for the intrapartum HIV testing and counseling was 99.55%. Only 1 woman declined re-testing in labour as she believed she could not have been infected after testing negative in early pregnancy. She however accepted testing in the immediately post partum period following further counseling. The mean turnaround time for availability of results in the initial phase of the study, when HIV rapid tests were carried out in the hospital laboratory was 288 ± 34.9 minutes while the turnaround time when rapid tests were done in the labour ward was 16.17 ± 2.1 minutes. The turn-around time for the initial phase was significantly higher than the turnaround time when the tests were conducted in labour ward (t -test = -79.43; $P = 0.00$). The time interval between the first HIV test among parturients with initial HIV negative results and repeat HIV test in labour ranged from 6 to 31 weeks with a mean time interval of 17.99 ± 7.2 weeks.

The sero-prevalence of undiagnosed HIV infection among all parturients in this study was 2.68% (6/224). The prevalence of HIV infection among parturients with unknown HIV status (unbooked) was 6.78% (4/59), while HIV seroconversion occurred in 1.21% (2/165) of parturients with initial HIV negative status. As shown in the table, educational level had a statistically significant association with HIV positive status in labour.

Discussion

This study have shown that HIV testing and counseling (HTC) using rapid tests strategy can be effectively deployed in the diagnosis of HIV infection during the period of a few hours when women are in labour. The simplicity of the test and the short duration for the test result to become available when undertaken at the point of care has favoured its use during labour^{17,18}. The short 'turn-around time' for HIV testing using rapid test was ably demonstrated by the mean time between blood collection and availability of rapid test results of 16.2 minutes in the latter phase of the study when the tests were run in the labour ward. This was similar to the turnaround time of 20 minutes reported in St. Petersburg rapid test study¹⁹. A statistically significant difference was found between the 'turn-around time' of rapid tests in the initial phase of the study conducted in the hospital laboratory and the latter phase conducted in the

Table. Socio-demographic characteristics and risk factor of parturients

Characteristic s	HIV Test Result		Total	Kruskal Wallis (H)	P-Value
	Negative	Positive			
Age Group (Years)					
≤ 19	1(0.4%)	0(0.0%)	1(0.4%)		
20-24	13(5.8%)	0(0.0%)	13(5.8%)		
25-29	57(25.4%)	1(0.4%)	58(25.9%)		
30-34	80(35.7%)	4(1.8%)	84(37.5%)		
35-39	50(22.3%)	1(0.4%)	51(22.8%)		
40-44	15(6.7%)	0(0.0%)	15(6.7%)		
≥ 45	2(0.9%)	0(0.0%)	2(0.9%)		
Total	218(97.4%)	6(2.6%)	224(100%)	0.003	0.955
Ethnicity					
Ibo	69(30.8%)	1(0.4%)	70(31.2%)		
Hausa	27(12.1%)	0(0.0%)	27(12.1%)		
Yoruba	34(15.2%)	1(0.4%)	35(16.6%)		
Fulani	6(2.7%)	0(0.0%)	6(2.7%)		
Others	82(36.6%)	4(1.8%)	86(38.4%)		
Total	218(97.4%)	6(2.6%)	224(100%)	1.825	0.177
Educational Level					
Nil/Koranic	5(2.2%)	0(0.0%)	5(2.2%)		
Primary	13(5.8%)	1(0.4%)	14(6.2%)		
Secondary	50(22.3%)	5(2.2%)	55(24.5%)		
Tertiary	150(67.0%)	0(0.0%)	150(67.0%)		
Total	218(97.4%)	6(2.6%)	224(100%)	10.884	0.001
Occupation					
Unemployed	69(30.8%)	2(0.9%)	71(31.7%)		
Unskilled	5(2.2%)	1(0.4%)	6(2.6%)		
Semi-Skilled	13(5.8%)	2(0.9%)	15(6.7%)		
Skilled	24(10.7%)	0(0.0%)	24(10.7%)		
Intermediate	46(20.5%)	1(0.4%)	47(20.9%)		
Category					
Senior	61(27.2%)	0(0.0%)	61(27.2%)		
Category					
Total	218(97.4%)	6(2.6%)	224(100%)	0.349	0.555
Coital Frequency					
Nil	7(3.1%)	0(0%)	7(3.1%)		
No Response	15 (6.7%)	0(0%)	15(6.7%)		
Occasionally	54(24.1%)	1(0.4%)	55(24.5%)		
1-2 times/week	110(49.1%)	3(1.3%)	113(50.4%)		
3-4 times/week	32 (14.3%)	2(0.9%)	34(15.2%)		
Total	218(97.4%)	6(2.6%)	224(100%)	0.023	0.879
Husband HIV Status					
Unknown	50 (22.4%)	4(1.8%)	54(24.2%)		
Negative	168 (75.0%)	1(0.4%)	169(75.4%)		
Positive	0 (0)	1(0.4%)	1(0.4%)		
Total	218(97.4%)	6(2.6%)	224(100%)	2.989	0.084

