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Individual And Institutional Level Factors That Influence Hiv Testing And Counseling Utilization During Antenatal Care In Nigeria

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INDIVIDUAL AND INSTITUTIONAL LEVEL FACTORS THAT INFLUENCE HIV TESTING AND COUNSELING UTILIZATION DURING ANTENATAL CARE IN NIGERIA

by

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PUBLIC HEALTH

ABSTRACT

Of the estimated 150,000 new HIV infections in children in 2015, 122,000 occurred in sub-Saharan Africa (SSA), with Nigeria accounting for a third of all cases. Most of these infections were acquired via mother-to-child transmission (MTCT). HIV testing and counseling, a critical first step in the prevention of MTCT (PMTCT), can ensure that HIV-positive women access services that can reduce HIV transmission risk. Incorporating HIV testing and counseling into antenatal care (ANC) is an integral component of the World Health Organization (WHO) strategies. This dissertation aims to understand factors that influence HIV testing and counseling during ANC. It is comprised of three manuscripts based on the following three aims: (1) Which are the institutional-level factors that influence HIV testing and counseling utilization during ANC in SSA? (2) What is the influence of individual-level factors on HIV testing utilization during ANC in Nigeria? and (3) How do institutional-level factors influence the provision and utilization of HIV testing and counseling during ANC in Nigeria?

The first manuscript in this dissertation (aim 1) is a systematic review of 40 quantitative, qualitative, and mixed-methods studies. Findings emphasized the importance of adequate institutional resources for the provision of HIV testing and counseling services in ANC. The second manuscript (aim 2) analyzed individual-level

predictors [defined using the Anderson Behavioral Model including predisposing (socio-demographic and cultural), enabling (socio-economic, knowledge and attitudes) and need (risk perception and health behaviors) factors] on HIV testing utilization (defined as: *ideal* (counseled and tested); *less ideal* (tested but not counseled); *opted-out* (counseled but not tested) and *missed opportunity* (neither counseled nor tested). Finding suggest that interventions focused on vulnerable populations may go a long way in increasing HIV counseling and testing utilization. The third manuscript (aim 3) examined how institutional-level factors, such as type of ANC facility and type of provider influence the provision and utilization of HIV testing and counseling during ANC in Nigeria. Results show that PMTCT training should first target lesser-skilled ANC providers and those who work in 'non-health' facilities.

Keywords: HIV testing, antenatal care (ANC), PMTCT, sub-Saharan Africa (SSA), individual factors, institutional factors.

DEDICATION

I dedicate this to my parents Mr. and Mrs. Paul Abiodun and Mojisola Taiwo Durojaiye. I became aware of my parents' dedication to my success right from an early age. Even when resources were limited, I was provided the right environment and resources needed to succeed, sometimes at the detriment of their comfort. My parents nurtured my love for learning, instilled important values in me and gave me the confidence that became the lens through which I see and conquer difficulties and challenges. Thank you mum and dad.

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INTRODUCTION

Sub-Saharan Africa (SSA) remains the major world region with the largest proportion of people living with HIV (PLHIV). By the end of 2015, there were at least 25.5 million PLHIV in SSA, of which 1.37 million were new infections,[1] and over half (almost 14 million PLHIV) were women of reproductive age.[2] Between 85–92% of pregnant women living with HIV are in SSA.[3,4] HIV can be transmitted from a woman who is positive to her child during pregnancy, childbirth and/ or breastfeeding. There is a 15–45% chance of mother-to-child transmission (MTCT) of HIV without treatment.[5] However, with effective prevention of MTCT (PMTCT) interventions, including antiretroviral treatment, transmission risk can be reduced to less than 1%.[33] Of the 150,000 new infections in children in 2015, 122,000 occurred in SSA, mostly through MTCT.[1]

The World Health Organization (WHO) in 2009 identified 22 target/ priority countries (all SSA countries including Nigeria, with the exception of India) as part of the global plan to reduce MTCT by 90% at the end of 2015. Only 6 (Botswana, Mozambique, Namibia, South Africa, Swaziland and Uganda) met the global plan target.[5] In 2016, the United Nations program on HIV/AIDS (UNAIDS) and other organizations launched "Start Free, Stay Free, AIDS Free" to end AIDS among children, adolescents and young women by 2020. PMTCT targets of this new initiative include reducing the number of new HIV infections among children to less than 40,000 by 2018 and less than 20,000 by 2020.[5]

The WHO began developing PMTCT/ HIV testing guidelines in 2000, with major revisions beginning in 2004. Prior to 2004, HIV testing of pregnant women occurred primarily through voluntary counseling and testing (VCT). However, studies that reported the inadequacies of this approach led the WHO to start recommending provider-initiated testing and counseling (PITC) for pregnant women during ANC in low-resource settings.[3,6] The subsequent 2007 and 2010 guidelines promoted the four components of the comprehensive approach to PMTCT;[7,14] the 2015 guidelines recommended Option B+[8]; and the 2016 guidelines continued to recommend PITC as a routine component of pregnant women's ANC package of care in high prevalence settings.[9] Table 1 below highlights the important details of these guidelines.

PITC may include both 'opt-out' or 'opt-in' approaches. With the opt-out approach, clients must specifically state that they do not wish to be tested after pre-test PMTCT counseling. Studies have shown that the opt-out approach has been significantly more successful in improving the HIV testing rate, compared to the opt-in approach in SSA.[10-13] The overarching goal is still the same whether patients "opt-in" or "opt-out" – pregnant women must make an informed decision to accept or decline the HIV testing recommendation by the healthcare provider. Pre-test information for pregnant women should include the risks of transmitting the virus to infants, actions that can be taken to reduce transmission, the use of antiretroviral therapy, and the breast feeding procedures for infants.[14] Accordingly, it is important to examine whether or not pregnant women in SSA are offered pre-test counseling on PMTCT as well as HIV testing during ANC.

This dissertation focuses on the testing of pregnant women for HIV, since HIV testing is the critical first step in the prevention of HIV transmission from mother to

child. When pregnant women are aware of their HIV status, they can access PMTCT services that can reduce HIV transmission.[8]

Incorporating HIV testing into ANC settings is an integral component of WHO strategies.[7,8,9] ANC is the mechanism of providing important health care services, including HIV testing and counseling as part of PMTCT for many women who otherwise many not seek health care. The extension of PMTCT services in Nigeria, a priority country, is crucial to reducing national and global MTCT rates. In 2013, Nigeria had an estimated 190,000 pregnant women[3] and 430,000 children[15] living with HIV/AIDS, including 51,000 newly infected children. This is one of the highest new HIV infection rates in the world.[16,17] Ninety percent of these children contracted HIV through MTCT.[16] Without effective interventions, the Ministry of Health estimates that from 67,500-125,000 babies would be infected yearly with HIV in Nigeria.[18]

The Nigerian health system is decentralized into three tiers – the federal, state and local government.[19] At the federal level, the federal ministry of health (FMOH) is responsible for creating and implementing policies, providing technical support for the nation's overall health system, and providing health services through tertiary hospitals,[20] including federal medical centers, teaching and specialty hospitals.[21,22] At the state level, the state ministries of health (SMOH) are responsible for the proper functioning of secondary hospitals. They also regulate and provide technical support for primary health centers.[19] The secondary (general) hospitals are the first level of specialty care centers that are available in the 36 states.[22] The local governments are responsible for primary health care management with support from the SMOH and private medical practitioners.[22] Based on the 2011 health facilities census by the FMOH, there were

34,173 health facilities in Nigeria,[23] with 30,098 (88.1%) primary health care, 3,992 (11.7%) secondary, and 83 (0.2%) tertiary facilites.[16,23]

Various factors have been cited for the low HIV testing utilization rate in SSA and Nigeria, including individual-level[24-28] and institutional-level factors[29-31]. Institutional-level factors are those that relate to the ANC facility where pregnant women seek care, including the types and practices of health workers at these facilities. Individual-level factors are patient-level characteristics. To improve pregnant women's willingness to accept HIV testing as part of PMTCT, an effective program should address the issues at the site or institutional-level and at the individual level.

Overview of the Dissertation

This dissertation seeks to understand factors that influence HIV testing and counseling during ANC. It is comprised of three manuscripts based on the following three aims: (1) to systematically review the institutional-level factors that influence HIV testing and counseling utilization during ANC in SSA, (2) to analyze the influence of individual-level factors on HIV testing utilization during ANC in Nigeria, and (3) to examine how institutional-level factors influence the provision and utilization of HIV testing and counseling during ANC in Nigeria.

The first study was a systematic review of studies on the influence of institutional-level factors on HIV testing and/ or counseling in SSA. While there are review studies that have been published on the individual-level factors that influence HIV testing and/ or counseling utilization, to the best of our knowledge, this maybe the first systematic review on the influence of institutional-level factors. This study systematically

reviewed articles in PubMed, Google Scholar, Cochrane Library and EMBASE following the guidelines presented in the PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions.[32] Each set of search terms applied to these databases was geared towards identifying studies that examined institutional-level factors that influence HIV testing and/ or counseling utilization during ANC in SSA. For all selected records that met the inclusion criteria, full texts of these records - whether quantitative, qualitative and mixed-methods studies were obtained and reviewed by two of the authors. Differences at each stage were resolved through consensus.

Empirical information extracted (where applicable) included: the study population (e.g. pregnant women or health workers), study outcome (whether HIV testing and/ or counseling), type of outcome (whether PITC or VCT), the study design, the settings where the study was conducted (including the country and region as applicable), characteristics of the ANC facility, sample size, study period and the institutional-level findings. Identifying institutional-level findings that facilitate or limit HIV testing utilization can help inform policies to improve HIV testing outcomes in Nigeria.

The second study aim was to analyze the influence of individual-level factors on HIV testing and counseling utilization during ANC in Nigeria. The 2013 Nigeria Demographic and Health Survey (NDHS), a cross-sectional and nationally representative survey providing current and retrospective information, was the main data source for this study. The sample size (9,695) included women who gave birth between 2011-2013 and attended ANC at least once during this period. In the NDHS 2013 database, women were asked three different questions pertaining to HTC: whether or not they received pre-test

PMTCT counseling (yes/no), were offered HIV testing (yes/no), and were tested for HIV (yes/no). We extend the approach of analyzing utilization of ANC-HIV testing beyond the question "*did you get tested for HIV?*", and examined the predictors of HIV counseling and testing using a novel conceptualization of the four possible testing and counseling outcomes: ideal, less ideal, opted-out and missed opportunity. Participants that were offered counseling, offered testing, and were tested for HIV were grouped into a category called 'ideal.' Participants who were not offered counseling, but were offered testing and were tested for HIV were grouped into a category called 'less ideal.' Participants who were offered counseling, offered testing but were not tested for HIV were grouped into a category we named 'opted-out.' This is the category of women who refused testing. Participants who were not offered counseling, offered testing and were not tested for HIV were grouped into a category we named 'missed opportunity.' Individual-level factors were classified into predisposing, enabling and need factors using the Anderson Behavioral Model (ABM) to evaluate which are the more important consideration for intervention purposes, a particularly salient concern in resource-limited settings.

The third manuscript (aim 3) examined how institutional-level factors influence the provision and utilization of HIV testing and counseling during ANC in Nigeria. The National Agency for the Control of AIDS (NACA) is responsible for the facilitation and engagement of the government and other important players in the health sector on the issues of HIV prevention, care and support. However, the Nigerian health system is decentralized into three tiers – the federal, state and local government - and uneven levels of commitment towards the various NACA programs and policies leads to the differences

in quality of services provided. Therefore, the overall goal of this study is to examine how institutional-level factors, such as type of ANC facility (private, public or 'others') and type of provider (doctors, nurses/ midwives or 'other providers') influence the provision and utilization of HIV testing and counseling during ANC. In the NDHS 2013 database, women were asked three different questions pertaining to HIV testing and counseling: whether or not they received pre-test PMTCT counseling (yes/no), were offered HIV testing (yes/no), and were tested for HIV (yes/no).

The first aim of this dissertation was to summarize empirical evidence on the institutional-level factors that influence HIV testing and counseling utilization in SSA. By identifying the factors that limit utilization, interventions could be geared towards addressing them. The second and the third papers of this dissertation will contribute new findings on the institutional- and individual-level factors that influence HIV testing and counseling utilization in Nigeria. The improvement of HIV testing of pregnant women in Nigeria will further advance the utilization of PMTCT programs which is crucial to the eradication of MTCT of HIV, both within the country and globally.

Table 1. Changes in WHO Guidelines on PMTCT and HIV Testing for Pregnant Women during ANC between 2004 – 2016

Year & Title	PMTCT Testing Recommendations	Important Feature
2004: UNAIDS/WHO Policy Statement on HIV Testing	Although client-initiated HIV (VCT) testing remained critical, the WHO began recommending routine offer of HIV testing (PITC) by health workers to all patients seen in the context of pregnancy, especially in high HIV transmission areas	The "3 Cs"; confidentiality, consent and counselling still applies. However, the standard pre-test counselling used in VCT services was adapted to ensure informed consent, without the need for a full information and counselling session.
2007: Guidance on provider-initiated HIV testing and counselling in health facilities	PITC should be offered for all clients and in all services, including the ANC, in generalized HIV epidemic settings. In concentrated HIV epidemic settings, PITC should be offered for clients who present with symptoms or medical conditions that could indicate HIV infection in clinical settings	Provision of specific pre-test information recommended (no need for individual pre-test counselling)
2007: The Prevention of Mother-to-Child Transmission of HIV and Pediatric HIV Care, Treatment and Support	Routine offer of HIV testing (with right to opt out) should be provided after group information/counselling session as part of a routine package of ANC	Began promoting the four components of the comprehensive PMTCT approach, including prevention of transmission from an HIV-positive woman to her child
2010: WHO PMTCT strategic vision 2010-2015	Promotes and supports the rapid scale-up of PITC in ANC, delivery, postnatal and family planning services	Continues to promote the four components of the comprehensive PMTCT approach, including prevention of transmission from an HIV-positive woman to her child
2013: Consolidated guidelines on use of antiretroviral (ARV) drugs for treating and preventing HIV infection	PITC for HIV **should** be considered a **routine** component of the package of care for pregnant women in all ANC settings in high prevalence settings (HPS). PITC **can** be considered a **key** component in low prevalence settings (LPS)	Recommendation of **Option B+** where life-long ART is provided to all pregnant and breastfeeding women who are HIV-positive irrespective of CD4 count or disease stage. If not possible, **Option B** for HIV-positive pregnant women
2015: Consolidated guidelines on HIV testing services	PITC for HIV **should** be considered a **routine** component of the package of care for pregnant women in all ANC settings in high prevalence settings (HPS). PITC **can** be considered a **key** component in low prevalence settings (LPS)	Recommendation of **Option B+** only for HIV-positive pregnant women regardless of CD4 count
2016: WHO recommendations on ANC for a positive pregnancy experience	PITC for HIV **should** be considered a **routine** component of the package of care for pregnant women in all ANC settings in high prevalence settings (HPS). PITC **can** be considered a **key** component in low prevalence settings (LPS)	None

THE INFLUENCE OF INSTITUTIONAL-LEVEL FACTORS ON HIV TESTING & COUNSELING UTILIZATION DURING ANTENATAL CARE IN SUB-SAHARAN AFRICA: A SYSTEMATIC REVIEW

by

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ABSTRACT

Of the estimated 150,000 new HIV infections in children in 2015, 122,000 occurred in sub-Saharan Africa (SSA) mostly via mother-to-child transmission (MTCT). HIV testing and counseling, a critical first step in the prevention of MTCT (PMTCT), can enable HIV-positive women access services that can reduce HIV transmission to <1%. Incorporating HIV testing into antenatal care (ANC) is an integral component of World Health Organization strategies. Various factors have been cited for the low ANC-HIV testing utilization rate in SSA, including patient-level and institutional-level factors. Institutional-level factors are those that relate to the ANC facility where pregnant women seek care, including the types and practices of health workers at these facilities. This study systematically reviewed all publications that have examined institutional-level factors influencing HIV testing utilization during ANC in SSA, and summarized the empirical evidence from these studies. Forty articles published between 2004-2016 were included: 23 quantitative (57.5%), 8 (20.0%) qualitative and 9 (22.5%) mixed-methods studies. Regardless of study design, the institutional-level findings emphasized the importance of adequate institutional resources for the provision of ANC-HIV testing services. Deficiencies were highlighted in three aspects of resources: staffing, availability of supplies, and infrastructure. Key staff-related limitations identified were: shortages of ANC workers, inadequate training, low compensation, and heavy workloads. Inadequate HIV test kits (supplies) and lack of on-site testing services and/ or dedicated testing counseling rooms (infrastructure) led to many additional missed opportunities for testing. Limitations in these resources were also linked to inadequate/omitted pre-test counseling,

which can also lead to lower acceptance of HIV testing. These inter-related factors may operate individually or in combination to adversely influence HIV testing utilization in SSA. With adequate resources, interventions addressing these limitations could significantly increase ANC-HIV testing utilization among pregnant women in SSA, and contribute to the prevention of MTCT and protection of maternal health.

