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Declining Rate of Infection with Maternal Human Immunodeficiency Virus at Delivery Units in North-Central Nigeria

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Abstract

HIV testing during labour and delivery provides a critical opportunity for administering appropriate interventions to prevent mother-to-child-transmission (PMTCT). We studied current HIV rates and infection trend among women tested during delivery following scale-up of PMTCT and antiretroviral therapy (ART) programs in Jos, north central Nigeria. Between March 2010 and January 2012, provider-initiated HIV testing and counselling was offered in early labour. Women were recruited from a government tertiary health centre, a faith-based hospital, and a private health centre. Those who previously tested HIV negative during antenatal care (ANC) and those who presented at the labour ward with unknown HIV status were tested. A total of 944 subjects (727 re-tested for HIV infection and 217 with unknown HIV status) were enrolled and tested during labour. The HIV incidence and sero-conversion rates during pregnancy among women who repeated HIV testing at delivery was 1.7 per 100 person-years of observation (pyo) and 0.6% (4/727), respectively, while the rate among those who tested for the first time in labour was 1.8% (4/217). Women who accessed ANC were older and had achieved a higher educational status than those who did not access ANC. A 3- to 5-fold decline in HIV incidence and prevalence rates was detected among women tested at delivery when compared to data from a report in 2004. It is not certain whether the decline in maternal HIV infection is due to the major state-wide scale-up of PMTCT and HIV treatment programs. A broader and purposefully designed evaluation study would be required to verify observed occurrence. *Afr J Reprod Health 2013 (Special Edition); 17[4]: 138-145*.

Keywords: HIV, PMTCT, incidence, Labour/delivery, Nigeria

Résumé

Le dépistage du VIH pendant l'accouchement offre une occasion cruciale pour la gestion des interventions appropriées pour prévenir la transmission de la mère - à - l'enfant (PTME). Nous avons étudié les taux actuels de VIH et les tendances de l'infection chez les femmes qui ont subi l'analyse pendant l'accouchement suite à l'intensification des programmes de la PTME et le traitement antirétroviral (ART) à Jos, dans le centre nord du Nigeria PTME et. Entre mars 2010 et janvier 2012 à l'initiative des dispensateurs le conseil et du dépistage ont été offerts en début de travail. Les femmes ont été recrutées dans un centre de santé tertiaire gouvernemental, un hôpital confessionnel et un centre de santé privé. Celles qui séronégatives lors des soins prénatals (SP) et celle qui se sont présentées à la salle de travail avec la condition du VIH inconnu ont des analyses. Un total de 944 sujets (727 ont répété l'analyse du dépistage du VIH et 217 avec l'état sérologique inconnu) ont été recrutées et ont subi l'analyse pendant le travail. L'incidence du VIH et des taux de séroconversion pendant la grossesse chez les femmes qui répétaient le dépistage du VIH à l'accouchement était de 1,7 pour 100 personnes- années d'observation (pyo) et 0,6 % (4/ 727), respectivement, tandis que le taux de celles qui ont subi l'analyse pour la première fois pendant le travail était de 1,8 % (4/ 217). Les femmes qui ont eu accès au SP étaient plus âgées et avaient atteint un niveau d'éducation plus élevé que celles qui n'ont pas eu accès au SP. Une baisse d'entre 3 et 5 fois de l'incidence du VIH et des taux de prévalence a été détectée chez les femmes qui ont subi l'analyse à l'accouchement par rapport aux données d'un rapport en 2004. Il n'est pas certain que le déclin de l'infection maternelle du VIH est dû aux grands programmes d'intensification et du traitement de la PTME et du VIH. Une plus grande étude d'évaluation qui a été conçue délibérément serait nécessaire pour vérifier les faits observés. *Afr J Reprod Health 2013 (Edition Spéciale); 17[4]: 138-145*.