labour ward showing that performing rapid HIV tests in labour at the point-of-care is feasible and associated with ready availability of result compared to when test was undertaken in the main laboratory in the health facility.

The HIV seroprevalence of 6.78% (4/59) documented in this study, among the unbooked

parturients with unknown HIV status in labour is high. Thus for approximately every seven 'unbooked' women in labour one was likely to be HIV positive. This finding is comparable to 6.7% and 6.5% reported in similar studies in Ibadan²⁰ and St Petersburg, Russia (6.5%)¹⁹ respectively. It is however lower than the finding in Jos University

teaching hospital (JUTH), Nigeria where a prevalence of 9.6%²¹ was reported. The MIRIAD study in USA reported a low HIV prevalence rate of 0.7%¹⁸ among pregnant women with unknown HIV status. The value reported in this study is lower than the 11.5% prevalence obtained in a study among antenatal clients in the same hospital²². The fewer number of unbooked pregnant women in this study could have affected the current report. It is also possible that some pregnant women who knew their HIV status to be positive deliberately avoided antenatal care and only presented for delivery in the hospital.

The HIV seroconversion rate of 1.21% obtained among the booked parturient women, with initial HIV negative status in index pregnancy was low compared to reports from within the country and other developing countries, including 2.1% in Jos, Nigeria²¹, 2.3% in Oshogbo, Nigeria²³, 3% in Tanzania²⁴, 4.6% in Bangkok²⁵, 5.2% in South Africa²⁶ and 7.9% in Malawi²⁷.

The comparatively low seroconversion rate recorded in this study was also highlighted in a recent study from Jos, Nigeria. In this 2013 report the authors found a seroconversion rate of 0.6% in the pregnant population, compared to the 2.1% seroconversion reported in 2006 in the same city²⁸. A low seroconversion rate of 0.25% was also reported from Benin City, Nigeria in 2013²⁹. This finding may signify downward trend in the incidence of new HIV infection among our pregnant women which can partly be attributed to improved HIV awareness, behavioural changes and availability of preventive and therapeutic interventions¹. A study in India reported a similar decrease in the incidence of acute HIV infection (seroconversion) in pregnancy, from 2.2/100 person years in 2002 to 0.73/100 person years in 2006³⁰. The researchers attributed this to a proportional decrease in high risk behavior among young married men thereby reducing risk of HIV transmission to their families.

Analysis of the six parturient women who were diagnosed HIV positive in labour, showed they were all young women (25-39year old), and sexually active in the index pregnancy. However, coital frequency was not found to be predictive and did not have a statistically significant association with HIV positive status in labour. The majority were unbooked (n=4; 66.7%) and booking status had a statistically significant relationship with HIV positive status in labour. This underscores the

importance of antenatal care patronage by pregnant women in prevention of HIV transmission to babies. Most of the HIV positive parturient women (n=5; 2.2%) had secondary education which is consistent with the finding of high prevalence of HIV among those with primary/secondary education in the FCT¹. It is noteworthy that 66.7% did not know their husband's HIV status which was found to have a statistically significant relationship with HIV positive status in labour. Husband's HIV status is an important factor in the prevention of HIV especially in a serodiscordant relationship.

The main limitation in this study is the inability to diagnose early infections until seroconversion has taken place. It is therefore possible that some new infections were missed. Also immunosuppressed or immunocompromised individuals infected with HIV-1 or HIV-2 may not produce adequate antibodies to the virus. Use of rapid test kits for these individuals may therefore give false negative results. Antigen based tests and HIV RNA or DNA tests have higher sensitivity and specificity and can detect viral particles unlike rapid tests. The ready availability and use of these tests in the future will mitigate these draw backs.