INTRODUCTION

Sub-Saharan Africa (SSA) has the largest number of people living with HIV (PLHIV), of which almost 14 million are women are of reproductive age.[54] It is also the 'home' of 85–92% of pregnant women living with HIV.[13,55] In addition 122,000 of the 150,000 new HIV infections in children worldwide occurred in SSA, mostly through mother-to-child (MTCT).[53] The virus can be transmitted from an HIV-positive woman to her child during pregnancy, childbirth and/ or breastfeeding. There is a 15–45% chance of mother-to-child transmission (MTCT) of HIV without treatment.[56] However, with effective prevention of MTCT (PMTCT) interventions, including antiretroviral treatment, transmission risk can be reduced to less than 1%.[73]

Effective PMTCT programs require a blend of different interventions within the WHO guidelines, including the prevention of transmission from HIV-positive mother to her child. HIV testing is the critical first step in the prevention of HIV transmission from mother to child. When pregnant women are aware of their HIV status, they can access PMTCT services that can reduce HIV transmission.[58] Incorporating HIV testing into antenatal (ANC) settings is an integral component of the WHO strategies.[57,58,59] ANC has been an important site of HIV testing for women in many countries. It provides opportunity for sexually active women to receive adequate HIV counseling and to tested for the virus. When tested, it becomes an important entry point into the PMTCT cascade of care.[13]

Although HIV testing of pregnant women in SSA has improved over time, it is still low in several countries. One earlier systematic review of patient-level characteristics reported a testing rate of 63% in Uganda, 80% in South Africa and 99.9% in urban

Zimbabwe.[1] Another study, using nationally representative demographic health survey (DHS) survey data (2008-2013) indicated ANC-HIV testing uptake rates of 81.5% in Uganda, compared to 69.4% in Mozambique, 54.4% in Nigeria and 45.4% in Congo (45.4%).[13]

Various factors have been cited as contributing to the low HIV testing uptake rate across most of the region. These include patient-level and institutional-level characteristics. Institutional-level factors are those that relate to the ANC facility where pregnant women have sought care, including the types and practices of health workers at these facilities. Example of institutional-level factors include the infrastructure on ground (i.e. waiting rooms, counseling rooms, and testing laboratory), supplies (i.e. HIV test kits), and human resources (skills and knowledge of the health workers, attitude of the workers, number of staff available). Literature reviews[1, 2, 3, 4] have been published on the patient-level influences on HIV testing and counseling (HTC) utilization, with one study[1] touching on HTC during ANC. However, to our knowledge, this is the first systematic review on the influence of institutional-level factors on HTC utilization for pregnant women in SSA. From earlier studies[5,15-18], institutional-level factors have been shown to play a role in HTC outcomes. For example, one study found that site factors played the most important role in uptake of testing for HIV among pregnant women[5].

To improve pregnant women's willingness to accept HTC as part of PMTCT, an effective program should address the issues at the site/ institutional-level, not just at the participant/ individual-level. This study systematically reviewed all publications that have examined institutional-level factors that influence HTC utilization during ANC in SSA, and summarized the empirical evidence from the studies.

METHODS

Search Strategy and Study Selection

This systematic review was conducted following the guidelines presented in the PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions.[6] The primary author (MD) and co-author (FB) searched four electronic databases for peer-reviewed publications: PubMed, Google Scholar, Cochrane Library and EMBASE. Each set of search terms applied to these databases was geared towards identifying studies that examined institutional-level factors that influence HIV testing and/ or counseling utilization during ANC in SSA. The search terms for PubMed were developed with the help of librarians at UAB Lister Hill Library. These PubMed search terms formed the basis for the other databases. Only PubMed and Cochrane databases allowed for the listing of all the SSA countries (as classified by the World Bank) as part of the terms. Google Scholar and EMBASE have restrictions on the number of terms allowed per search. Appendix 1 shows the adapted search terms for each electronic database, and the resulting number of articles each set of terms produced. PubMed yielded the highest number of articles (394), followed by Google Scholar (228). Searches in all the databases were restricted to publications between 2004 and 2016. Year 2004 was chosen as the starting year to coincide with the publication of the first major WHO guideline on HIV testing.[13] Prior to 2004, HIV testing of pregnant women occurred primarily through voluntary counseling and testing (VCT). However, several studies have reported the inadequacies of this approach, which led the WHO to start recommending provider-initiated testing and counseling (PITC) for pregnant women during ANC in low-resource settings. All searches are current as of August 31, 2016.

After publications were identified from each database, inclusion/ exclusion criteria (described below) were applied to select eligible studies for this review. The methodology for selecting eligible studies for this systematic review is described in figure 1 below. Screening was done individually by both reviewers (MD & FB) following these steps: 1) titles were screened to remove duplicate studies from the use of multiple databases; 2) abstracts were screened individually to remove all records that did not meet the inclusion criteria; 3) screening of full texts of articles further using the eligibility criteria; 4) selected articles from the full text review that met the criteria were eligible for data extraction. For all selected records, both reviewers compared data extraction results. Initial concordance was over 60% and differences at each stage were resolved through consensus.

In other to be included in the systematic review, an article had to meet the following criteria:

1. Published in a peer-reviewed journal
2. Study design could be qualitative, quantitative or mixed methods
3. Evaluated HIV testing and/or counseling during ANC for pregnant women as outcomes (studies were included even if this was not the primary purpose of the research)
4. Examined institutional-level factors that influence HTC outcomes during ANC for pregnant women as described above.
5. Conducted in a SSA region, based on the World Bank country classification scheme
6. Published in English language.

7. Published between 2004 and 2016

ANC-HTC was defined as such conducted in public (government hospitals, government health centers, stand-alone VCT center, family planning clinic mobile clinic, fieldworker, school based clinic and other public sector), private (stand-alone VCT center, mobile clinic and school based clinic) or other healthcare settings (correctional facility, and other types of facilities). Articles were not excluded based on the type of ANC facility.

Quality Assessment

Quality of included studies is an important step in a systematic review. To assess the quality of the quantitative studies, the *Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies* developed by the National Institute of Health (NIH)[7] was adapted for this study. This tool used the 14 key criteria adapted from the NIH tool to assess the quality of quantitative studies reviewed here. Studies were rated as 'poor' if 4 or more criteria have 'no' responses, 'fair' if less than 4 of the criteria have 'no' responses, and 'good' if none of the criteria have a 'no' response. To assess the quality of the qualitative studies, the *Critical Appraisal Skills Program (CASP)* tool with 10 key criteria was adapted.[8] There is no standard rating system based on these criteria. However, from a literature review of studies that have assessed quality of studies for systematic review, the following approach was used to assess the included studies: 'poor' if 2 or more criteria have 'no' responses, 'fair' if less than 2 of the criteria have 'no' responses, and 'good' if none of the criteria have 'no' response.

In addition, there is no standard quality assessment tool recommended for mixed methods studies (used both qualitative and quantitative methods), therefore, to assess the quality of the mixed methods studies, the qualitative part of each study was ranked using the CASP tool[8] and the quantitative part of the study was ranked using the NIH tool.[7] Ratings of each part of the study remained as listed above. Afterwards, the lowest ranked of the study aspects was chosen as the final quality assessment for the mixed methods studies. For example, if one aspect of a mixed method study was rated poor, and the other rated fair, the final quality ranking for the study would be poor. The reviewers assessed the quality of included studies individually and then compared their rankings (whether poor, fair or good). Any disagreement was resolved through consensus.

Data Extraction and Syntheses

A data extraction form based on the Cochrane Public Health Group's data extraction template was employed.[9] This form was pilot-tested on randomly-selected studies from the eligible articles, and refined as needed. Information extracted (where applicable) from each eligible article into the coding form included: the study population (e.g. pregnant women or health workers), study outcome (whether HIV testing and/ or counseling), type of outcome (whether PITC or VCT), the study design, the settings where the study was conducted (including the country and region as applicable), characteristics of the ANC facility, sample size, study period and the institutional findings.

Findings were presented using the Cochrane's Summary of Findings (SoF) table format. SoF tables provide a way of presenting key findings from the data extraction in a

succinct and clear manner.[6] The SoF tables (Table 1) includes information on the study population, settings, the study period, sample size, quality assessment of studies, source of data (if facility data was used), the type of outcomes measured, the study design/ methods, and the summary of the results**.**

For the qualitative studies, the additional goal was to generate new theoretical insights. Based on review of previous studies that have systematically analyzed qualitative studies, the meta-synthesis (also known as meta-ethnography) process described in Katz et al., (2013)[10] and originally proposed by Noblit and Hare (1988) was employed.[11] This process was used to identify themes that recurred frequently or were dominant throughout the study. First-order findings (reflecting the responses of participants and usually placed in quotations in the included studies) were used to support second-order interpretations (interpretations of participants' responses made by the authors of these studies) to gain new insights (third-order constructs) into the influence of institutional-level factors on HIV testing during ANC among pregnant women in SSA. For the mixed methods studies, the *research synthesis by aggregation* methodology described in Sandelowski et al. (2012) was employed.[12] This methodology for data synthesis depends on both qualitative and quantitative aspects of the study potentially addressing the same outcomes/factors. The findings that address the same connection between more than one aspect of the target outcome(s) are then assimilated. Aggregation can be done at the subject- or study-level. Since subject-level information is not always available (qualitative findings are usually presented at the study level with first-order constructs taking precedence over descriptive statistics), this systematic review employed

research synthesis by aggregation at the study level for the mixed methods result synthesis.

RESULTS

Summary of Included Articles

The initial databases search yielded 639 records, with 612 records remaining after duplicates were removed. All the titles and abstracts of the 612 articles were screened and 564 articles were excluded for not meeting the eligibility criteria described above. The full texts of the remaining 48 articles were screened, and 8 articles were excluded because they focused only on ANC and facility-based delivery barriers and facilitators without touching on HTC of pregnant women. Some of the excluded articles touched on HTC but did not report any institutional level factors.

Study Design

Of the 40 articles included in the review, 23 were quantitative studies (57.5%), 8 (20.0%) were qualitative studies and 9 were mixed methods studies (22.5%). The majority of the quantitative studies were cross-sectional studies, while the qualitative studies were mostly conducted using in-depth interviews and observational methods. The mixed methods studies used a combination of in-depth interviews and cross-sectional questionnaire methods. Mixed method and qualitative studies constituted 42.5% of the total number of included articles.

Table 1 below shows the summary of findings for the 40 articles that were included in this review, divided by study design. The first section contains the SoF of the

23 quantitative articles, the second section contains the SoF of the 8 qualitative articles, and the third section contains the SoF of the 9 mixed methods articles.

Type of Outcome Measured/Explored

The outcomes of interest are HIV testing and/ or pre-test counseling. As seen in column 3 of table 1, of the 40 articles, 4 examined counseling only (10.0%), 10 examined testing only (25.0%) while 26 (65.0%) examined both HIV testing and counseling outcomes. 16 of the 40 articles (40.0%) examined HIV testing and/ or counseling outcomes as the primary/ only study focus, 16 (40.0%) as part of other PMTCT outcomes, 6 (15.0%) as part of non-PMTCT outcomes, and 2 (5.0%) as part of both PMTCT and non-PMTCT outcomes. Non-PMTCT outcomes include review of ANC facilities and services, feasibility and cost of implementing health service delivery, and health facility capacity strengthening.

Type of HIV Testing

Only 5 (12.5%) of the articles specifically mentioned examining VCT of pregnant women, and the rest of the articles (n=35, 87.5%) did not specifically state VCT. However, it is important to note that excluding the approach of HIV testing used in these studies does not mean that the study solely focused on PITC/opt-out approach - the standard WHO recommendation since 2004.

Study Settings

Five of the 40 studies (12.5%) were conducted in more than 1 SSA country, 2 were performed in 2 countries (both studies were in Tanzania & Uganda), another 2 were in four countries each [(Congo, Mozambique, Nigeria and Uganda); (Cameroon, Cote D'Ivoire, South Africa and Zambia)] and 1 included 15 countries (Benin, Democratic Republic of Congo, Cote D'Ivoire, Gabon and Ghana, Kenya, Lesotho, Malawi, Nigeria, Rwanda, South Africa, Tanzania, Togo, Uganda, and Zambia). Of the 35 remaining studies, 6 were conducted in South Africa, 5 in Tanzania, 5 in Uganda, 4 in Burkina Faso, 3 in Malawi, 3 in Kenya, 2 in Zimbabwe, and 1 each in Botswana, Cameroon, Cote d'Ivoire, Ethiopia, Ghana, Mozambique, and Nigeria.

The majority of the studies (N = 13, 32.5%) were conducted in rural areas, with 11 (27.5%) also conducted in urban areas and only 3 (7.5%) conducted in semi-urban/ peri-urban areas. Additionally, 13 studies (32.5%) were conducted in more than one region of the study country(ies), the majority of which were conducted in rural, urban and peri-urban areas.

Study Period

Even though only articles published between 2004 and 2016 were included, the period during which the research was conducted for these articles varied greatly. Study period was broken down into three groups; studies conducted on or before 2004 (before the PITC recommendation by the WHO began), studies between 2004 & 2010 (the WHO introduced updated PMTCT guidelines in 2010), and studies between 2010 & 2016. Of the 40 articles, 2 (5%) did not specify the study period. Also, 3 (7.5%) of the studies did

not fit clearly in the study period categories, with 2 of the studies considering 2002-2005 data and 1 covering two time periods (from 2002 to 2003, then 2005). Of the remaining 35 (87.5%) articles, 8 (22.9%) were conducted on or before 2004, 15 (42.9%) were conducted between 2004 and 2010, 12 (34.3%) were conducted between 2010 & 2016.

Study Population

The studies included a diverse range of study participants, which were grouped into 6 categories. The majority (N=13, 32.5%) of the studies included *health workers and pregnant women* as participants (one of these studies did not include health workers in the study population, but examined health workers (doctors, nurses and midwives) as part of the facility data assessment), 9 (22.5%) studies assessed *pregnant women only,* 8 (20.0%) assessed *pregnant women with at least one other study population* (6 of the 8 with the 'others population' included health workers), 7 (17.5%) assessed *health workers only,* 2 (5.0%) assessed *mothers only* (mostly postpartum women), and 1 (2.5%) assessed *health workers and mothers.* Of the 40 studies, 27 included health workers as participants.

Upon further review, 6 of the 27 studies did not specify the types of health workers (3 of the 6 referred to the workers as those providing ANC and postnatal/maternity care). Of the 21 studies that specified the types of health workers, 15 included nurses and/ or midwives (75%), 10 (50%) included counselors, 8 (40%) included facility or clinic officer/ administrators/ managers/ directors/ coordinators, 5 (25%) included physicians, 4 (20%) included community health workers/ traditional birth attendant/ health itinerant agents/ community counseling aides, 3 (15%) included

laboratory staff/ technicians, 2 (10%) included pharmacists/ pharmacy technicians, 2 (10%) included public health specialists, 1 (5%) included a biologist, and 1 (5%), in addition to specifying the types of health workers, also specified "others."

Facility-Level Data

All 40 articles explored institutional-level factors. Each of the 40 studies was conducted in a health facility and/ or participants were recruited from a health facility (mostly during ANC). However, not all studies used facility level data (i.e. data about the ANC facility e.g. location and size) and most studies focused on health workers in these facilities. Of the 40 articles, only 13 (32.5%) used facility-level data in addition to other institutional-level factors being examined.

Sample Size

The sample size in studies with pregnant women ranged from a low of 16 to a high of 283,410 (the largest sample size was from the 15-country study by Audureau et al., 2013). Other studies included samples ranging from 6-387 health workers and 29-313 participants in other study population categories.

Study Quality Assessment

Qualitative studies were rated 'poor' if 2 or more of the 10 criteria had a 'no' response, 'fair' if less than 2 of the criteria had a 'no' response, and 'good' if none of the criteria had a 'no' response. Quantitative studies were rated 'poor' if 4 or more of the 14 criteria had a 'no' response, 'fair' if less than 4 of the criteria had a 'no' response, and

'good' if none of the criteria had a 'no' response. For the mixed methods studies, each aspect of the study was rated separately using the same quantitative and qualitative ranking system. Afterwards, the lowest ranked of the study aspects was chosen as the final quality assessment for the mixed methods studies. For example, if one aspect of a mixed method study was rated poor, and the other rated fair, the final quality ranking for the study would be poor.

Of the 8 qualitative studies, 6 (75%) were rated 'good', 1 (12.5%) was rated fair and 1 (12.5%) was rated poor. Of the 23 quantitative studies, 21 (91.3%) were rated fair and 2 (8.7%) were rated poor. No quantitative study was rated good. Of the 9 mixed methods studies, 6 (66.7%) were rated fair and 3 (33.3%) were rated poor. No mixed methods study was rated good.