Mots-clés: VIH, la PTME, le travail /accouchement, Nigeria

Introduction

In 2012, Nigeria had an estimated national HIV prevalence of 3.1%. With a population of about 162 million people, the estimated number of people infected with HIV was 3.4 million. Women above 15 years of age accounted for 1.7 million while children aged less than 14 years old accounted for 430,000 of the total number of persons living with HIV/AIDS (PLWHA) in Nigeria. Ninety percent of the infected children acquired the infection from their mothers¹⁻³. New HIV infections among pregnant women in 2010 were estimated to exceed 210,000. Of this number, only 23% of the women and 11% of the exposed infants received antiretroviral (ARV) drugs to prevent mother-to-child transmission (MTCT) of HIV³.

Without the use of ARV drugs, it has been shown that 15-45% of HIV-infected mothers transmit the virus to their infants and more than half of HIV-infected infants die before the age of one year.⁴ Appropriate use of ARVs dramatically reduces the risk of HIV transmission either in pregnancy, at delivery and during the breastfeeding period to as low as 1-2%⁴. Maternal and infant morbidity and mortality also decrease with the use of ARVs^{4,5}. To achieve virtual elimination of new HIV infections, universal access to HIV testing and treatment has been recommended^{5,6}. As global scale-up of HIV programs continues, monitoring the effectiveness of HIV prevention and intervention strategies being implemented is imperative.

HIV testing or re-testing late in the third trimester of pregnancy or in labour has been assessed in both developed and resource constrained settings. The practice has been found to be a feasible, acceptable, and a cost-effective strategy to detect HIV-infected mothers particularly as a critical opportunity for intervention with ARVs to prevent MTCT⁸⁻¹⁴. Rapid HIV testing has high sensitivity and specificity, when compared to standard enzyme-linked immunosorbent assay (EIA) techniques. It is favoured for the ease of implementation with the short time for results that would determine the need for PMTCT intervention, minimal equipment and required training^{13,14}.

In Jos, Plateau State, located in north central Nigeria, the HIV prevalence among pregnant women attending antenatal care (ANC) was 8.2% in 2003⁷. Re-testing of previously HIV negative pregnant women in 2004 revealed high seroconversion rates of 2.1% and incidence rate of 6.6 per 100 person-years of observation (pyo). In addition, a prevalence rate of 9.6% was found among those with unknown HIV status and tested for the first time in labour⁸.

Through funding received from the Bill and Melinda Gates Foundation, the Harvard/APIN PEPFAR project began at JUTH in 2001. At the time, a modern research Laboratory was established and commissioned in 2002 to provide HIV/AIDS and STI treatment and research services. Plateau State was mapped out and maternity services were assessed in each of the 17 local government areas, with a population of about 3.2 million people. Personnel training and site renovations were done and equipment provided. Behavioral surveys of groups at high risk for acquiring HIV/AIDS and PMTCT activities also commenced. These efforts were followed by scaling-up PMTCT activities using the national protocols and guidelines. In 2004, PEPFAR funding resulted in the expansion of comprehensive HIV/AIDS, PMTCT and laboratory services to include antiretroviral therapy (ART) monitoring which currently provides services to 15,000 HIV patients. Across Plateau state, similar services were developed for 14 government, faith-based or private secondary hospitals with linkages to over 50 primary health clinics. Between 2004 and 2006, PMTCT coverage rose from 6.5% to 47.5%¹⁵.

Our goal in this analysis was to determine the current rates of maternal HIV infection at delivery units in Jos, North Central Nigeria. Two groups of pregnant women in labour and delivery in three different hospitals (tertiary, faith-based and private) in the city were studied. Data was also recorded for women who accessed ANC services, but did not return to deliver at the site and were compared with those who returned to deliver. In this study, we report the current HIV rates among women tested at labour and delivery settings in Jos, north central Nigeria.