Conclusion

Labour provides another opportunity for detection of HIV positive pregnant women. Following appropriate training, the use of rapid test for HIV diagnosis at the point of care is feasible in our health facilities. This study identified some previously undiagnosed HIV infected women in labour and hence HIV exposed babies who benefited from PMTCT interventions. HCT in labour has potential to improve access to and uptake of PMTCT services among pregnant women. Efforts aimed at elimination of pediatrics HIV should include intrapartum HCT especially in areas with high HIV prevalence.

Contribution of Authors

COA conceived and designed the study. BCU collected and analysed the data and prepared the manuscript. KWD reviewed the manuscript for important intellectual content.

References

1. Federal Ministry of Health [Nigeria] National HIV &

- AIDS and Reproductive Health Surveys 2012 (NARHS Plus). Federal Ministry of Health, Abuja, Nigeria. 2013.
2. The Working Group on Mother – to – Child Transmission of HIV. Rates of Mother-to-Child Transmission of HIV I in Africa, America and Europe: Result from 13 perinatal studies J. Acquir Immune Defic Syndr Hum Retroviral 1995; 8:506-510.
3. UNAIDS. 2011 Report on the global AIDS epidemic: The global challenge. Available at: <http://www.unaids.org>. Assessed on 10 December 2013.
4. Dabis F, Ekpin ER. HIV-1/AIDS and maternal and child health in Africa. *Lancet*, 2002; 359:2097-2104.
5. Agboghoroma OC. Prevention of Mother -to-Child transmission of HIV/AIDS. In: Okonofua FE. *Confronting the Challenge of Reproductive Health in Africa: A Textbook for Students and Development Practitioners*. Benin: WHARC, 2014 : 345-366.
6. National Population Commission (NPC) [Nigeria] and ICF International. *Nigeria Demographic and Health Survey 2013* Abuja, Nigeria, and Rockville, Maryland USA. NPC and ICF International; 2014. https://www.population.gov.ng/images/ng/images/dhs_data/nds_2013/2013_ndhs_final_report.pdf. Accessed January 26th, 2015.
7. Moodley D, Esterhuizen TM, Pather T, Chetty V, Ngaleka L. High HIV incidence during pregnancy: compelling reason for repeat HIV testing. *AIDS* 2009; 23: 1255-1259.
8. Gray RH, Li X, Kigozi G, Serwadda D, Brahmbhatt H et al. Increased risk of incident HIV during pregnancy in Rakai, Uganda: a prospective study. *Lancet* 2005; 366: 1182-88.
9. Patterson KB, Leone PA, Fiscus SA, Kuruc J, McCoy SI et al. Frequent detection of acute HIV infection in pregnant woman. *AIDS* 2007; 21: 2303-2308.
10. Nesheim S, Jamieson DJ, Danner SP, Maupin R, O'Sullivan MJ. Primary human immunodeficiency virus infection during pregnancy detected by repeat testing. *AJOG*; 197: 149.e1-149.e5.
11. Federal Ministry of Health, Nigeria. *National Guidelines for Prevention of mother-to-child transmission of HIV*, 4th edition, Abuja, Federal Ministry of Health, 2010.
12. Centres for Disease Control and Prevention. Revised recommendations for HIV Testing of Adults, Adolescents, and Pregnant Women in Health-Care settings. *MMWR* 2006; 55(No. RR-14) :1-16.
13. Sansom SL, Jamieson DJ, Farnham PG, Bulterys M, Fowler MG. Human immunodeficiency virus retesting during pregnancy: costs and effectiveness in preventing perinatal transmission. *ObstetGynecol* 2003;102(4):782-790. [http://dx.doi.org/10.1016/S0029-7844\(03\)00624-0](http://dx.doi.org/10.1016/S0029-7844(03)00624-0).
14. Udeh B, Udeh C, Graves N. Perinatal HIV transmission and the cost-effectiveness of screening at 14 weeks' gestation, at the onset of labour, and the rapid testing of infants. *BMC Infect Dis* 2008;8:174-8. <http://dx.doi.org/10.1186/1471-2334-8-174>. PMID: 19117527. PMCid:2642823.