Summary of HIV Testing and Counseling Rates

The HIV testing uptake rate ranged from 26-100% across the studies. The lowest uptake rate (26%) was reported in a study which was conducted in Chitungwiza, Zimbabwe between 1999 and 2001. The highest uptake rates (99 –100%) were reported in studies that implemented an intervention to improve testing rates. Some of these studies reported pre-intervention uptake rates that were as low as 40%. The majority of the studies reported HIV testing uptake rates greater than 70%. Since 50% of the counseling-only studies used qualitative methods and 25% used mixed methods, the HIV counseling uptake rate was rarely reported quantitatively in percentage terms. The few that reported descriptive statistics showed uptake rates of counseling ranging from 7–95%. The lowest uptake rate (range of 7-29%) was reported in a study conducted in a

semi-rural region of Burkina Faso between May and June 2007.[30] The HTC approach in this study was VCT and this could explain the low rates reported. The PITC has been proven to result in better HTC outcomes and it is the WHO recommended standard during ANC.

Although some of the worst HIV testing and counselling uptake rates were found in studies conducted before 2004, rates as low as 45% were still reported in studies conducted between 2011-2013. HIV testing and counselling rates did not appear to have consistently improved or worsened over time. For example, one study conducted in rural Zimbabwe between 1999-2001 reported a 99.1% HIV testing rate, while another study conducted in Dar-es-Salaam Tanzania between 2001-2002 reported HIV testing utilization rate of 77.2%.

Institutional-Level Findings from the Quantitative Studies

Institutional-level factors that were shown to facilitate or prevent HTC utilization are presented in Table 3 below. Facilitators include: pregnant women receiving their ANC services from a skilled attendant compared with an unskilled attendant [higher odds of being tested if women received their ANC services from a skilled attendant vs. unskilled 1.78 (99% CI: 1.45-2.18)] in one study of four SSA countries[13]], ensuring availability of supplies (e.g. HIV test kits) at the ANC facility [facilities in Malawi that were out of HIV test kits once every quarter or less frequently were seven times more likely to have high uptake of HIV testing in ANC than facilities that were out of stock three or four times [AOR 7.2 (1.3–50)] [(14,15)], comprehensive on-site staff training[(16)], involving staff in decision making[(16)], improvement in work conditions for health

workers[16], improving infrastructure in the facilities[33], and the site of ANC as a significant factor in determining a woman's odds of accepting HIV testing acceptance[17] (P <0.0001)[18] [a trend towards a higher rate of refusal to test for HIV at the peri-urban clinics in South Africa (8.3% v. 5.9%; OR 1.44, 95% CI 0.8 - 2.7)][51]. The barriers include: HIV test kits shortages[19,20,21,22, 23,24,25], inadequate number of ANC staff [19,20,21,26,23,24,25,26,27], lack of adequately trained staff for PMTCT[17,24,26], inadequate infrastructure[20,23,28], privacy concerns[21], referring pregnant women to other sites for testing/ lack on on-site testing[14], poor integration of PMTCT into ANC care[29], poor quality/ limited pre-test counseling[23,30,31,28], and heavy work load of ANC staff[22,24,31] [a medium ANC monthly service volume (30-100/month) was a site-level predictor of HIV testing in 15 SSA countries (-7.6; CI -15.1 to -0.1)][26].

Institutional-Level Findings from the Qualitative Studies

After reviewing each of the 8 qualitative studies in detail, 7 second-order constructs relevant to HTC uptake were identified, supported by a first-order construct. Key themes were generated into a line of reasoning that led to 6 third-order constructs. These were grouped into 3 distinct third-order labels that were categorized as themes in Table 3 below.

Theme 1 – Resources. The lack of different types of resources was the most commonly cited institutional-level factor that influenced the uptake of HIV testing in the qualitative studies[37,38,39,41,44,45,46]. This includes inadequate HIV testing supplies (more evident in facilities in the rural areas), ANC staff shortage (staff in urban facilities were more likely to feel overwhelmed by the number of patients seen), and inadequate infrastructure –

from no counseling rooms to small waiting rooms. When HIV testing kits became unavailable, women were sometimes asked to return for testing, which led to missed opportunities. In addition, shortage of ANC staff resulted in heavy work-load for the health workers, which led to reports of workers been overwhelmed by the number of clients, and as a result being unable to provide adequate pre-test counseling to all the women. Inadequate pre-test counseling can also discourage the uptake of HIV testing. Also, staff shortage led to long queues and waiting times for the pregnant women. This discouraged the women from getting tested, or even returning for ANC. Long queues and waiting times were also consequences of inadequate infrastructure like counseling, testing and waiting rooms. According to one of the health workers from the Minnie et al, 2011[38] study:

"*I am supposed to do individual counselling but because there is not enough space and time, I do it in a group…"*

Theme 2 - Staff training and well-being. The majority of the ANC health care providers took on PMTCT services (including HTC) as additional duties to their normal ANC responsibilities. Therefore, they required training on PMTCT services. However, from the qualitative studies, relatively few of the ANC staff in these studies have had training in PMTCT services.[38,45] The few that have been trained in PMTCT did not have up-to-date training.[37,46] These sentiments were mostly expressed by the staff themselves, suggesting an important concern that should be addressed: *"HIV is changing every day, we need more training…"* [Health worker Minnie et al, 2011].[38]

The lack of adequate training seemed to be obvious to the clients as well, which could erode patients' confidence in their healthcare provider. For example, according to

one of the pregnant women from the Asiyanbola et al, 2016[37] study: "*They should employ more trained and qualified personnel and not just anybody"* This may also refer to the training of the health personnel in other ANC services

Health workers not only feel inadequately prepared to provide PMTCT services, they also do not feel well compensated for their duties. This is because PMTCT services are an added responsibility to the already burdened staff. This leads to low morale of the workers, and as a result little effort is put into HTC. This also affects the provider-client relationship negatively. The women are treated harshly by overworked and under-compensated workers. According to one of the health workers from the Sprague at al., 2011[39] study: "*I provide five counselling sessions per day, and then I stop [because] I have other work to do" (Eastern Cape hospital, October 2008)." "When someone is harsh or rude, it can hamper your service - some [staff] are very rude, and do not use good language, so the woman is fearful…she may return home… so the language and behaviour of those providers is very, very, very important (Health official, Gourlay et al, 2014[40])"*

Theme 3 - Pre-test counseling. Although pre-test counseling is an outcome of interest in this systematic review (separate from HIV testing), the way it is been performed is also one of the institutional-level factors that influenced HIV testing uptake in the qualitative studies. Instances of limited or omitted counseling were found in the qualitative studies[37,40,41,45]. Lack of pre-test counseling was often noted, and when available, tended to be brief and incomplete. This led to incomplete information for pregnant women to make informed decision about getting tested for HIV in some of these facilities. Also, counseling was done in groups making it harder for pregnant women to ask questions or

be better informed about HIV testing. An example was from the Gourlay et al, 2014[40] study: *"…I remember the nurse didn't tell me anything.... others are saying that when you go there to test, the nurse will first give you counselling – she will ask you 'are you ready', but I remember she didn't ask me. I didn't get any counselling."* However, it is important to note that group counseling can also be an effective way to deliver PMTCT information, especially when individuals have the opportunity to ask questions in a more private setting later.

In other instances, incomplete information meant pregnant women did not know they could opt-out from testing, thereby increasing the uptake of HIV testing[37,40]. An example was from the Asinyanbola et al, 2016[37] study: *"It is compulsory, you don't do the test, they would not allow you to register, it is by force."*

Institutional-Level Findings from the Mixed Methods Studies

The research synthesis by aggregation methodology produced results similar to those from the quantitative and qualitative studies. The same barriers were apparent in the mixed methods studies reviewed. Reported barriers to HTC utilization include limited infrastructure (including waiting areas, and space for counseling and testing) [(32,33,34)], supply shortage (including HIV test kits shortages) [(32,33,34,35)], low staffing levels [(32,33)] limited staff training in HTC [(36)], perception of privacy & confidentiality [(42)], long waiting times [(42)], rudimentary counseling process [(43)], and the perception of poor relationship between the pregnant women and health workers[(34,42)].

DISCUSSION

Forty (40) quantitative, qualitative and mixed-methods studies published between 2004-2016 from 21 SSA countries were systematically reviewed. Even though SSA is one region, it is also a heterogeneous setting. The institutional-level findings derived from all three study designs across the region yielded essentially inter-related findings that center on lack of different types of resources. These findings may combine or strengthen one another to influence HTC utilization. Deficiencies were repeatedly highlighted particularly in three aspects of resources: staff-related (including staff training and well-being), availability of testing supplies, and infrastructure at the ANC facility. Limitations in staff-related resources and infrastructure led to instances of inadequate/ omitted counseling which can discourage the utilization of HIV testing.[37,40,41,45]

Key staff-related limitations from this review are: shortage of ANC health workers,[19,20,27,37,43,44,45,46] inadequately trained health workers in PMTCT,[29,38,52] skill-level of health workers,[13] poor compensation for health workers,[39] and heavy workload.[45] These limitations led to even more factors that influenced the uptake of HTC, including long queues and waiting times at the ANC facility,[47,33,36] brief/ incomplete counseling sessions,[30,31,34] and poor provider-client relationship (including lack of supportive communications).[16,40]

Similar staff-related deficiencies have been observed beyond the SSA region. In a systematic review that assessed barriers to HIV testing in Europe,[66] some of the health workers felt that their training had not prepared them adequately to understand and

address the challenges of HIV in pregnancy. Furthermore, a critical review of nursing implications of PITC in SSA[68] found that that even though health workers (nurses) did not mind initiating HIV testing and counseling, they felt the need for more training and managerial support.[68] In another systematic review of qualitative studies on uptake of HIV testing in SSA, perceived poor attitude of health workers and lack of confidence in the ability of the workers discouraged HIV testing uptake among pregnant women.[67]

Inadequate testing supplies, including lack of on-site testing, led to many missed opportunities for HIV testing at some ANC facilities.[19,20,21,22,24,31,35,38] Women were asked to return for testing when supplies became unavailable, but most of these women did not return.[14] Also, uptake fell dramatically when pregnant women were referred to other ANC facilities for testing.[49 Similar to studies already published,[70,71] lack of HIV test kits and supplies led to disruption in HIV services provision in a resource-limited setting and limited HIV-testing uptake.

Limitations of infrastructure also played a major role in restricting utilization of HIV testing and counseling. Multiple studies [28,32,34,37] found that many ANC facilities did not have dedicated counseling and/ or testing rooms. This became an issue with the women who valued their privacy and also made it impossible for individual counseling with these women.[42] Group counseling was often held in waiting areas, making it very uncomfortable for most women to ask questions about the testing process.[28] The consent process was also poorly done as a result,[33,44] leading to poor perception of privacy and confidentiality by the women.[21,42] An earlier assessment of HIV testing in SSA identified perceived lack of confidentiality by health workers discouraged HIV testing in general.[67] Similar findings have been reported among African migrant women in the

United Kingdom.[66] Also, a review of pre-test counseling of pregnant women found that HIV testing and could be influenced by whether they were counselled in a group or individually. Knowledge improved better after group counseling, while uptake of HIV testing improved after counseling.[68] Therefore, the combination of both group and individual counseling could be an effective way to improve HIV testing and counseling.

Although only examined in very few studies, the rural-urban divide appears to contribute to the limitations around resources. Using a facility located in an urban site positively influenced HIV testing utilization.[18,51] One study found that ANC health workers in urban facilities were more likely to feel more overwhelmed because of the higher number of patients seen.[18] Urban facilities were more likely to have greater concerns with staff-related resources.[18] In Botswana, variations in the implementation of PITC were observed across urban and rural areas, with nurses in urban areas feeling more burdened with PITC work and PITC.[72]

Several study limitations should be noted. First, not all studies reported the approach to HIV testing considered (whether PITC or VCT), thereby preventing examination of potential differences in the outcome. It would have been preferable to compare HIV testing and counseling utilization by the type and level of the ANC facilities, that is, whether these were primary, secondary or tertiary level facilities. However, only one study[41] reported on how the type of facility influenced utilization. The data quality for many of these studies was poor, and the number of articles that met the study criteria for review was not large. Although it is possible that some articles may have been missed, strenuous efforts were made to reduce this possibility by searching multiple databases and having a co-author conduct a separate search. In addition, the

quality of a systematic review depends on what has been published. Other limitations include restricting article selection to those published in English only. Lastly, the majority of the quantitative studies did not report effect sizes, confidence intervals, and/ or significance levels for the relationships between institutional-level factors and HTC uptake outcomes among pregnant women.

With the inclusion of studies with different methodologies, this study provides a robust analysis of the influence of institutional-level findings on ANC-HIV testing and counseling utilization. This review has revealed several institutional-level factors, primarily related to the availability of different types of resources, that can limit HIV testing and/ or counseling uptake among pregnant women at ANC facilities in SSA. Perhaps the most difficult institutional-level factors to improve would be the limitations relating to health facility infrastructure. More research is needed on how to improve these limitations in a cost-effective way, especially for the resource-limited SSA. With adequate inputs and interventions centered around resources, it would be possible to significantly reduce the impact of many of the barriers that impair HIV testing and counseling uptake in SSA.

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FIGURE & TABLES

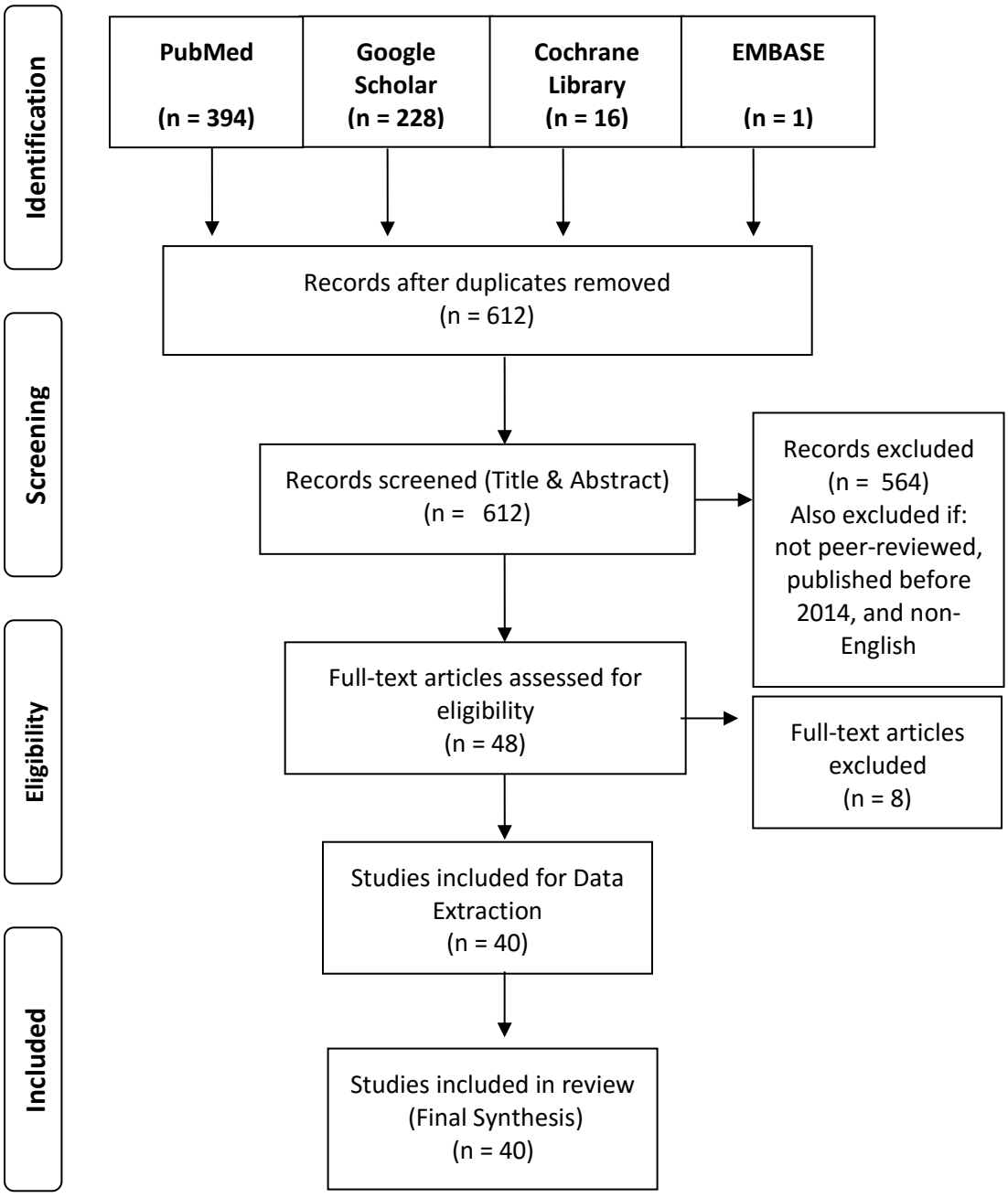

Figure 1. The flow of information through the different phases of the systematic review