Methods

The pregnant women included in this evaluation had been seen in delivery between March 2010 and January 2012 at one of three Harvard/APIN PEPFAR sites: the Jos University Teaching Hospital (JUTH), a government tertiary health centre, Our Lady of Apostles (OLA) Hospital, a faith-based hospital and Solat Women's Hospital, a private health facility. As part of the existing program, a provider-initiated, opt-out HIV testing and counselling approach was offered to pregnant women with unknown or previously HIV negative status that were presenting at antenatal care visits or labour using the opt-out approach^{14,17-19}. As recommended by CDC/WHO and the Nigerian National PMTCT guidelines, the rapid HIV testing serial algorithm employed the use of rapid HIV test kits starting with Determine (Alere Medical Co., Japan.) followed by Unigold (Trinity Biotech PLC, Ireland), with Statpak (Chembio Diagnostic Systems, New York, USA) as the tie breaker test^{14,16,17,18}. The concordance of the results of the quality control panel samples distributed to the testing sites was used to confirm the proficiency of the testing personnel and the accuracy of HIV test results (data not shown). On-site supervision of testing procedures, quality assurance procedures including use of control panels, data collection and entry were completed by certified Medical Laboratory Scientists.

Women provided written informed consent and institutional ethical review board approvals from the Ethics Committee at JUTH and the Institutional Review Board at the Harvard School of Public Health were obtained for the study. Women diagnosed as HIV seropositive were provided ARV drugs according to WHO and 2010 Nigerian national PMTCT protocols adopted by the Harvard/APIN PEPFAR program^{4,16}.

Demographic data and HIV test results were documented and entered into a FileMaker Pro database (Santa Clara, CA, USA). EPI InfoTM 7²⁰ was used for calculating incidence, seroconversion and prevalence rates, while Stata v 10.1²¹ was used for conducting all additional statistical analyses. For the analyses, the women were stratified into: 1) women who tested HIV negative during the antenatal period or, 2) those who came to deliver

with unknown HIV status (Figure 1). To determine whether there were differences between women who enrolled for antenatal care and came to the hospital to deliver and those who did not, the demographic data of the two groups were compared. For the comparison of continuous variables, the Wilcoxon Rank Sum test was used and for categorical variables, either chi-square or the Pearson's exact test was used as relevant. The significance level was set at $p=0.05$.

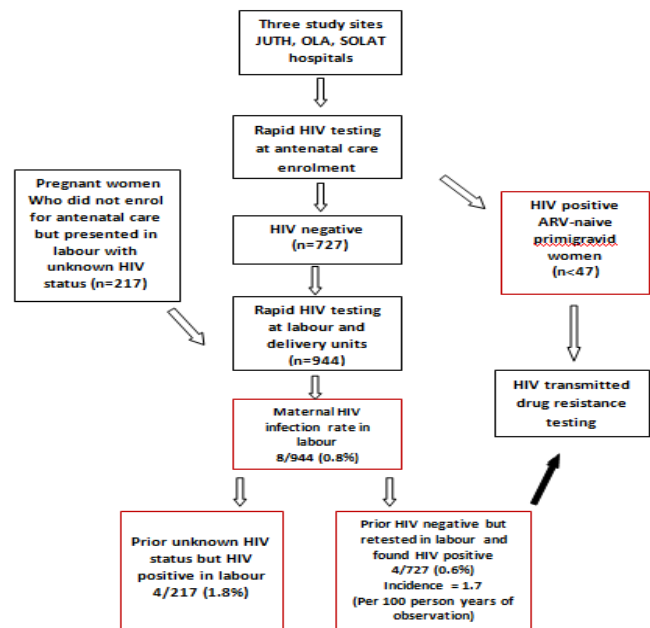


Figure 1. Study work-flow for surveying maternal HIV infection rates

Results

A total of 944 subjects, including 727 previously accessing antenatal care and 217 not previously enrolled and with unknown HIV status, were tested for HIV in the labour wards of the three health institutions between March 2010 and January 2012. The median age of the group was 28.0 years (range: 25-32 years; Table 1). Of the 727 women who tested HIV negative previously at ANC, 4 were confirmed HIV-seropositive, resulting in a seroconversion rate of 0.6% and an incidence of 1.7 per 100 pyo. The prevalence rate among the women who had not enrolled in ANC and had their first HIV test at labour was 1.8% (4/217; Figure 2).