15. Lu L, Kieffer MP, Legwaila K, Mahdi MA, Chouraya C, Waligo A, Shabalala F. Repeat HIV testing in labor and delivery as a standard of care increases ARV provision for women who seroconvert during pregnancy. *AIDS* 2009;23:1255-9.
16. Homsy J, Klamya JN, Obonyo J, Ojwang J, Mugumya R, et al. Routine intrapartum HIV counseling and testing for prevention of mother-to-child transmission of HIV in a rural Uganda hospital. *J Acquir Immune Defic Syndr* 2006; 42(2): 149-154.
17. HIV Diagnosis: A Guide For Selecting Rapid diagnostic Test Kits (RDT) Kits. Available at: http://www.who.int/bct/Main_areas_of_work/BTS/HIV_Diagnostics/HIV_Test_Kit_Evaluation.htm. Assessed on 30th October, 2013.
18. Bulterys M, Jamieson DJ, O'Sullivan MJ, Cohen MH, Maupin R, et al. Rapid HIV-1 testing during labor – A multicentre study. *JAMA* 2004; 292(2): 219-223.
19. Kissin DM, Akatova N, Rakhmanova AG, Vinogradova EN, Voronin EE et al. Rapid HIV testing and prevention of perinatal HIV transmission in high-risk maternity hospitals in St. Petersburg, Russia. *Am J Obstet Gynecol* 2008; 198: 183.e1-183.e7.
20. Nkwocha GC, Adesina OA, Arowojolu AO, Bamgboye EA, Adewole IF, Ilesanmi AO. Sensitivity, Specificity and Predictive Values of Determine HIV-1/2, Rapid HIV Antibodies among Booked Antenatal Women in University College Hospital, Ibadan. 2012; 1:461.
21. Sagay AS, Musa J, Adewole AS, Imade GE, Ekwempu CC, Kapiga S, Sankale JL, Idoko J, Kanki P. Rapid HIV testing and counseling in labour in a Northern Nigerian setting. *Afr J Reprod Health*. 2006 Apr; 10(1): 76-80.
22. Agboghoroma OC, Iliyasu Z. HIV Prevalence and trends among pregnant women in Abuja, Nigeria: A 5-year analysis. *Trop J Obstet Gynaecol* 2015; 32 (1); 82-89.
23. Afolabi AF, Adeyemi AS, Owonikoko KM, Adeomi AA, Adeniji AO. Human immune deficiency virus infection: seroconversion during pregnancy. *International Journal of General Medicine and Pharmacy* 2013; 2(3): 53-62.
24. Urassa W, Kaaya S, Mwakagile D, O'Brien M, Antelman G, Hunter D, et al. Evidence of a substantial decline in prevalence of HIV-1 infection among pregnant women: data from 1995 to 2003 in Dar es Salaam, Tanzania. *Scand J Publ Health* 2006; 34: 272 -278.
25. Dhayendre M, Tonya ME, Thusie P, Vani C, Linda N. High HIV incidence during pregnancy: compelling reason for repeat HIV testing. *AIDS* 2009; 1255 – 1259.
26. Rehle T, Shisana O, Pillay V, Zuma K, Puren A, Parker W. National HIV incidence measures: new insights into the South African epidemic. *S Afr Med J* 2007; 97: 194-199.
27. Taha TE, Dallabetta GA, Hoover DR, et al. Trends of HIV -1 and sexually transmitted diseases among pregnant and postpartum women in urban Malawi. *AIDS* 1998; 12: 197.
28. Imade GE, Sagay AS, Musa J, Ocheke AN, Adeniyi DS, et al. Declining rate of infection with maternal human immunodeficiency virus at delivery units in North Central Nigeria. *Afr J Reprod Health* 2013; Special Edition; 17(4): 138-145.

29. Onakewhor JUE, Osemwenkha A, Ovbagbedia O, Omoigberale AI, Sadoh WE, et al. Appraisal of repeat intrapartum human immunodeficiency virus screening in a prevention of mother-to-child transmission program in Nigerian. *Journal of HIV and Human Reproduction* 2013; 1(2): 70-76.
30. Gupta N, Sastry J, Brookmeyer R, Phadke MA, Bhosale RA, et al. Declining HIV infection rates among recently married primigravid women in Pune, India. *J Acquir Immune Defi Syndr* 2007;45: 570-573.