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
QUANTITATIVE STUDIES						
1. Gunn et al, 2016 **Four countries**	2011-2013	Testing only *The only outcome*	Cross-sectional study **(CSS)** with pregnant women (N=25,201)	No	Fair	- 60.7% of women received HIV testing; Ugandan (81.5%), Mozambique (69.4%), Nigeria (54.4%) and Congo (45.4%) - Higher odds of being tested if women received their ANC services from a skilled attendant vs. unskilled 1.78 (99%CI:1.45-2.18)
2. Tenthani et al, 2015 **Southern and Central, Malawi**	01/01/2010-03/31/2014	Testing (Ascertainment) only *The only outcome*	Analyses of records of pregnant women pre (n=100,515) & post (n=94,345)	Yes *19 Facilities*	Fair	- Testing rate of 82.3% in the pre Option B+ period and 85.7% in the B+ period - HIV test kits shortages and insufficient numbers of staff posed major barriers to reducing MTCT
3 Coulibaly et al, 2014 **Ouagadougou, Burkina Faso**	01/2011-02/2012	Testing only *As part of non-PMTCT outcomes*	CSS & facility records of health workers (N=127) pregnant women (N=67,592), HIV+ women (N=1064) and HIV+ children (N=313)	Yes *103 Facilities*	Fair	- 85.9% were tested for HIV - Shortage of staff, testing kits and on-site facilities
4. Some et al, 2014 **Ouagadougou, Burkina Faso**	08-10/2008	Both HTC (VCT) *As part of PMTCT outcomes*	CSS of health workers (N=387)	Yes *38 Facilities*	Fair	- 86.2% of new patients benefited from counselling and 57.6% from HIV testing. - Some testing kits only in 62.3% facilities and unlimited only in 50% of the facilities

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
5. van Lettow et al, 2014 **Malawi**	2012-2013	Both HTC *As part of PMTCT outcomes*	Facility assessment/ survey using four models: A, B, C & D	Yes *141 Facilities*	Fair	- Model A had the highest uptake rate of HTC at 82%. Model B at 68% and Model C at 70%. Model D had no ANC - Facilities with HIV test kits shortage less frequently were 7 times more likely to have high uptake of HTC than facilities that were out of stock 3 or 4 times [AOR:7.2 (95%CI:1.3–50)]
6. Audureau et al, 2013 **15 SSA Countries**	2002-2005	Both HTC *As part of PMTCT outcomes*	Review of aggregate data collected on pregnant women (N=283,410)	Yes *269 Facilities*	Fair	- Overall 61.5% tested after counseling (% varies by country) - ANC monthly service volume (30-100/month) was the only site-level predictor of HIV testing found (-7.6; CI -15.1 to -0.1)
7. Ediau et al, 2013 **Northern Uganda**	01/2010-09/2011	Both HTC *As part of non-PMTCT outcomes*	Review of health facility data on pregnant women (N=537 & 562) and their male partners (N=130, 180)	No	Fair	- 80.7% tested and counseled in the first month. 97.3% in the fourth quarter of 2010, and 99.5% in the third quarter of 2011. - Deferring HIV testing to future visits is a missed opportunity, and reasons include HIV test kits shortage
8. Ekouevi et al, 2012 **Four countries**	07/2008-05/2009	Both HTC (VCT & PITC) *As part of PMTCT outcomes*	Facility survey of pregnant women (N=132) and health workers (N=6)	Yes *32 Facilities*	Poor	- 92.0% overall counseling uptake (% varies by country) 84 (mean) of overall blood testing for HIV (mean varies by country) - Detailed improvement on operational factors are essential to HTC success

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
9 Larsson et al, 2012 **Rural, Uganda**	05/2008–05/2010	Both HTC *The primary outcome*	Quantitative interview and database review of pregnant women (N=881)	No	Fair	- At ANC facilities with HIV testing services, 85% were tested. Only 6% at facilities with no testing (referred), and 20% received counseling regarding HIV. Overall, 64.0% were tested for HIV. - Lack of on-site HIV testing services led to missed opportunities for PMTCT
10. Kinuthia et al, 2011 **Nairobi & Nyanza Kenya**	09/2008-03/2009	Testing Only *As part of non-PMTCT outcomes*	CSS of mothers (N=2700)	No	Fair	- 92.1% reported testing - Reasons mothers were not tested included lack of services/ failure of staff to offer testing (43.5%), and slow service provision (12.3%)
11. Horwood et al, 2010 **KwaZulu-Natal, S. Africa**	10/2007-02/2008.	Testing only *As part of PMTCT outcomes*	CSS and records review of mothers (N=872) and health workers (N=26)	No	Fair	- 97.3% reported testing - Clear policies are required in regard to roles and responsibilities of health workers
12. Pfeiffer et al, 2010 **Mozambique**	2005-2008	Both HTC (VCT & PITC) *As part of PMTCT & non-PMTCT outcomes*	Review of aggregate data collected on pregnant women and unknown population from a large study population (size unclear)	Yes *222 Facilities*	Fair	Only 20,000 people had been tested in 19 separate VCT sites without integrated counseling & testing (PITC). With integrated PITC, > 100,000 were tested in 103 sites in 2007 alone
13. Creek et al, 2009 **Francistown, Bostwana**	2003	Testing only *As part of PMTCT outcomes*	CSS of pregnant and postpartum women (N=504) with health workers (N=82)	No	Fair	- 73% were tested for HIV - Health workers reported discomfort with their knowledge and skills

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
14. Moodley et al, 2009 **KwaZulu-Natal, S. Africa**	08-09/2007	Both HTC *As part of PMTCT outcomes*	CSS of post-natal mothers (N=805)	Yes *53 Facilities*	Fair	- All 53 clinics offered HCT and 8 (15%) clinics were identified with HIV testing rates of <80%. 91% testing rate average (range 40-100%). 84% had a documented record of access to HCT. - A trend towards a higher rate of refusal to test for HIV at the peri-urban clinics (8.3% v. 5.9%; OR 1.44, 95% CI 0.8 - 2.7)
15. Rispel et al, 2009 **Eastern Cape, S. Africa**	2007	Both HTC *As part of PMTCT outcomes*	CSS and database review of health workers (N=51), pregnant women (N=296), HIV+ women (N=70) and trad. hlth pract (N=101)	No	Fair	- 74% reported that they had been offered HCT; 67% tested for HIV and only 43% tested during a previous pregnancy. - 67% reported staff shortages and high patient loads, 56% reported demoralized overworked staff, 44% reported insufficient training and 29% reported shortage of HIV rapid test kits as barriers to providing PMTCT services
16. Delvaux et al, 2008 **Urban, Côte d'Ivoire**	07/2002-05/2003 2005 (post)	Testing Only *As part of PMTCT & non-PMTCT outcomes*	CSS and observation checklist of pregnant women (N=606 pre and 591 post) & health workers (N=102 pre and 99 post)	Yes *5 Facilities*	Fair	- 63% (range 42%-81%) of women (1st ANC) were offered an HIV test. The overall testing rate was 42% - When inter-personal communication and confidentiality improved, testing also improved.

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
17. Sarker et al, 2007 **Rural Burkina Faso**	07-12/2004	Both HTC *Primary outcome*	CSS of pregnant women (N=430)	No	Fair	- 77% were counselled, of whom 73% went on to be tested. - 42% did not understand process of pre-test counseling.
18. Wanyu et al, 2007 **Rural Cameroon**	07/2002-06/2005	Both HTC *As part of PMTCT outcomes*	Database review of pregnant women (N=2331) and TBAs (N=30)	No	Fair	- 99.1% tested for HIV - Shortage of HIV tests kits, supervision and support of the PMCT-trained birth attendants on a regular basis
19. Delva et al, 2006 **Mombasa, Kenya**	3/10-10/12/2002	Counseling only *The only outcome*	Quantitative observation of pregnant women (N=91)	No	Poor	Low frequency and duration of the counselling. The mean duration of the individual pre-test counselling sessions was 6.6 min (SD/4.8 min and two extremes of 20 and 34 mins)
20. Harms et al, 2005 **Uganda and Tanzania**	11/2001-02/2002	Both HTC (Knowledge of) *As part of PMTCT outcomes*	CSS in Uganda (751 persons (440 clients of antenatal and outpatient clinics, 43 health workers, 239 villagers, 29 TBAs), and Tanzania (574 persons (410 clients, 49 health workers, 93 villagers, 18 TBAs)	No	Fair	Traditional birth attendants´ knowledge on both MTCT and preventive measures was extremely poor.
21. Shetty et al, 2005 **Chitungwiza, Zimbabwe**	07/1999-06/2001,	Both HTC (VCT) *As part of PMTCT outcomes*	Quantitative interview of pregnant women (N = 6051) & health workers (N=35)	No	Fair	- 1824 (30%) underwent pre-test counselling and 1547 (26%) were tested - Human resource constrained environment affected counseling.

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
22. Misiri et al, 2004 **Blantyre, Malawi**	2003	Questions on HTC *As part of non-PMTCT outcomes*	CSS of health workers (N=27)	No	Fair	- 51.85% reported having one trained HIV counsellor, 37.03% had no counsellor and 11.11% were not sure of the availability of a counsellor in their facility. - 77.78% of HW reported teaching ANC attendees about HIV/AIDS and only 37.0% reported offering routine STI screening
23. Westheimer et al, 2004 **Dar-es-Salaam, Tanzania**	08/13/2001-11/27/2002	Both HTC (mostly on testing) *Primary outcome*	Quantitative interview of pregnant women (N=14,235)	No	Fair	- 77.2% accepted HIV testing - The site at which recruitment occurs is a significant factor in determining a woman's odds of accepting HIV testing acceptance (*P* for trend <0.0001.
QUALITATIVE STUDIES						
24. Asinyanbola et al, 2016 **Ibadan, Nigeria**	Not Specified	Both HTC *Primary outcome*	Focus groups, observations and inventory checklists of pregnant women (N=40)	Yes *3 Facilities*	Fair	- No counseling in 2 of 3 facilities - Shortage of staff and test kits, lack of a dedicated counseling room and procedural inadequacies.
25. Gourlay et, al 2014 **Rural Tanzania**	2012	Both HTC *As part of PMTCT outcomes*	In-depth interviews and observations of pregnant women (N=21 of which 16 are HIV +) Health Workers (=9) & Community participants (N=61)	No	Good	Unclear communication by providers about the testing process, eroded trust in providers, confidentiality concerns, disrespectful staff, and omission of counselling was often noted

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
26. Rujumba et al, 2013 **Eastern, Uganda**	01-05/2010	Both HTC *Primary outcome*	In-depth interviews and observations of pregnant women (N=30 of which 15 were HIV+) & health workers (N=6)	No	Good	Testing services exist at lower level health centers infrequently, shortage of HIV test kits, overwhelmed health workers, inadequate attention during counseling/ incomplete counselling information
27. Vernooij and Hardon, 2013 **Rural Uganda**	04-07/2008	Counseling only *The only outcome*	Observations (participant & non-participants), semi-structured interviews and policy checklist of health workers. (N=12)	No	Good	Staff shortage and poor consent process
28. Minnie et al, 2011 **North-west province, South Africa**	Pre-2009	Counseling only *The only outcome*	Qualitative interview of health workers (N = 7)	No	Good	Need for additional training, supervision and mentoring, staff shortage, heavy workload, lack of trust in the testing process and confidentiality issues
29. Sprague et al, 2011 **Eastern Cape, S. Africa**	03/2008-02/2009	Both HTC *As part of PMTCT outcomes*	Qualitative interview of pregnant women (N=83 HIV+ women), care givers (N=32) & health workers (N=38)	No	Good	Staff HIV test supplies shortages, delayed HIV testing, late payment of lay counsellors
30. Medley & Kennedy, 2010 **Central Uganda**	Not Specified	Both HTC *Primary outcome*	Qualitative interview of health workers (N = 30)	No	Good	Shortage of clinic supplies counsellors, and lab personnel; heavy workload; perceived lack of training by and inadequate space for counselling
31. Perez et al, 2004 **Rural, Zimbabwe**	2000	Both HTC (VCT) *As part of PMTCT outcomes*	Qualitative observational of pregnant women (N=3856) & Health workers (N=22)	No	Poor	- 2298 pregnant women had received pretest counselling after 18 months and the acceptance of HIV testing reached 93.0%. - Shortage of human resources and inadequate training program

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
MIXED METHODS STUDIES						
32. An SJ, et al, 2015 **Morogoro, Tanzania**	09-12/2012	Both HIV testing and counseling (HTC) *Primary outcome*	Qualitative, quantitative interviews, and observations of pregnant women (N=203) & health workers (N=65)	Yes *18 Facilities*	Quant: **Fair** Qual: Good	-33% health centers could not undertake HIV testing. Counselling was uneven and remained below 50%. -Limitations in structural inputs**,** such as infrastructure, supplies, and staffing and brief/ incomplete ANC counselling sessions
33. An SJ, et al 2015 **Morogoro, Tanzania**	09-12/2012	Both HTC *Primary outcome*	Qualitative, quantitative interviews, and observations of pregnant women (N=203) & health workers (N=65)	Yes *18 Facilities*	Quant: **Fair** Qual: Good	Confidentiality concerns, long queues, poor consent process and lack of supportive communications
34. Baker et, al 2015 **Rural Tanzania and Uganda**	11/2011-04/2014	Testing only *As part of non-PMTCT outcomes*	Qualitative, quantitative interviews and health facility survey of pregnant women (N=4415) & health workers (N=15)	Yes *122 Facilities*	Quant: **Fair** Qual: Fair	- Tanzania: 65% HIV test effective coverage estimate Uganda: 37% HIV test effective coverage estimate - Poor health facility readiness in both Uganda and Tanzania and test kits shortages in Uganda
35. Balira R, et al, 2015 **Mwanza City, Tanzania**	09/2008-07/2009	Testing Only *As part of non-PMTCT outcomes*	Structured questionnaire & observation of pregnant Women (N=1137) & health workers (N=76)	No	Quant: **Poor** Qual: Good	- 79.4% tested during pregnancy - Long wait times, and lack of training (only 46.7% of ANC facilities staff had received training in HIV testing provision).
36. Kwapong et al, 2014 **Kumasi, Ghana**	08-11/2011	Both HTC *Primary outcome*	Qualitative, quantitative interviews, and focus group discussion of pregnant (N=300) & health workers (N=12)	No	Quant: **Fair** Qual: Good	- 76.0% tested during pregnancy - Lack of information, perceptions of privacy and confidentiality, waiting times and poor relationship with health workers.

Table 1. Characteristics and findings of the articles included in the systematic review

Study ID & Setting	Study Period	HIV Testing and/or Counseling?	Study Methods, Population & Size	Facility Data Assessment	Quality Assessment	Findings
37. Vindigni et al, 2014 **Rural Kenya**	05-06/2010 & 2004-2010	Testing Only *As part of non-PMTCT outcomes*	Ecological analysis & individual interviews of health Workers (N=13)	Yes *13 Facilities*	Quant: **Poor** Qual: Poor	Low staffing of nurses. With additional nurses, health centers were better equipped to provide PMTCT services
38. Phaswana-M et al, 2011 **Rural Eastern Cape, South Africa**	04–07/2007 & 04–07/2008	Both HTC *As part of PMTCT outcomes*	Qualitative, quantitative interviews, and observations pregnant women (N=296, Pre & 239 post) HIV+ women (N=70, pre & 142 post) & Health Workers (N=31)	No	Quant: **Poor** Qual: Fair	- Tested during last pregnancy (43.2% pre & 66.7% – post intervention) and counselled during last pregnancy (73.6% pre & 95.4% – post intervention) - The long waiting periods at the facilities, relatively short length of the counselling sessions remained a serious concern.
39. Ismali & Ali 2009 **Addis Ababa, Ethiopia**	04-05/2008	Counseling only *The only outcome*	Cross-sectional study and observation and interviews of health workers (N = 9)	No	Quant: **Fair** Qual: Fair	Counselors' communicative skill with clients may be considered 'satisfactory' generally but unusually brief, rudimentary and lacked depth and coverage
40. Sarker et al, 2009 **Rural Burkina Faso**	05-06/2007	Both HTC *Primary outcome*	Cross-sectional study, observation and interviews of pregnant women (N = 16) & Health Workers (N = 6)	No	Quant: **Fair** Qual: Fair	- Counseling opt-in very low (7%-29%) and acceptance of testing after PTC was as high as 100% - Gap in internal organization resulted in increased burden to health workers, resource shortage, high work load, poor infrastructure, lack of training and poor supervision and poor interaction with the pregnant women

Table 2. Results of the meta-synthesis of the qualitative studies from the systematic review

Third-order Labels/ Themes	Third-Order Constructs	Second-Order Constructs	Summary Definition	First-Order Constructs	Sources
Lack of Resources	Lack of adequate testing supplies	Insufficient HIV testing kits	Testing kits were not enough, and where available were unreliable.	*"They need advanced equipment [testing equipment] so that there won't be mistake. (Multigravida group)"*	Asiyanbola et al, 2016[37]
	Shortage of ANC staff	Heavy work load, lack of testing personnel	ANC health workers are usually overwhelmed with large number of clients. This leads to long queues and long waiting times which discourages pregnant women from getting tested, or even returning for ANC.	*"Here you work that you forget to eat"... and "Would you believe me if I tell you that I help 17 people during a day?"*	Minnie et al, 2011[38]
	Inadequate infrastructure	Lack of on-site laboratory, lack of space for testing	Some facilities lacked on-site testing facilities. Those with testing facilities had small waiting areas, small rooms, leading to long queues and long waiting times	*"There should be a kind of re-assessment of the laboratories, because at times, they will say you are positive when you are negative, so they should be assessing the laboratories bi-annually so that there won't be error in the result they give out."*	Asiyanbola et al, 2016[37]
				"I am supposed to do individual counselling but because there is not enough space and time, I do it in a group, but if I take the woman to determine if she wants to do the test or if she is willing to do the test now, we are alone"..)."	Minnie et al, 2011[38]