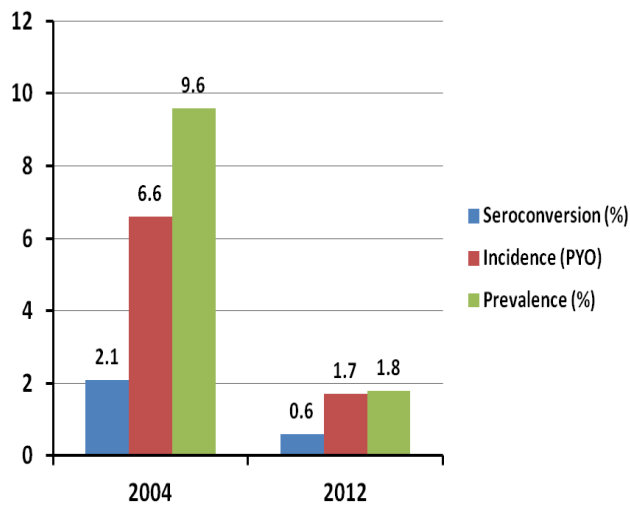


Figure 2. Declining rates of maternal HIV infections in labour and delivery settings (2004 to 2012)

Of the 8 pregnant women who were found HIV positive at delivery in this study, the 4 who had previously attended antenatal care visits, were younger in age and lower in gravidity and parity when compared to those who did not book for antenatal care but came to deliver in the hospital (i.e. Age: mean= 23.7 years; range= 22-25 years versus mean=36.5 years; range 30-40 years;

gravidity: mean =2, range 1-3 versus mean=6, range 3-9 and parity: mean =1, range= 0-1 versus mean=4; range= 2-7).

A comparison of characteristics of the women who delivered in the hospital to those that did not was described (Table 1). Pregnant women who did not enroll for antenatal care and had no knowledge of their HIV status accounted for 23% (217/944) of the subjects that were tested during labour. The majority of the women were married (98%). Pregnant women who enrolled in antenatal care and delivered at the hospital, were slightly older ($P<0.001$), more likely to have a tertiary-level education ($P<0.001$) and more likely to be business people than those who did not access ANC. Pregnant women who enrolled for antenatal care, but did not return to the hospital for delivery were more likely to have had more than one pregnancy compared to those women that delivered at the hospital. Among those who delivered at the hospital, religious affiliation (Christianity versus Islam) appeared to differ between those receiving antenatal care and those who did not (Table 1). Christians were more likely to receive antenatal care than Muslims ($P=0.020$).

Table 1. Characteristics of pregnant women tested for HIV Infection at delivery settings and those who did not return to deliver at the hospitals where enrolled for antenatal care

Characteristics	Women that delivered at the hospital			Received ANC, but delivered elsewhere (D)	p-value for comparison of A vs. B	p-value for comparison of C vs. D
	Received ANC and re-tested in labour (A)	No ANC, tested in labour (B)	Subtotal (C)			
Total number, n (%)	727 (77)	217 (23)	944	243		
HIV infection rate, n (%)	4 (0.6)	4 (1.8)	8 (0.8)	-		
Site, n (%)					<0.001	<0.001
JUTH	449 (62)	36 (17)	485 (51)	59 (31)		
OLA	188 (26)	179 (82)	367 (39)	133 (69)		
Solat	90 (12)	2 (1)	92 (10)	0 (0)		
Median age, years (Range)	28 (25-33)	27 (22-31)	28 (25-32)	29 (25-32)	<0.001	0.32
Religion, n (%)						
Christian	197 (83)	98 (73)	295 (79)	203 (84)	0.020	0.170
Islam	41 (17)	37 (27)	78 (21)	40 (16)		
Marital status, n (%)						
Married	235 (99)	128 (95)	363 (98)	243 (100)	0.013	0.014
Single	2 (1)	7 (5)	9 (2)	0 (0)		
Education					<0.001	0.064
None	23 (10)	15 (11)	38 (10)	8 (6)		
Primary	30 (13)	38 (28)	68 (19)	15 (11)		