Inadequate Staff Training & Well-Being	Inadequately trained health workers	Poor/ not up to date training of staff in PMTCT	Relatively few staff in majority of these facilities have had training in PMTCT services. Those that have had training have not had up to date training.	*"...counsellors they are also in the need to get some, to be counselled"* *"HIV is changing every day, we need more training"* *"They should employ more trained and qualified personnel and not just anybody"*	Minnie et al, 2011[38] Asiyanbola et al, 2016[37]
	Poor remuneration for health workers	Low salaries and benefits	Health workers are poorly paid and expected to do more work than they can handle. This leads to low morale of the workers which leads to haphazardly done work. This often leads to lack of trust in providers by these women.	*"I provide five counselling sessions per day, and then I stop [because] I have other work to do" (Eastern Cape hospital, October 2008)."* "*When someone is harsh or rude, it can hamper your service - some [staff] are very rude, and do not use good language, so the woman is fearful…she may return home… so the language and behaviour of those providers is very, very, very important (Health official#1)"*	Sprague at al, 2011[39] Gourlay et al, 2014[40]
Lack of or poor quality pre-test counselling	Limited counseling	Omitted counselling, Limited/ shortened counselling sessions,	Lack of pre-test counseling were often noted. When available, counselling sessions were brief and incomplete because of heavy work load of the staff. This led to inadequate information pregnant women needed to make decision about getting tested in some of	*"Interviewer: Before they test, don't they give you any counselling? Participant: They just tell me 'sit there so we can check your health' (IDI, HIV-negative woman#5)"* *"When I went to test I remember the nurse didn't tell me anything....others*	Gourlay et al, 2014[40]

		these facilities. Also, most counseling was done in groups making it impossible for pregnant women to ask questions or be better informed about HIV testing.	*are saying that when you go there to test, the nurse will first give you counselling – she will ask you 'are you ready', but I remember she didn't ask me. I didn't get any counselling. (IDI, HIV-negative woman#6)"*

THE INFLUENCE OF INDIVIDUAL-LEVEL FACTORS ON HIV TESTINGUTILIZATION DURING ANTENATAL CARE IN NIGERIA

by

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ABSTRACT

In sub-Saharan Africa, the use of prevention of HIV transmission from mother-to-child (PMTCT) services, including HIV testing and counseling, increased from 3% in 2003 to 73% in 2014. However, this rate remains low compared to other regions of the world. Nigeria has the second highest number of people living with HIV (PLHIV), but only 30% of HIV-positive pregnant women received PMTCT services in 2014. Yet, mother-to-child transmission (MTCT) of HIV remains high. Individual-level factors influence health service utilization, including HIV testing, the critical first step in PMTCT. Using nationally representative Nigerian Demographic Health Survey (NDHS) data from 2011-2013, we examined the individual-level predictors of HIV testing and counseling utilization during ANC among pregnant women. Utilization was defined as: *ideal* (counseled and tested); *less ideal* (tested but not counseled); *opted-out* (counseled but not tested) and *missed opportunity* (neither counseled nor tested). Individual-level predictors were defined using the Anderson Behavioral Model (ABM), and they include predisposing (socio-demographic and cultural), enabling (socio-economic, knowledge and attitudes) and need (risk perception and health behaviors) factors. A total of 9,695 women aged 15-49 years from the NDHS were included in this analysis. Weighted multinomial logistic regression analysis was used to determine the association between the predictors and HIV testing and counseling outcomes, with *ideal* as the reference category. Younger age (OR:3.32, 95% CI:1.61-6.88), low education (OR:5.53, 95% CI:2.86-10.72) and non-polygyny (OR:0.59, 95% CI:0.40-0.87) were predisposing factors significantly associated with being in the missed opportunity versus ideal

category. Low income (OR:9.78, 95% CI:5.39-17.74), high knowledge of PMTCT (OR:1.58, 95% CI:1.38-1.82), urban residence (OR:0.61, 95% CI:0.45-0.83), high stigmatizing attitudes towards PLHIV (OR:1.26, 95% CI:1.06-1.49), and low spousal education (OR:5.52, 95% CI:3.12-9.77) were enabling factors significantly associated with being in the missed opportunity versus ideal category. Having less than 4 ANC visits (OR:1.86, 95% CI:1.26-2.74) was the only need factor most associated with being in the missed opportunity category versus ideal category. Similar predisposing, enabling and need factors associated with being in the missed opportunity category were also associated with being in the less ideal and opted-out categories. Public health interventions focused on these vulnerable populations may go a long way in increasing HIV counseling and testing rates and reducing MTCT of HIV in Nigeria.

INTRODUCTION

In sub-Saharan Africa (SSA), the use of prevention of HIV transmission from mother-to-child (PMTCT) services, including HIV testing and counseling, increased from 3% in 2003 to 73% in 2014.[7] However, this rate remains low compared to other regions of the world. In Nigeria, the second largest country in the world in terms of the number of people living with HIV (PLHIV), only 30% of HIV-positive pregnant women in Nigeria received PMTCT services in 2014,[7,8] and one study reported that only 54% got tested during antenatal (ANC) between 2008-2013[7]. HIV prevalence was estimated at 4.1% in 2010 using ANC clinic data.[31] Individual-level factors has been shown to influence health service utilization, including HIV testing, the critical first step in the (PMTCT).[1-5] When pregnant women are aware of their HIV-positive status, they can access PMTCT services, notably lifelong antiretroviral therapy supplies that can reduce the rate of HIV transmission to less than 1%.[6] The extension of PMTCT services in Nigeria is crucial to sharply reducing national and global MTCT rates. In 2013, Nigeria had an estimated 190,000 pregnant women[7] and 430,000 children[12] living with HIV/AIDS, including 51,000 children newly infected - among the highest new childhood HIV infection rates in the world.[10,13] Over 90% of these children contracted HIV through MTCT.[10] Without effective interventions, the Ministry of Health estimates that from 67,500-125,000 babies would be infected yearly with HIV in Nigeria.[14]

HIV testing of pregnant women occurred primarily through voluntary counseling and testing (VCT) prior to 2004. However, the inadequacies of this approach led the World Health Organization to start recommending provider-initiated testing and counseling (PITC) for pregnant women during antenatal care (ANC) in low-resource

settings starting in 2004.[7,18] PITC may include both 'opt-out' or 'opt-in' approaches. Studies have shown that the opt-out approach has been significantly more successful in improving the HIV testing rate, compared to the opt-in approach in SSA.[20-23] The overarching goal regardless of the approach is to enable pregnant women to make an informed decision regarding HIV testing following recommendations by the healthcare provider. Pre-test information/ counseling is vital for adequate HIV testing and for guaranteeing effective and ethical PMTCT care efforts.[18] ANC provides an ideal opportunity for sexually active women to receive adequate HIV counseling and testing, and when properly implemented, ANC may serve as an important entry point into the PMTCT cascade of care.[7] However, according to the 2013 Nigeria Demographic and Health Survey (NDHS) and the federal Ministry of Health's National HIV/AIDS and Reproductive Household Survey of 2012, one in three (33.9% and 34.9% respectively) pregnant women did not utilize ANC services in Nigeria.[29-30] This rate varied by geopolitical zone (30% in the North West versus 87% in the South West), wealth status (68% difference between the poorest and the richest), and educational level (52% difference between women with no education and those who had completed secondary or higher).[51]

Research studies have attempted to evaluate the determinants of ANC-HIV testing and counseling by pregnant women in Nigeria. Most studies have been region-specific or hospital-based,[3,26,34,36,52] although two have recently used the nationally representative NDHS data[7,37] Furthermore, most studies have examined only a single endpoint i.e. HIV testing or HIV counseling. Here, using the 2013 NDHS, we extend the approach of analyzing utilization of ANC-HIV testing beyond the question "*did you get tested for*

HIV?", and examined the predictors of HIV counseling and testing using a novel conceptualization of the four possible testing and counseling outcomes: ideal, less ideal, opted-out and missed opportunity.

MATERIALS AND METHODS

Data Source and Study Population

Data from the 2013 NDHS, a cross-sectional and nationally representative survey providing current and retrospective information was utilized for this study. To ensure population and health estimates representative at the national, zonal and state levels, a stratified three-stage cluster sampling design was used to take account of the high geographic diversity of the country, which includes 6 regions (also known as geopolitical zones), 36 states, and the Federal Capital Territory, Abuja. A detailed description of the 2013 NDHS survey design, settings and data collection is provided in the NDHS 2013 report.[29] The NDHS dataset was restricted to only women who gave birth in the last two years of data collection and used ANC in order to minimize recall bias and enhance comparability with previous studies.[25] A total of 38,948 women responded to the 2013 NDHS,[15] 14,220 women gave birth between 2011-1013 and 9,695 women attended ANC at least once during this period, constituting the final sample for this study.

Ethical Considerations

Permission for the use of this data was obtained from the Demographic and Health Surveys Program, and the institutional review board of the University of Alabama at Birmingham.

Study Outcome

The NDHS survey included three different questions pertaining to HIV testing and counseling: whether or not they received pre-test PMTCT counseling (yes/no), were offered HIV testing (yes/no), and were tested for HIV (yes/no). A multinomial outcome variable with four categories based on these responses was generated. Figure 1 outlines the flow of participants based on responses to these questions. Participants who were offered counseling, offered testing, and tested for HIV were classified as *'ideal.'* This is the optimal outcome experienced by every pregnant woman during ANC. Participants who were not offered counseling, but were offered testing and were tested for HIV were classified as *'less ideal.'* Participants who were offered counseling, offered testing but were not tested for HIV were classified as *'opted-out.'* Participants who were not offered counseling, offered testing but were not tested for HIV were grouped into a category labelled *'missed opportunity.'*

Independent Variables

Many conceptual frameworks have been used to explain healthcare utilization, with the Andersen behavioral model (ABM)[38] being among the most widely applied. This model consists of three interrelated sets of factors (predisposing, enabling and need, PEN). This formed the organizing framework for the individual-level factors evaluated in this study. We explored the influence of each PEN category on the multinomial outcome variable to evaluate which are more important for intervention purposes, a particularly salient concern in resource-limited settings. Based on existing literature[1-5], and available NDHS data, we identified PEN factors that may explain the uptake of ANC-HIV testing

in this study population, as summarized and defined in *table 1*. The predisposing factors included demographic, social and cultural factors that may influence ANC-HIV testing including age, and ethnicity, education, marital status, employment, religion and polygyny. The enabling factors represent patients' ability to utilize ANC-HIV testing and include personal and other resources available and include socio-economic such as wealth, place of residence, partner's highest level of education, and whether or not the patients have health insurance; as well as knowledge and attitude factors which include high knowledge of PMTCT, high bargaining power, and a low level of stigmatizing attitudes towards people living with HIV. The need factors include participant health behaviors that may predispose them to higher risk of HIV infection, including lifetime number of sex partners, age at first sexual intercourse, history of sexually transmitted infections), and perception of risk of being infected (knowing someone with AIDS) with HIV. In addition, variables measuring utilization of other health services were included in the analysis such as timing of first antenatal visit and number of antenatal visits.

It should be noted that some of the study variables may be relevant for more than one category of the PEN factor. For example, wealth could be both a predisposing and enabling factor. However, for the purposes of this analysis, variables are assigned to PEN categories based on their most likely association with HIV testing outcomes. We hypothesized that the predisposing (such as educational attainment) and enabling factors (such as wealth) would have more influence on ANC-HIV testing utilization than need factors.

Statistical Analysis

Principal component analysis (PCA) was used to generate composite scores for three enabling factors that utilized multiple questions in the NDHS. These enabling factors are knowledge of PMTCT, stigmatizing attitude towards PLHIV and bargaining power. This approach reduces the number of variables (data/ data dimension) with very little loss of information, and is widely used in studies examining multiple predictors clustered within fewer domains or factors.[53] This has been recommended as a better analytic approach compared with using weighted averages of the original variables. The first PCA component for women's PMTCT knowledge explained 82% of the variance of the 3 measures. For bargaining power, the first component for women's bargaining power explained 66.4% of the variance of the 4 measures. For the stigmatizing attitudes, the first component for women's stigmatizing attitudes explained 31.36% of the variance of the 6 measures, and the second component explaining 22.65% of the variance. Together, these explained 54.0% of the total variability in the data.

Individual weights and cluster and strata information capturing the NDHS sampling design was utilized for all statistical analysis. This approach is recommended by DHS to allow for the adjustment of missing responses to certain questions and make the data more nationally representative of the study population.[39] Descriptive analysis was conducted using survey-weighted statistics to determine the distribution of baseline demographic, socio-cultural, socio-economic, knowledge and attitudes, risk perception, and health behavior factors. Survey-weighted multinomial logistic regression models were generated to determine the relationship between these individual-level factors and ANC-HIV testing utilization. Multinomial logistic regression analysis is used when the

dependent variable, here ANC-HIV testing utilization, is nominal with more than two categories (in this case, four categories). For multinomial logistic regression, the probability distribution of the response is polytomous (m = 1, where m is the number of categories) instead of binomial. For a nominal dependent variable with m = 4 categories, the multinomial regression model estimates 4 – 1 = 3 logit equations. Therefore, a multinomial regression is a multi-equation model. This study followed the simple approach of analyzing multinomial data: selecting one of the response categories as a baseline or reference category, calculating the log-odds for all other categories relative to the reference category. The reference category for this analysis is the *ideal category*. Below is the model that represents the multinomial logistic regression analysis for this study:

$$\text{Log}\ (\pi_i{}^{(M)} / \pi_i{}^{(0)} = \alpha^M + \beta_1{}^M X_{1i} + \beta_2{}^M X_{2i} + \cdots + \beta_k{}^M X_{ki}$$

The log-odds for each non-reference category M (less ideal category, opt-out category, and missed opportunity category), where M = 1,…4-1, against the reference category 0 (ideal category) depends on the values of the independent variables (individual-level factors) using the above equation. For each category (M), $\beta_1{}^M$ $\beta_2{}^M$ and $\beta_k{}^M$ are parameter estimates of the individual-level factors. For all analyses, p values $\leq$ 0.05 were considered statistically significant. All statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS) version 22 (SPSS Inc., Chicago, IL, USA)

RESULTS

Descriptive Statistics

A total of 9,695 women ages 15-49 were included in this analysis. The majority (94.8%) of the women were married or living with a partner, and 25.6% of those were in a polygynous union (Table 3). Only 9.3% had completed at least higher education whereas 31.4% did not have any formal education. Over 23% had partners who did not have any formal education, while 17.8% had partners with a higher education. Two-thirds (67.0%) reported being employed during the study period, compared to 27.4% who were unemployed. Most women were in the highest two wealth quintiles, with 23.9% and 24.6% categorized as part of the *richer* and *richest* quintiles. It is important to note that this is the population of women that attended ANC, and may indeed represent women who could afford care. More women lived in rural than in urban areas (53.2% vs 46.8%), and almost all participants (97.8%) did not have health insurance. Most women (80%) who used ANC made at least 4 visits as recommended by WHO, but 61.7% made their first visit only in the second trimester. Virtually all the women (96.4%) reported that they have not had any STIs in the last 12 months, and 16.8% said they knew someone who has or is suspected to have the AIDS virus. The majority (90.6%) of the study population tested for HIV if they were offered counseling. These study participants were in the *ideal category* of HIV counseling and testing. The detailed descriptive statistics have been presented in table 3 below.

Predisposing Factors

When compared to women with higher education, women with no formal education were more likely to be in the missed opportunity (OR: 4.64, 95% CI: 2.34-9.20), opted-out (OR: 2.78, 95% CI: 1.76-4.38), or less ideal (OR: 2.41, 95% CI: 1.81-3.22) category. Women with only primary level of education were also more likely to be in the opted-out (OR:4.66, 95% CI:3.07-7.07), less ideal (OR: 2.10, 95% CI:1.58-2.80), or missed opportunities (OR: 5.53, 95% CI: 2.86-10.72) category. Younger women (15 - 19 year olds) were over 3 times (OR: 3.32, 95% CI: 1.61-6.88) more likely to be in the missed opportunity category, and almost twice (OR: 1.73, 95% CI: 1.08-2.78) as likely to be in the less ideal category compared with older women (40-49 year olds). Women in non-polygynous relationship versus polygynous were also less likely to be in the opted-out (OR: 0.74, 95% CI: 0.56-0.96), less ideal (OR: 0.69, 95% CI: 0.57-0.85) or missed opportunity category (OR: 0.59, 95% CI: 0.40-0.87).

Enabling Factors

The higher knowledge of PMTCT was associated with being in less ideal (OR:1.25, 95% CI:1.13-1.38) or missed opportunity (OR:1.58, 95% CI:1.38-1.82) groups. In addition, higher HIV stigmatizing attitude was associated with being in the less ideal (OR:1.38, 95% CI:1.22-1.55) or missed opportunity (OR:1.49, 95% CI:1.21-1.83) category, and higher bargaining power was associated with being in the less ideal (OR:1.17, 95% CI:1.07-1.27), or missed opportunity category (OR:1.26, 95% CI:1.06-1.49). When compared with women in the richest quintile, poorer women were more likely to be in the opted-out, less ideal and missed opportunity categories. There was

decreasing odds of being in the missed opportunity category with increasing income (poorest: OR:9.78, 95% CI: 5.39-17.74; poorer OR: 6.86, 95% CI: 4.17-11.28; middle OR: 3.51, 95% CI: 2.14-5.75); richer OR: 1.99, 95% CI: 1.21-3.27). Similarly, women with partners with no formal education were at least five times more likely to be in the missed opportunity category (OR:5.52, 95% CI: 3.12-9.77), so also women whose partners had only completed primary education (OR:3.40, 95% CI: 1.94-5.97) or who had only secondary education (OR:2.06, 95% CI: 1.22-3.47). Urban women were less likely to be in the opted-out (OR:0.71, 95% CI:0.58-0.88), less ideal (OR:0. 60 95% CI:0.51-0.70) and missed opportunities groups (OR:0.61, 95% CI:0.45-0.83) compared to women who live in the rural region.

Need Factors

Pregnant women with less than four ANC visits were more likely to be in the less ideal category (OR:1.82, 95% CI:1.49-2.23) and missed opportunity category (OR:1.86, 95% CI:1.26-2.74), compared to women with more than four ANC visits. Women with a history of STIs in the last 12 months were more likely (OR:1.30, 95% CI:1.06-1.60) to be in the less ideal category than were those with no such history. Women whose age at first sex was less than 15 years were less likely to be in opted-out category (OR:0.19, 95% CI:0.05-0.65), when compared to women whose age at first sex was 25 years or older. Women who said they knew someone with AIDS were less likely to be in the less ideal category (OR:0.67, 95% CI:0.50-0.89).

DISCUSSION

This is the largest study using a large, nationally representative dataset to examine how individual-level factors influence HIV counseling and testing during ANC among Nigerian women. Importantly, by conceptualizing ANC-HIV counseling and testing outcomes simultaneously into ideal, less ideal, opted-out and missed categories, and utilizing the ABM framework to evaluate predisposing, enabling and need factors, this study provides a comprehensive approach to improving understanding of the determinants of low HIV testing and counseling rates among Nigerian women.

Results showed that the likelihood of being in the ideal category increased with wealth status, the women's and partner's educational attainment- the predisposing factors included in analysis. These variables likely increase the likelihood of pregnant women receiving HIV testing by eliminating socio-economic barriers. In contrast, the lower wealth quintiles and low educational attainment for both pregnant women and their partners were more strongly associated with missed opportunities, the least optimal category. Education is a known predictor of HIV testing utilization, with most studies showing higher education to be associated with higher willingness to accept HIV testing and counseling.[40-44] Women in non-polygynous relationships were more likely to be in the ideal group, while women in polygynous relationships were more likely to be in the other three categories. This is consistent with previous studies that showed pregnant women did not think that they were at risk for getting infected with HIV because they were in monogamous relationships with a trusted partner.[40-41]

Enabling factors significantly influenced HIV testing and counseling, with women residing in urban areas more likely to be in the ideal category. This may be due to the

higher education and income characteristic observed in urban women in Nigeria compared with rural areas. Furthermore, Nigerian women with more knowledge of PMTCT were more likely to be offered testing without counseling (less ideal category), and to be in the missed opportunity category where they are not tested for HIV. Previous study[7] have shown that higher knowledge of PMTCT improved HIV testing outcomes, which is not consistent with our findings. This could be because our knowledge of PMTCT was a composite score. Similarly, women with more bargaining power were more likely to be in the less ideal and missed opportunity categories. However, as expected from previous study[45], women who held more stigmatizing attitudes towards PLHIV were more likely to fall in the three less than ideal categories (opted-out, less ideal and missed opportunities).

Significant associations were also observed with need factors. For instance, women who had at least 4 ANC visits (as recommended by the WHO) were more likely to be in the ideal category versus in the less ideal or missed opportunity categories, and women with no history of STIs were more likely to be in the ideal category versus in the less ideal category. In addition, women who knew someone with AIDS were more likely to be in the ideal category. These observations were consistent with other work showing that knowing someone who was HIV-positive is predictive of greater willingness to get tested for HIV testing during pregnancy.[45] Other studies have found that when perceived susceptibility to HIV is high, pregnant women are more willing to get tested for HIV,[46-48] and that the number of ANC visits a pregnant woman has received is related to HIV testing uptake.[2,34]

Marital and employment status were predisposing factors that did not have statistically significant associations with HIV testing and counseling in this analysis, but these factors have been shown in other studies to correlate with HIV testing uptake. Fabiani et al.,[43] found that women who responded to being married had lower uptake of HIV testing, whereas Matovu et al.,[49] found HIV testing and counseling acceptance to be higher among married women. However, most survey respondents in this study (94.8%) were married, and the marital status variable accounted for women who were not married either because they were divorced or widowed, by listing them as separate categories during analysis. Most studies that have shown significant association have only asked if the women were married or not. The type of employment could more important than whether one is actually employed. For example, in Northwestern Ethiopia, the occupational status of women was shown to be predictive of willingness to accept HIV testing and counseling.[49,50] Among the need factors, neither the timing of first ANC visit nor the number of lifetime sexual partners were statistically significant, but this may not be surprising given the goal that every pregnant woman who showed up for ANC should be offered testing regardless of the timing of her first visit. Also, women might have responded to the number of lifetime sexual partners the way they felt would be socially acceptable.

The unique analytic approach in this study provides a comprehensive assessment of the complex set of factors that influence HIV testing and counseling in a resource limited setting. Nearly all other studies to date of the individual-level characteristics that influence the utilization of ANC-HIV testing in Nigeria have been region-specific or hospital-based.[3,26,34,36] One study has also utilized DHS data,[7] but only assessed

individual-level factors that were selected a priori without a particular conceptual framework and did not analyze HIV testing utilization using the multinomial approach adopted here. Another study which used nationally representative data,[37] did not focus on HIV testing as part of ANC, but examined the determinants of HIV testing among couples. [37] Second, the use of the standardized, nationally representative NDHS data enables us to minimize bias since the survey was designed to sample from all socio-demographic groups and all regions of the country. Misclassification was also minimized since the NDHS is implemented by highly trained healthcare professionals residing in the local communities. This study also has several limitations that should be noted. Firstly, study outcomes were based on self-reported data, potentially susceptible to social desirability or recall bias. Secondly, the number of women who were positive when tested for HIV could not be determined. However, these limitations are also offset by a number of strengths of the study. Third, there may be other culture-specific factors that may influence HIV counseling and testing that could not be assessed here. Future in-depth qualitative studies may be needed to better identify these factors. Lastly, we excluded women who were not offered testing in this analysis. Compared to women who were offered testing ($p<0.000$), women who were not offered were more likely to be married (96.1% vs 94%), in the youngest age category (8.5% vs 5.5%), and in a polygynous union (32.2% vs 20.2%). They were also less likely to be employed at the time of interview (65.5% vs 68.1%) and be in the category of those with the highest level of education (1.8% vs 14.2%). Further analysis is required to determine why these women were not offered testing, including whether or not some of these women attended ANC with prior knowledge of their HIV status.

Improved understanding of the relative importance of how PEN factors influence HIV testing utilization during ANC visits could offer valuable guidance on how to better develop programs and policies for implementing HIV testing during ANC in Nigeria and elsewhere. This study suggests that interventions to improve ANC-HIV testing should first target women who are very young, poor, less educated and with partners who are less educated, live in rural areas, in a polygyny relationship, and who have high stigmatizing attitudes towards PLHIV. More research is needed on how to implement an intervention to address these limiting individual-level factors. A higher level of HIV testing of pregnant women in Nigeria will further advance the utilization of PMTCT programs which is crucial to the eradication of MTCT of HIV, both within the country and globally.

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FIGURES & TABLES

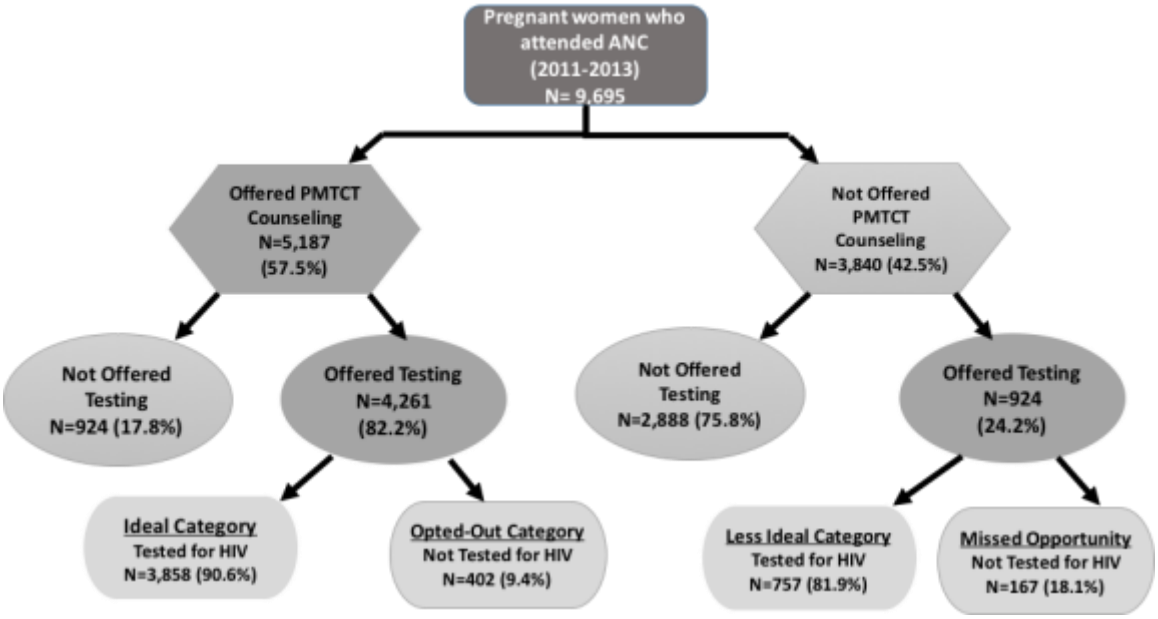

Figure 1. The Polytomous ANC-HIV Testing Responses Generated Using the Multinomial Approach

Table 1. The individual-level factors selected as predictors and their corresponding PEN category

		Variables	Definition & Measurement
Predisposing Factors	Demographic	Age	Age in 5-years gap at the time of survey: 15-19, 20-24, 25-29, 30-24, 35-39 & 40-49 years
		Ethnicity	Hausa/Fulani, Igbo, Yoruba, and other minority groups categorized as 'others'
	Social	Education	Highest education level attained: none, primary, secondary and higher
		Marital Status	Current marital status: never married, married/ living together, widowed, divorced/separated/no longer living together
		Employment	Employed in the last 12 months: no, currently working, in the past year/ on leave in the last 7 days
	Cultural	Religion	Catholic, other Christians, and Islam
		Polygyny	Number of other wives by partner: none, at least one
Enabling Factors	Knowledge & Attitudes	Knowledge of PMTCT	High knowledge of PMTCT factor score
		Bargaining Power	High bargaining power factor score
		Stigma Attitude	Low stigmatizing attitude against PLHIV factor score
	Socio-Economic	Wealth	Household wealth status; poorest, poorer, middle, richer and richest
		Residence	Place of residence: Urban, rural
		Partner's education	Partner's highest level of educational attained: none, primary, secondary and higher
		Health insurance	Covered by of health insurance: no, yes
Need Factors	Risk Perception	Knows someone with AIDS	Knowledge of someone who has or is suspected to have the AIDS virus
	Health Behaviors	Number of lifetime partners	Number of lifetime sex partners a woman has had
		Age at first intercourse	Age at first sexual intercourse
		History of STDs	History of STIs in the last 12 months preceding the survey: no or yes
		Timing of first ANC visit	If first, second or third trimester
		Number of ANC visits	If less than or more than four visits

Table 2. Results of Principal Component Analysis for Knowledge of PMTCT, Bargaining Power and HIV Stigma Attitudes

Variable	Component Matrix	Mean (SD)	Communalities
Knowledge of PMTCT			
AIDS virus can be transmitted during pregnancy[1]	0.92	1.23, 1.96	0.82
AIDS virus can be transmitted during delivery[1]	0.90	1.31, 2.01	0.85
AIDS virus can be transmitted during breastfeeding[1]	0.90	1.29, 1.78	0.82
Eigenvalue of the first component = 2.58			
Proportion of variance explained by the first component = 82.73%			
Kaiser-Meyer-Olkin MSA = 0.75			
Bartlett's Test of Sphericity p-value = <0.001			
Bargaining Power			
Final say on own health care[2]	0.88	3.08, 1.09	0.78
Final say on making large purchases on the household[2]	0.88	3.11, 1.08	0.77
Final say on visits to families or relatives[2]	0.65	3.38, 1.04	0.42
Final say on what to do with the husband's salary[2]	0.83	2.86, 1.12	0.69
Eigenvalue of the first component = 2.65			
Proportion of variance explained by the first component = 66.35%			
Kaiser-Meyer-Olkin MSA = 0.78			
Bartlett's Test of Sphericity p-value = <0.001			
HIV Stigma Attitude			
Would want HIV infection in family to remain secret[3]	0.42	0.80, 1.19	0.37
Willing to care for relative with AIDS[3]	0.47	1.07, 1.58	0.37
A female teacher infected, but is not sick, should be allowed to continue teaching[3]	0.44	0.92, 1.51	0.42
	0.32	0.69, 1.24	0.41
Would buy vegetables from vendor with HIV[3]	0.77	0.68, 1.31	0.84
People with HIV should be ashamed of themselves[3]	0.78	0.73, 1.37	0.83
People with HIV should be blamed for bringing disease to community[3]			
Eigenvalue of the first component = 1.88			
Proportion of variance explained by the first component = 31.36%			
Kaiser-Meyer-Olkin MSA = 0.56			
Bartlett's Test of Sphericity p-value = <0.001			

[1]Questions on Knowledge of PMTCT in the DHS dataset
[2]Questions on Bargaining Power in the DHS dataset
[3]Questions on Bargaining Power in the DHS dataset

Table 3. Descriptive Statistics of the Individual-Level Factors using the Anderson Behavioral Model, NDHS 2013

Predisposing Factors	N (%)	Enabling Factors	N (%)/ Mean SD	Need Factors	N (%)
Age (Years)		**Wealth Category**		**No of ANC Visits**	
15-19	650 (6.7)	Poorest	1,123 (11.6)	Less than four	1859 (19.9)
20-24	2128 (22.0)	Poorer	1,787 (18.4)	More than four	7470 (80.1)
25-29	2776 (28.6)	Middle	2,074 (21.4)	**Timing of ANC Visit**	
30-34	2070 (21.3)	Richer	2,322 (23.9)	First Trimester	2555 (26.6)
35-39	1384 (14.3)	Richest	2,388 (24.6)	Second Trimester	5928 (61.7)
40-49	687 (7.1)	**Partner's Education**		Third Trimester	1125 (11.7)
Marital status		No Education	2,170 (23.1)	**Knows one w AIDS**	
Never married	267 (2.8)	Primary	1,939 (20.7)	No	7582 (83.2)
Married/ With Partner	9193 (94.8)	Secondary	3,565 (38.0)	Yes	1536 (16.8)
Widow	91 (0.9)	Higher	1666 (17.8)	**Lifetime Sex Partners**	
Divorced/ Separated	144 (1.5)	**Residence**		1 Partner	6513 (67.3)
Polygyny		Urban	4,534 (46.8)	2 Partners	2090 (21.6)
No other wife	6801 (74.6)	Rural	5,161 (53.2)	3-5 Partners	988 (10.2)
More than one wife	2316 (25.4)	**Health Insurance**		6-9 Partners	53 (0.5)
Ethnicity		No	9454 (2.2)	≥ 10 (+ don't know)	30 (0.3)
Hausa/ Fulani	2952 (30.4)	Yes	211(97.8)	**Age at First Sex**	
Igbo	1542 (15.9)	**Knowledge of PMTCT**		9-14 years	1843 (19.1)
Yoruba	1621 (16.7)	Composite Score	1.23 (1.96)	15-18 years	4399 (45.5)
Others	3581 (36.9)	**Bargaining Power**		19-25 years	2486 (25.7)
Religion		Composite Score	3.08 (1.09)	26-38 years	311 (3.2)
Catholic	1038 (10.8)	**Low Stigma Attitude**		Others	633 (6.5)
Other Christian	3551 (37.0)	Composite Score	0.80 (1.19)	**STI (last 12 months)**	
Islam	4999 (52.1)			No	9187 (96.4)
Highest Education Level				Yes	334 (3.5)
No Education	3042 (31.4)			Don't Know	13 (0.1)
Primary	2148 (22.2)				
Secondary	3599 (37.1)				
Higher	906 (9.3)				
Employment 12 Months					
No	2658 (27.4)				
Currently working	6500 (67.0)				
Worked past yr/ 7 days	527 (5.4)				