Secondary	115 (49)	61 (46)	176 (48)	78 (59)		
Tertiary	67 (28)	20 (15)	87 (24)	32 (24)		
Occupation					0.020	<0.001
Business	77 (33)	33 (25)	110 (30)	82 (43)		
Civil Servant	35 (15)	14 (11)	49 (13)	40 (21)		
Housewife	119 (51)	76 (57)	195 (53)	70 (36)		
Other/None	4 (2)	9 (7)	13 (4)	0 (0)		
Gravidity					0.024	<0.001
1	228 (33)	86 (41)	314 (35)	34 (18)		
2	153 (22)	39 (19)	192 (21)	56 (29)		
3	136 (19)	25 (12)	161 (18)	41 (21)		
4	182 (26)	58 (28)	240 (26)	60 (31)		

Discussion

We observed a 3- to 5-fold decline in maternal HIV incidence and prevalence rates in women attending the labour and delivery settings in Jos as compared to the rates reported in the same city by Sagay et al in 2006⁸. This study was conducted in three Harvard/APIN-sponsored sites which provided health services to pregnant women of diverse social economic strata in the city of Jos, thus reducing bias in the population sampled compared to the previous study which was conducted in JUTH alone⁸. Caution needs to be exercised in the generalization of these findings since the study sites were limited to the city of Jos. In order to determine the impact of the HIV/AIDS prevention and intervention programs in Plateau State, it would be necessary to conduct specifically designed study across urban, sub-urban and rural communities of the state, as well as other settings.

Compared to 2004 data⁸, there was a remarkable decrease from 38.6% (166/430) in 2004 to 23% (217/944) in the number of women who did not enroll for antenatal care, but reported for delivery with unknown HIV status and received HIV testing for the first time during labour. The majority of women who did not enroll for antenatal care were delivered at the faith-based hospital, OLA (82.5%, 179/217). The tertiary teaching hospital, JUTH accounted for 16.6% and the private hospital Solat accounted for 0.9%. The reasons for these large site differences in attendance for delivery is unknown and merits further study.

The feasibility, acceptability and cost-effectiveness of the use of rapid HIV testing to enhance rapid access to HIV/AIDS services including PMTCT and ARV therapy have been

widely reported but its implementation is currently not universal^{5,6}. In our previous studies, we reported high acceptance (99.8%) of rapid HIV testing and counselling in labour and also the involvement of husbands and couples counselling as a method to improve PMTCT uptake in our program^{8,23}. The finding of high acceptance rates of rapid HIV testing in labour is consistent with other reports⁹⁻¹¹. In the current study, we employed the provider-initiated opt-out approach recommended by the 2010 National PMTCT guidelines and CDC/WHO for HIV testing and counselling^{14,16,17}. The high acceptance of this practice had earlier been reported in Jos⁸. This fact underscores the urgency for the complete integration of HIV testing into existing health systems and the offering of HIV testing as another routine test with the patients being offered the option to decline. Rapid HIV testing will continue to be the mainstay in the drive to virtual elimination of new HIV infections because of the ease of training non-Laboratory specialists to do the testing, the brevity of time involved between testing and intervention, low cost and scalability. Nurses, midwives and obstetrics resident doctors who worked in labour ward settings at the three health institutions were trained on rapid HIV testing and quality control measures, including the use of sample panels¹⁹. The accuracy of test results and collection of relevant data at the three sites were supervised and monitored by a Medical Laboratory Scientist designated primarily for this purpose¹⁹. The analysis of the quality assurance data using both known and blinded quality control samples provided concordant results over time at the three sites (data not shown). In addition, for women who might have delivered at odd hours in the night, it was often not possible to test all the

pregnant women that needed to be tested. The explanation provided was the issue of personnel shortage and the pressure of the heavy workload in the labour ward. These missed opportunities also might have reduced the number of women that were seen in ANC, but not tested at delivery and therefore underestimated our prevalence and incidence estimates. These missed opportunities can potentially be avoided through task-shifting, where designated night staff are trained and supervised to take up HIV testing as their primary duty.

The majority of the pregnant women we studied were married (97.6%-100%). We have found that taking advantage of marriage to involve husbands in the PMTCT program was a morale booster for the mothers in their compliance or adherence to prescribed interventions, such as ARVs and breastfeeding options. Single motherhood is not common in Nigeria; these women accounted for 0-2.4% of the total study subjects in this evaluation. Of the 7 single pregnant women, 5 did not enroll for antenatal care, but came to deliver at the hospital. We are not sure of the significance of this finding; further studies of the factors associated with single motherhood, antenatal enrollment and HIV infection may be a topic for future research.

Some of the limitations and the challenges we encountered in this study include the following. Women who came to deliver at the hospitals fell short of the number that enrolled for antenatal care. As a result, HIV seroconversion rates could not be fully investigated. In contrast to resource rich settings, where most women give birth in hospitals, only 40-70% of pregnant women deliver in health institutions in Nigeria^{9,22}.

In an effort to eliminate possible bias in our reporting, the demographic data including age, education, religion, marital status and gravidity were compared between 343 women who enrolled for antenatal care, but did not return to deliver and those who delivered at the hospital. Pregnant women who did not enroll for antenatal care but delivered at the hospital with unknown HIV status were younger in age, less educated (<0.001) and less likely to be business people than those who enrolled and delivered at the hospital. Pregnant women who enrolled for antenatal care but did not

return to the hospital for delivery were more likely to be business women and have had more than one pregnancy than those women that delivered at the hospital. Comparing the data obtained from Christians and Muslim who delivered at the hospital, religion appear to have significant influence between those receiving antenatal care and those who did not. Christians were more likely to access antenatal care than Muslims. These findings provide openings for strategic and targeted design of interventions towards enhancing universal access to antenatal care, HIV testing and PMTCT services.

Finally, of note, the rapid HIV test kits used for this study detect only HIV antibodies in the blood samples of the study subjects. This means that pregnant women in the "window period" of infection during labour, when the level of antibodies would be absent or too low for detection may have been missed. The need for improved, sensitive and reliable point of care rapid HIV testing devices that can detect early infection and preferably HIV antigens are now being advocated to increase the detection rates of recent infections for early intervention²⁴.

In conclusion, we have shown that rapid HIV testing in labour is useful for detecting HIV infections in pregnant women as an important opportunity to provide needed PMTCT interventions. Over a six year period, we have reported a declining trend in maternal HIV infection at delivery settings in Jos. Whether this finding has a relationship with the major scale-up of PMTCT and care and treatment services would require verification with a study specifically designed to evaluate such impact both in Jos city and Plateau State at large. Government policies and support that will encourage delivery in health facilities and rapid HIV testing are urgently needed to achieve the goals of an HIV-free generation.

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Contribution of Authors

GEI, ASS, PJK conceived and designed the study. DSA, MI, RP, AS, ME collected data. STM, PJK, GEI, JM analysed the data. The manuscript was prepared by GEI, ASS, PJK, and STM. All authors reviewed and approved the final version of the manuscript.