Table 4. Result of the Multinomial Logistic Regression Analysis of the PEN Factors on ANC-HIV Testing Utilization

	Opted-Out*	Less Ideal*	Missed Opportunity*
Predisposing Factors			
Age (Years)			
15-19	1.49 (0.86-2.58)	**1.73 (1.08-2.78)**	**3.32 (1.61-6.88)**
20-24	0.83 (0.52-1.24)	1.30 (0.90-1.88)	1.19 (0.62-2.30)
25-29	0.79 (0.52-1.19)	1.17 (0.82-1.67)	0.59 (0.30-1.15)
30-34	0.76 (0.49-1.16)	0.94 (0.65-1.36)	0.65 (0.33-1.28)
35-39	0.67 (0.42-1.06)	1.14 (0.78-1.66)	0.86 (0.43-1.73)
40-49	Ref	Ref	Ref
Marital Status			
Never	1.47 (0.64-3.40)	0.95 (0.42-2.13)	1.58 (0.49-5.09)
Married/ Living with a partner	0.75 (0.37-1.53)	1.20 (0.63-2.30)	0.67 (0.24-1.84)
Widowed	1.60 (0.56-4.53)	1.84 (0.73-4.65)	0.39 (0.04-3.97)
Divorced/ Separated	Ref	Ref	Ref
Polygyny			
Only one wife	**0.74 (0.56-0.96)**	**0.69 (0.57-0.85)**	**0.59 (0.40-0.87)**
More than 1 wife	Ref	Ref	Ref
Ethnicity			
Fulani/ Hausa	1.00 (0.73-1.37)	1.05 (0.86-1.29)	1.06 (0.69-1.63)
Igbo	1.11 (0.83-1.50)	1.09 (0.89-1.32)	1.06 (0.70-1.61)
Yoruba	**1.79 (1.38-2.32)**	**0.33 (0.25-0.44)**	0.86 (0.56-1.32)
Other Minorities	Ref	Ref	Ref
Religion			
Catholic	**0.67 (0.47-0.95)**	1.10 (0.87-1.38)	0.66 (0.41-1.08)
Other Christian	1.00 (0.80-1.25)	0.97 (0.82-1.15)	**0.69 (0.50-0.97)**
Islam	Ref	Ref	Ref
Education			
No Education	**2.78 (1.76-4.38)**	**2.41 (1.81-3.22)**	**4.64 (2.34-9.20)**
Primary	**4.66 (3.07-7.07)**	**2.10 (1.58-2.80)**	**5.53 (2.86-10.72)**
Secondary	**2.32 (1.55-3.47)**	**1.56 (1.21-2.02)**	**2.06 (1.07-3.97)**
Higher Education	Ref	Ref	Ref
Employed			
Not employed	1.20 (0.59-2.46)	1.32 (0.54-3.23)	1.03 (0.48-2.22)
Currently Employed	1.22 (0.62-2.40)	1.71 (0.74-4.00)	0.93 (0.45-1.93)
Employed last wk/ last year	Ref	Ref	Ref
Enabling Factors			
Knowledge of PMTCT (Index Score*)*	1.05 (0.89-1.23)	**1.25 (1.13-1.38)**	**1.58 (1.38-1.82)**
Bargaining Power (Index Score)	0.99 (0.89-1.11)	**1.17 (1.07-1.27)**	**1.26 (1.06-1.49)**
HIV Stigma Attitude (Index Score)	**1.24 (1.11-1.38)**	**1.12 (1.03-1.25)**	**1.42(1.24-1.61)**
Health Insurance (Yes, No)	**0.17 (0.05-0.53)**	0.70 (0.45-1.10)	0.33 (0.09-1.18)
Residence			
Urban	**0.71 (0.58-0.88)**	**0.60 (0.51-0.70)**	**0.61 (0.45-0.83)**
Rural	Ref	Ref	Ref
Partner's Education			
No Education	**3.04 (2.06-4.49)**	**2.30 (1.76-3.02)**	**5.52 (3.12-9.77)**
Primary	**3.10 (2.20-4.38)**	**1.63 (1.27-2.10)**	**3.40 (1.94-5.97)**
Secondary	**1.90 (1.39-2.61)**	**1.40 (1.14-1.73)**	**2.06 (1.22-3.47)**
Higher	Ref	Ref	Ref
Wealth			
Poorest	**2.42 (1.47-3.99)**	**3.22 (2.27-4.57)**	**9.78 (5.39-17.74)**
Poorer	**2.16 (1.53-3.07)**	**2.46 (1.91-3.17)**	**6.86 (4.17-11.28)**
Middle	**1.95 (1.46-2.61)**	**1.96 (1.58-2.44)**	**3.51 (2.14-5.75)**
Richer	**1.64 (1.26-2.14)**	**1.36 (1.11-1.67)**	**1.99 (1.21-3.27)**
Richest	Ref	Ref	Ref
Need Factors			
Any STI last 12 months (Yes, No)	0.80 (0.47-1.34)	**1.30 (1.06-1.60)**	1.22 (0.82-1.81)
Number of Lifetime Sexual Partners	1.00 (0.99-1.02)	1.01 (1.0-1.03)	0.99 (0.91-1.06)
Knows Someone with AIDS (Yes, No)	**0.67 (0.50-0.89)**	1.03 (0.84-1.25)	0.70 (0.45-1.09)

Table 4. Result of the Multinomial Logistic Regression Analysis of the PEN Factors on ANC-HIV Testing Utilization

Age at First Sex			
< 15 Years	**0.19 (0.05-0.65)**	0.31 (0.08-1.20)	0.39 (0.11-1.44)
15-18 Years	0.32 (0.10-1.01)	0.44 (0.12-1.62)	0.51 (0.14-1.83)
19-25 Years	0.46 (0.14-1.58)	0.46 (0.12-1.74)	0.58 (0.16-2.07)
>25 years	Ref	Ref	Ref
Number of ANC Visits			
Less than 4 visits	1.09 (0.81-1.48)	**1.82 (1.49-2.23)**	**1.86 (1.26-2.74)**
4 or more visits	Ref	Ref	Ref
Timing of First ANC			
1st Trimester	0.98 (0.67-1.42)	0.94 (0.70-1.25)	0.62 (0.34-1.12)
2nd Trimester	0.85 (0.60-1.22)	0.85 (0.65-1.12)	0.98 (0.58-1.65)
3rd Trimester	Ref	Ref	Ref

*With referenced to the Ideal Category. ORs and 95% CI reported for each category. **Bold indicate statistically significant ORs at p-value mostly < 0.001**

INFLUENCE OF INSTITUTIONAL-LEVEL FACTORS ON PROVISION & UTILIZATION OF HIV TESTING & COUNSELING DURING ANTENATAL CARE IN NIGERIA

by

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ABSTRACT

Nigeria has one of the world's highest new HIV infection rates among children, with about 51,000 children newly infected in 2013. HIV testing and counseling during pregnancy is a critical first step in prevention of mother-to-child transmission (PMTCT), as this ensures access to PMTCT services, including lifelong antiretroviral therapy that can reduce mother-to-child transmission to less than 1%. The Nigerian health system is decentralized into three tiers – the federal, state and local government, but uneven levels of commitment towards the various programs and policies administered by the National Agency for the Control of AIDS (NACA) at all three tiers may lead to differences in service quality. This study examines how institutional-level factors, such as type of ANC facility (private, public or non-health) and type of provider (doctors, nurses/ midwives or other providers), influence the provision and utilization of HIV testing and counseling during ANC. Data from the 2013 Nigeria Demographic and Health Survey (n=9,695 women aged 15-49 years) were utilized in this study. Weighted chi-square tests, initial and adjusted multivariate logistic regression methods were used to assess the relationship between the outcomes and predictors. In bivariate analyses, the highest HIV testing and counseling rates were observed among women using private health facilities for ANC and treated by a doctor. In the multivariate analyses, there were no statistically significant differences in the utilization of HIV testing and counseling between doctors and nurse/midwife. However, women who saw other providers (who were not doctors or nurses/midwives) were significantly less likely to report being offered PMTCT counseling (AOR:0.60, CI:0.50-0.72), offered HIV testing (AOR:0.47, CI:0.39-0.57) and

tested for HIV (AOR:0.45, CI:0.37-0.55). Women who used private versus public facilities were less likely to be offered counseling (AOR:0.82, CI:0.72-0.92), offered testing (AOR:0.79, CI:0.69-0.90) and tested (AOR:0.79, CI:0.70-0.90) after adjusting for other factors. Likewise, but to a greater extent, women who used non-health facilities versus public facilities were less likely to be offered counseling (AOR:0.39, CI:0.30-0.50), offered testing (AOR:0.25, CI:0.19-0.32), and tested (AOR:0.27, CI:0.19-0.32). These findings suggest that PMTCT training should first target lesser-skilled ANC providers and those who work in homes or other non-health facility settings to further improve HIV testing and health outcomes in Nigeria.

INTRODUCTION

Most of the 110,000-150,000 new childhood HIV infections in 2015 occurred in sub-Saharan Africa (SSA), primarily through mother-to-child transmission (MTCT).[1,2] Nigeria has one of the highest new infection rates among children in the world, with an estimated 51,000 infections in 2013.[3,4] Overall, an estimated 60% of new HIV infections in western and central Africa in 2015 occurred in Nigeria.[37] In 2016, the United Nations program on HIV/AIDS (UNAIDS) and other organizations launched a new initiative to reduce the number of new HIV infections among children worldwide to less than 40,000 by 2018 and less than 20,000 by 2020.[1] Effective prevention of MTCT (PMTCT) interventions can reduce HIV transmission risk to less than 1% if an HIV-positive woman follows the antiretroviral therapy (ART) as recommended throughout pregnancy, labor, and delivery (including putting her baby on the ART for 4-6 weeks).[1,38] Testing for HIV in pregnant women is a critical first step in PMTCT. When pregnant women know their HIV status, they are able to access other important PMTCT services, including. lifelong antiretroviral therapy that can reduce HIV transmission.

The World Health Organization (WHO) began recommending provider-initiated testing and counseling (PITC) for pregnant women during antenatal care (ANC) in low-resource settings in 2004.[7,18] PITC may include both 'opt-out' or 'opt-in' approaches. Studies worldwide, including in SSA countries, have shown that the opt-out approach is significantly more successful in improving the HIV testing rate, compared to the opt-in approach.[20-23] The Nigeria Federal Ministry of Health (FMOH) recognized the opt-out approach to HIV testing of pregnant women as the preferred testing method in the 2010 national PMTCT guideline.[4] The PMTCT National Task Team (NTT) is tasked with not

only developing the guidelines, but also implementing them across the country.[4] The majority of the PMTCT programs are health facility based, therefore, the extent to which this approach is being implemented during ANC across facilities in the country is not clear.

ANC provides an opportunity for sexually active women to receive adequate HIV counseling and to be tested for the virus. A positive HIV test becomes the important entry point into the rest of the PMTCT services that are offered as part of the cascade of care.[14] An estimated 4.1% of pregnant women (using antenatal care data) were HIV-positive in 2010. The 2013 Nigeria Demographic and Health Survey (NDHS) showed that 39% of pregnant women did not received ANC services from a skilled ANC provider (classified by the NDHS as "a doctor, nurse or midwife, or auxiliary nurse or midwife"), and almost half (49.0%) had less than the recommended four or more ANC visits during the pregnancy.[15] This rate varied by geopolitical zone with only 30% of ANC utilization among pregnant women in the North West compared to 87% in the South West. Poor, and less educated women as also less likely to use ANC.[33]

The Nigerian health system is decentralized into three tiers – the federal, state and local government.[7] At the federal level, health services are provided through tertiary hospitals,[8] including federal medical centers, teaching hospitals and specialty hospitals.[9,10] The state ministries of health (SMOH) are responsible for the proper functioning of secondary (general) hospitals.[7] The local governments are responsible for primary health care management with support from the SMOH and private medical practitioners.[10] Based on the 2011 FMOH health facilities census, there were 34,173 health facilities in Nigeria,[11] with 30,098 (88.1%) primary health care facilities, 3,992

(11.7%) secondary facilities and 83 (0.2%) tertiary facilites.[4,11] Approximately 38% of all facilities were classified as private[4] and more than 60% are government owned (public).[11] The majority of pregnant women use public facilities for their ANC, and subsequently for delivery likely due to that fact that public facilities are cheaper and more readily available than private facilities.[34]

The first national PMTCT guideline in Nigeria was created in 2001[4] and was first instituted in tertiary institutions, and rolled out to secondary hospitals and later primary health centers.[4] However, the organization of health care services is hindered in practice by the duplication of roles and responsibilities among the different tiers,[7] uneven level of commitment towards the various health programs and national policies across regions, leading to differences in quality of service and resources across regions.[12] Considering the decentralization of the health system of Nigeria, the tendencies of uneven level of commitment towards various health programs like HIV testing during ANC cannot be discounted. Studies conducted elsewhere, including in Northern Vietnam,[31] indicate that women tested at a lower level ANC facility were more likely to have received HIV counseling, with ANC nurses who work at primary level ANC facilities better equipped to promote HIV testing. One nationally representative study assessed quality of ANC in Nigeria, and found that public and private health facilities are more likely to offer better quality of ANC than homes or any other type of facility.[34]

Institutional-level factors could influence whether or not a pregnant woman would be offered HIV counseling and/ or testing in the first place.[20-23] Pre-test information/ counseling is vital for adequate HIV testing and for guaranteeing effective PMTCT care efforts.[18] Accordingly, in addition to HIV testing utilization, it is important to examine

whether or not pregnant women in Nigeria are offered pre-test counseling on PMTCT as well as HIV testing during ANC in the first place. To the best of our knowledge, this is the first nationally representative study to do so. Gunn et al., 2016[14] also used the 2013 NDHS to assess HIV testing utilization in four SSA countries (including Nigeria), but did not assess whether or not pregnant women were offered counseling and/ or testing in the first place. The only institutional-level factor assessed in their study was whether or not the ANC provider was skilled or un-skilled.[14] This study examines how multiple institutional-level factors (beyond the skill of the ANC provider) influence the provision and utilization of HIV testing and counseling during ANC in Nigeria.

MATERIALS AND METHODS

Data Source and Study Population

This study uses the nationally representative 2013 NDHS, a large, cross-sectional survey providing current and retrospective information on multiple health issues. The NDHS used a stratified three-stage cluster sampling to take account of the high geographic diversity of the country, which includes 6 regions (also known as geopolitical zones), 36 states, and the Federal Capital Territory, Abuja. The primary sampling unit, referred to as a cluster in the 2013 NDHS, was defined on the basis of enumeration areas (EAs) using the 2006 EA census frame. A detailed description of the 2013 NDHS survey design, settings and data collection is provided in the NDHS 2013 report.[15] Although this dataset contains information for some variables over the previous 5-year period, sample selection for this study was restricted to only women who gave birth in the last 2 years of data collection (February 2011-June 2013), and attended ANC. Restricting the sample

selection to women who gave birth in the last 2 years minimizes recall bias and is compatible with previous related studies.[25] A total of 38,948 women responded to the 2013 NDHS[15] and 14,220 gave birth between 2011-1013, 9,695 of whom attended ANC at least once during this period and who constitute our study sample.

Ethical Considerations

Permission for the use of this data was obtained from the Demographic and Health Surveys (DHS) Program, and the institutional review board (IRB) of the University of Alabama at Birmingham.

Study Outcomes

Respondents were asked three questions pertaining to HIV testing and counseling: if they received pre-test PMTCT counseling (yes/no), were offered HIV testing (yes/no), and were tested for HIV (yes/no). For counseling, pregnant women were asked if someone *talked to them about: (a) babies getting the AIDS virus from their mother, (b) preventing the virus, and (c) getting tested for the virus.* A binary variable for complete pre-test PMTCT counseling was generated; '1' if the respondent answered 'yes' to all of these 3 questions and "0" otherwise.

Independent Variables

Institutional-level factors were generated based on the two available predictors: 'type of ANC facility' and the 'type of ANC provider.' There were also nine 'type of provider by facility' factors based on these two variables. Types of ANC facilities

assessed were: *public sector* (government hospital, government health center, government health post/ dispensary, and other public sector), *private sector* (private hospital/ clinic, and non-health (this includes own home, other home, and other, representing facilities outside of the range of standard health care). Type of ANC provider was assessed using the DHS categorization for *doctor, nurse/midwife* and other providers (nurse auxiliary, traditional birth attendant, village health worker, community extension health worker, and others). Some of the women saw more than one provider during ANC, but the highest skilled provider was selected as the main provider during analysis. For example, for women who saw both doctors and nurses, only doctors were selected as main providers. A third variable representing provider type by facility group was categorized as: Doctor (Private), Doctor (Public), Doctor (Non-health), Nurse/ Midwife (Private), Nurse/ Midwife(Public), Nurse/ Midwife (Non-health), Other Providers (Private), Other Providers (Public), and Other Providers (Non-health). The study hypothesizes that pregnant women attending ANC in public facilities, and those seen by a doctor are more likely to be offered counseling, offered testing, and be tested for HIV.