References

- UNAIDS Report on the Global AIDS Epidemic. 2012.
- United nations General Assembly Special Session (UNGASS). Country Progress Report, Nigeria. National Commitments and Policies Instrument (NCPI). 2012.
- Nigeria: PMTCT - UNICEF www.unicef.org/aids/files/Nigeria_PMTCT_Factsheet_2012.pdf.
- WHO, 2010, 'Antiretroviral drugs for treating pregnant women and preventing HIV infection in infants: Towards Universal Access', Geneva.
- Mahy M, Stover J, Kiragu K, Hayashi C, Akwara P, Luo C, Stannecki K, Ekpini R, Shaffer N. What will it take to achieve virtual elimination of mother-to-child transmission of HIV? An assessment of current progress and future needs. *Sex Transm Infect.* 2010 Dec; 86 Suppl 2:ii48-55.
- Ciaranello AL, Perez F, Keatinge J, Park JE, Engelsmann B, Maruva M, Walensky RP, Dabis F, Chu J, Rusibamayila A, Mushavi A, Freedberg KA. What will it take to eliminate pediatric HIV? Reaching WHO target rates of mother-to-child HIV transmission in Zimbabwe: a model-based analysis. *PLoS Med.* 2012 Jan; 9(1):e1001156. Epub 2012 Jan 10.
- Sagay AS, Kapiga SH, Imade GE, Sankale JL, Idoko J, Kanki P. HIV infection among pregnant women in Nigeria. *Int J Gynaecol Obstet.* 2005 Jul; 90(1):61-67.
- Sagay AS, Musa J, Adewole AS, Imade GE, Ekwempu CC, Kapiga S, Sankale JL, Idoko J, Kanki P. Rapid HIV testing and counselling in labour in a northern Nigerian setting. *Afr J Reprod Health.* 2006 Apr; 10(1):76-80.
- Bulterys M, Jamieson DJ, O'Sullivan MJ, Cohen MH, Maupin R, Nesheim S, Webber MP, Van Dyke R, Wiener J, Branson BM; Rapid HIV-1 testing during labour: a multicenter study. Mother-Infant Rapid Intervention at Delivery (MIRIAD) Study Group. *JAMA.* 2004 Jul 14; 292(2):219-223.
- Jamieson DJ, Cohen MH, Maupin R, Nesheim S, Danner SP, Lampe MA, O'Sullivan MJ, Webber MP, Wiener J, Carter RJ, Rivero Y, Fowler MG, Bulterys M. Rapid human immunodeficiency virus-1 testing on labour and delivery in 17 US hospitals: the MIRIAD experience. *Am J Obstet Gynecol.* 2007 Sep; 197(3 Suppl):S72-82.
- Kieffer MP, Nhlabatsi B, Mahdi M, Hoffman HJ, Kudiabor K, Wilfert CM. Improved detection of incident HIV infection and uptake of PMTCT services in labour and delivery in a high HIV prevalence setting. *J Acquir Immune Defic Syndr.* 2011 Aug 1; 57(4):e85-91.
- Bello FA, Ogunbode OO, Adesina OA, Olayemi O, Awonuga OM, Adewole IF. Acceptability of counselling and testing for HIV infection in women in labour at the University College Hospital, Ibadan, Nigeria. *Afr Health Sci.* 2011 Mar; 11(1):30-35.
- Moodley D, Esterhuizen TM, Pather T, Chetty V, Ngaleka L. High HIV incidence during pregnancy: compelling reason for repeat HIV testing. *AIDS.* 2009 Jun 19; 23(10):1255-1259.
- Bernard M, Branson BM, Handsfield HH, Lampe MA, Janssen RS, Taylor AW, Lyss SB, Clark JE. Revised Recommendations for HIV Testing of Adults, Adolescents, and Pregnant Women in Health-Care Settings. *CDC MMWR Recommendations and Reports.* September 22, 2006/ 55(RR14); 1-17.
- Sagay AS. Facing the challenges of motherhood: that these little ones may live. Series/report unijos inaugural lecture; series 44.2010.dspace.unijos.edu.ng/handle/10485/1038.
- The New National Guidelines (2010) for PMTCT and Infant Feeding in the Context of HIV. Nigeria. Dr. Godfrey Esiru; National PMTCT Coordinator.
- WHO, 2007, Guidance on provider-initiated HIV testing and counselling in health facilities.
- WHO 2010, Delivering HIV test results and messages for re-testing and counselling in adults.
- Moodley D, Moodley P, Ndabandaba T, Esterhuizen T. Reliability of HIV rapid tests is user dependent. *S Afr Med J.* 2008 Sep; 98(9):707-709.
- EPI Info™ 7 (<http://www.cdc.gov/epiinfo>).
- Stata v 10.1 (www.stata.com).
- Ekele BA, Tunau KA. Place of delivery among women who had antenatal care in a teaching hospital. *Acta Obstet Gynecol Scand.* 2007; 86(5):627-630.
- Sagay AS, Musa J, Ekwempu CC, Imade GE, Babalola A, Daniyan G, Malu N, Idoko JA, Kanki P. Partner disclosure of HIV status among HIV positive mothers

Imade et al.

in Northern Nigeria. *Afr J Med Sci.* 2006 Dec; 35
Suppl: 119-23.

24. Taegtmeier M, MacPherson P, Jones K, Hopkins M,
Moorcroft J, Lalloo DG, Chawla A. Programmatic

Declining Maternal HIV Rates

evaluation of a combined antigen and antibody test
for rapid HIV diagnosis in a community and sexual
health clinic screening programme. *PLoS One.* 2011;
6(11):e28019. Pub 2011 Nov 22.