Study Covariates

Variables that may also influence the association between facility type and provider type in relation to HIV testing utilization were also included in analysis as potential confounders. These include: sociodemographic factors (age, ethnicity, education, marital status and employment), perceived need (parity and number of ANC visits), physical accessibility (residence, geographical location and distance to health

service) and economic accessibility (wealth and health insurance). Study variables are summarized in Table 1.

Statistical Analysis

Weighted descriptive statistics were generated to evaluate the distribution of study variables. The DHS recommends use of individual weights, strata and cluster information to adjust missing responses to and ensure the generalizability of more nationally representative,[15] therefore weights were applied in all statistical models. The relationships between the institutional-level factors and the 3 binary outcomes were assessed using initial (Model 1) and adjusted (Model 2) logistic regression. The initial model contains the institutional-level factor (type of facility and type of provider) and sociodemographic (SD) variables. Model 2 was fully adjusted and additionally included perceived need, physical accessibility and economic accessibility variables. For all analyses, p values ≤ 0.05 were considered statistically significant. All statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS) version 22 (SPSS Inc., Chicago, IL, USA).

RESULTS

Descriptive statistics

A total of 9,695 women aged 15-49 years were included in this analysis (Table 1). The majority (94.8%) were married or living with a partner. Only 9.3% had higher formal education (equivalent of a college degree), and 31.4% did not have any education at all. Two-thirds (67.0%) reported being employed during the past 2 years,

and 24% and 25% of women, respectively, were in the highest two wealth quintiles. More women lived in the rural areas than in the urban (53.2% vs 46.8%), and 1 in 4 (25.2%) lived in the north west geographical zone. Almost all participants (97.8%) did not have health insurance. Most women had between 2–4 children (multiparous – 46.9%). The majority of the women (80%) who used ANC made at least 4 visits as recommended by the WHO, and the majority used a public ANC facility for care (74.5%), and saw a nurse/ midwife (58.6%). For the majority of the participants (77.5%), distance was not a barrier to accessing health care when medical help was needed. The detailed descriptive statistics are presented in Tables 2 and 3 below.

Even though the majority of the women used public ANC facilities (74.5%), women were more likely to be offered counseling (66.4%), offered testing (69.8%) and be tested (62.3%) if they used a private facility ($p<0.001$). Similarly, although the majority of women saw a nurse/midwife (71.2%), they were slightly more likely to be offered counseling (62.1%), offered testing (65.6%) and be tested (61.0%) if they saw a doctor ($p<0.001$). With the exception of doctors in other facilities (91.7% offered counseling), highest HIV testing and counseling rates were observed among doctors in private facilities - 75.7% offered testing and 70.4% of the women got tested ($p<0.001$). Younger women, married women and those who reported barriers to accessing a healthcare facility were less likely to be offered counseling, offered testing and be tested compared to older women (Table 2). However, women who had health insurance as well as those who resided in urban areas, were more likely to be offered counseling, offered testing and be tested compared to those who lacked health insurance or who lived in rural

areas. HIV counseling and testing also increased with higher levels of wealth and of educational attainment (Table 3).

In the initial model (adjusted for sociodemographic factors) of the multivariate logistic regression analysis, women who received ANC in non-health facilities settings were 52% less likely to be offered counseling (OR:0.48, 95% CI:0.38-0.60), 70% less likely to be offered testing (OR:0.30, 95% CI:0.24-0.39), and 68% (OR:0.32, 95%CI:0.25-0.42) less likely to get tested for HIV compared with women who used public facilities (Table 4). In the fully adjusted model (model 2), attending non-health facilities remained significantly associated with less HIV counseling and testing. Additionally, in the initial model, there were no statistically significant differences between those who received ANC at private and public facilities. We examined the sociodemographic factors of the women who attended the three types of facilities and we found that they differ by level of education, with 34% of women attending private facilities more likely to have higher education compared to 5.5% of women with no education ($p<0.001$). In addition, younger women (15-19 years) were less likely to use private ANC facilities (12.2%) compared to 23.1% of older women ($p<0.001$). In the fully adjusted model, women attending private ANC facilities were approximately 23% less likely to be offered counseling (OR:0.82, 95%CI:0.72-0.92), 21% less likely to be offered testing and be tested for HIV - (OR:0.79, 95%CI:0.69-0.90) and (0.79, 95%0.70-0.90) respectively compared with women attending public facilities.

In the initial model evaluating provider type in relation to HIV counseling and testing, women who saw other ANC providers (others less skilled than doctors and nurses/ midwives) were 44% less likely to be offered counseling (OR:0.56, CI:0.47-0.66),

55% less likely to be offered testing (OR:0.45, CI:0.37-0.54), and 58% (0.42, 0.35-0.50) less likely to get tested for HIV when compared to those who saw a doctor. This association remained significant in the fully adjusted model. In subgroup analysis examining the odds of being tested for HIV if women were offered both testing and counseling vs. only offered testing but not counseling (data not shown), women were at least twice as likely to test for HIV if they were offered both counseling and testing than if they were offered only testing and not counseling (OR: 2.11, CI:1.73-2.56).

DISCUSSION

This study used nationally representative NDHS data to analyze the influence of institutional-level factors, specifically facility type and provider type, on being HIV testing and counseling outcomes among almost 10,000 women who attended ANC and gave birth between 2011-2013. Most women accessed ANC services at public facilities (74.5%) and saw a nurse/ midwife (71.2%). In Nigeria, the public health sector is larger than the private health sector and employs majority of the health workers.[4] Even though the majority of the study participants saw a nurse and used a public facility, they were more likely to be offered HIV testing, offered PMTCT counseling, and tested for HIV if they saw a doctor and used a private facility. In one study that systematically reviewed implications of PITC among nurses in SSA, it found that nurses are generally enthusiastic about PITC but they believe it increases their workload and induces work related stress.[39] This sometimes make it impossible for nurses to provide HIV counseling and testing to all the pregnant women they see. However, it should be noted that after adjusting for sociodemographic factors, there were no statistically significant differences in the

outcomes if women received ANC at private vs public facility. This suggests that sociodemographic factors influence where the women seek care, which in-turn influence HIV counseling and testing. This is similar to a study that analyzed the acceptability and feasibility of HIV testing and counseling in Zambia ANC clinics. It was found that while public facilities offer increased accessibility (cheaper and more affordable), using private facilities may offer increased confidentiality and are preferred by those who can afford it.[41]

In addition, although there was no significant difference in HIV counseling and testing among women seeing a doctor vs. nurse/midwife, rates were significantly lower when women attended non-health facilities and were seen by non-professional healthcare providers. These findings are in line with a previous study which observed similar findings when looking at HIV testing utilization, [14] although the study did not formally evaluate whether a woman would be offered counseling and testing in the first place.

Residing in urban areas was significantly associated with HIV counseling and testing, in line with a previous study showing that urban women were more likely to get tested for HIV than rural women.[14] Most non-health facilities are located in the rural areas where policy implementation are limited, and standard ANC practice are rarely followed, potentially explaining the urban-rural divide and highlighting potential strategies for public health interventions focused on increasing HIV testing and counseling rates among pregnant women in Nigeria. Also, one study assessed the utilization of PMTCT in northern Tanzania and found that outcomes were better in urban region compared to the rural region because of differences in the start-up of the PMTCT

programs. Programs in urban region benefit from program maturity, hence better PMTCT outcomes.[40]

This study is one of the few nationally representative studies to examine the effect of institutional-level factors on HIV testing utilization during ANC in Nigeria, and one of the first to explicitly focus on institutional-level factors on the provision and utilization of HIV testing and counseling during ANC. Several limitations should be noted, however. Firstly, outcomes were based on self-reported data, potentially susceptible to social desirability or recall bias. Secondly, information concerning the ANC facilities and/ or providers that the pregnant assessed for care was limited in the dataset. For example, most of the participants saw more than one provider during ANC, and it was impossible to determine who the main provider was. Data is few years old (included women who gave birth between 2011-2013), and may not be generalizable to other SSA countries. In addition, the counseling outcome variable in this study only allowed for women who said they received all three information on pre-test PMTCT counseling, and we were unable to assess women who did not receive ANC.

Provision and utilization of HIV testing and counseling is still low among pregnant women receiving ANC in Nigeria. However, lower rates were detected among women who saw providers who are less skilled than doctors and/ or nurses. No difference was detected between seeing a doctor or a nurse in all outcomes. In addition, although differences were found between using a public vs private facility, poorer findings were detected among those who used non-health facilities. Therefore, it appears that more PMTCT training should be targeted towards health providers less-skilled than doctors or nurses to improve HIV testing outcomes in Nigeria. In addition, PMTCT improvements

should begin in facilities that are non-health and encourage underserved women to seek care in government or even private facilities (although outcomes in private facilities were significantly lower in the fully adjusted analysis). However, regardless of the kind of facilities the women use, implementation of standardized HIV testing guidelines in all facilities must be highlighted as a public health priority. Up-to-date PMTCT training should be targeted towards all health workers in all facilities. It may be difficult to reach providers *in non-health* settings, but outreach programs have been shown to be an effective approach to reach obscure locations in other low-resource settings.[35,36]

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TABLES

Table 1. Summary & Categorization of the Selected Predictors Using NDHS 2011-2013

	Variables	Definition & Measurement
Sociodemographic	Age	Current age in 5-year categories, at the time of survey
	Ethnicity	Responses include Hausa/Fulani, Igbo, Yoruba, and others.
	Education	Highest education level attained
	Marital Status	Current marital status: See categorization below
	Employment	Whether the respondent has worked in the last 12 months
Perceived Need	Parity	Primiparous, multiparous, grand-multipara, and great-grand-multipara
	Number of ANC Visits	Less than four visits and more than four visits
Economic Accessibility	Wealth	Household wealth status; See categorization below
	Health insurance	Covered by of health insurance: no, yes
Physical Accessibility	Residence	Place of residence: Urban, rural
	Geographical Location	North east, north west, north central, south east, south west, south south
	Distance to health facility	A big problem and not a big problem.

Table 2. Descriptive Statistics of the Institutional-Level and Perceived Need Factors and HTC Outcomes, DHS Nigeria 2013

	N (%)	% Offered Counseling	% Offered Testing	% Tested
Institutional-Level Factors				
Type of Facility				
Private	2133 (21.8)	66.4*	69.8*	62.3*
Public	7289 (74.5)	56.6*	56.0*	50.6*
Non-Health	357 (3.7)	42.5*	34.5*	29.5*
Type of Provider				
Doctor	1190 (12.3)	62.1*	65.6*	61.0*
Nurse	6903 (71.2)	60.5*	60.7*	54.9*
Others	1507 (15.5)	39.7*	37.0*	31.0*
Provider by Facility				
Doctor (Private)	354 (3.7)	64.2*	75.7*	70.4*
Doctor (Public)	833 (8.6)	61.1*	62.1*	57.7*
Doctor (Non-Health)	12 (0.1)	91.7*	66.7	66.7
Nurse/ Midwife (Private)	1528 (15.8)	69.0*	71.5*	63.7*
Nurse/ Midwife(Public)	5344 (55.1)	59.1*	58.6	53.1
Nurse/ Midwife (Non-Health)	121 (1.3)	53.6	42.9*	40.2*
Others (Private)	247 (2.6)	52.7	49.8*	40.7*
Others (Public)	1056 (10.9)	40.5*	38.6*	32.5*
Others (Non-Health)	220 (2.3)	31.7*	26.7*	20.1*
Perceived Need Factors				
Number of ANC Visits				
Less than four	1859 (19.9)	41.9*	43.8*	39.3*
More than four	7470 (80.1)	61.4*	61.0*	55.1*
Parity (Number of Births)				
1	2072 (21.4)	60.4*	63.5*	56.2*
2-5	4544 (46.9)	61.1*	61.6*	56.2*
5-7	1740 (17.9)	53.3*	51.5*	46.7*
≥7	1339 (13.8)	46.0*	42.7*	37.7*

N = Frequency
%* statistically significant at alpha level of <= 0.05

Table 3. Descriptive statistics of the sociodemographic, economic, and physical accessibility factors and HTC outcomes, DHS Nigeria 2013

	N (%)	% Offered Counseling	% Offered Testing	% Tested
Sociodemographic Factors				
Age (Years)				
15-19	650 (6.7)	39.0*	42.2*	33.9*
20-24	2128 (22.0)	53.5*	51.6*	46.5*
25-29	2776 (28.6)	60.8*	61.9*	56.5*
30-34	2070 (21.3)	61.8*	61.6*	56.0*
35-39	1384 (14.3)	59.6*	61.6*	56.1*
40-49	687 (7.1)	54.8*	52.2*	45.9*
Highest Education Level				
No Education	3042 (31.4)	38.1*	30.7*	27.6*
Primary	2148 (22.2)	50.6*	50.7*	42.2*
Secondary	3599 (37.1)	68.7*	72.8*	66.5*
Higher	906 (9.3)	86.0*	92.3*	88.6*
Marital Category				
Not Currently Married	9193 (94.8)	63.9*	68.0*	57.2*
Currently Married	502 (5.2)	57.1*	57.0*	51.7*
Employment Last 12 Months				
No	2658 (27.4)	54.8*	55.6*	50.7*
Currently working	6500 (67.0)	59.0*	58.9*	52.8*
Worked past year/ 7 days	527 (5.4)	52.1*	51.7*	48.0*
Ethnicity*				
Hausa/ Fulani	2952 (30.4)	42.2*	36.3*	33.7*
Igbo	1542 (15.9)	64.9*	75.2*	68.5*
Yoruba	1621 (16.7)	76.0*	73.4*	63.0*
Others	3581 (36.9)	58.0*	59.9*	54.5*
Economic Accessibility Factors				
Wealth Index				
Poorest	1123 (11.6)	25.8*	22.9*	19.2*
Poorer	1787 (18.4)	39.0*	34.6*	29.9*
Middle	2074 (21.4)	52.6*	51.8*	45.3*
Richer	2322 (23.9)	65.3*	66.2*	59.7*
Richest	2388 (24.6)	79.6*	84.0*	78.5*
Health Insurance				
No	9454 (97.8)	56.9*	56.9*	51.1*
Yes	211 (2.2)	84.6*	92.3*	90.3*
Physical Accessibility Factors				
Distance Difficulty				
Not a problem	7512 (77.5)	42.8*	42.7*	38.0*
A problem	2155 (22.2)	61.4*	61.7*	55.8*
Geographical Region				
North Central	1479 (15.3)	59.7*	57.4*	52.8*
North East	1559 (16.1)	47.2*	47.9*	42.4*
North West	2447 (25.2)	43.4*	39.1*	37.0*
South East	1217 (12.6)	60.9*	72.7*	65.6*
South South	1086 (11.2)	66.3*	72.0*	65.9*
South West	1908 (19.7)	75.0*	71.2*	61.4*
Residence				
Urban	4534 (46.8)	69.9*	73.4*	66.8*
Rural	5161 (53.2)	45.7*	42.6*	37.9*

N = Frequency
%* statistically significant at alpha level of <= 0.05

Table 4. Association between Institutional-Level Factors and HTC Outcomes, DHS Nigeria 2013

Institutional-Level Factors	Offered Counseling		Offered Testing		Tested for HIV	
	OR (95%, CI)		OR (95%, CI)		OR (95%, CI)	
	Initial (Model 1)	Adjusted (Model 2)	Initial (Model 1)	Adjusted (Model 2)	Initial (Model 1)	Adjusted (Model 2)
Type of Facility						
Public	Ref	Ref	Ref	Ref	Ref	Ref
Private	0.93 (0.83-1.05)	**0.77 (0.67-0.87)***	0.98 (0.87-1.11)	**0.79 (0.69-0.90)***	0.93 (0.83-1.04)	**0.79 (0.70-0.90)***
Non-Health	**0.48 (0.38-0.60)***	**0.39 (0.30-0.50)***	**0.30 (0.24-0.39)***	**0.25 (0.19-0.32)***	**0.32 (0.25-0.42)***	**0.27 (0.21-0.35)***
Type of Provider						
Doctor	Ref	Ref	Ref	Ref	Ref	Ref
Nurse/ Midwife	1.09 (0.95-1.25)	1.05 (0.91-1.22)	0.98 (0.85-1.14)	0.91 (0.78-1.07)	0.92 (0.80-1.07)	0.90 (0.77-1.04)
Others	**0.56 (0.47-0.66)***	**0.60 (0.50-0.72)***	**0.45 (0.37-0.54)***	**0.47 (0.39-0.57)***	**0.42 (0.35-0.50)***	**0.45 (0.37-0.55)***

Odds Ratio (OR) & Confidence Interval (CI) in bold* are statistically significant at alpha level of <0.05
Model 1 includes sociodemographic variables (age, ethnicity, education, marital status and employment)
Model 2 adjusted model 1 for perceived need (parity and number of ANC visits), physical accessibility (residence, geographical location, and distance to health facility) and economic accessibility variables (wealth, and health insurance)

CONCLUSION AND FUTURE DIRECTIONS

Each of the three manuscripts that make up this dissertation provide new findings for the study of HIV testing and counseling utilization during antenatal care (ANC) in Nigeria and sub-Saharan Africa (SSA). Prior to this contribution, studies of ANC-HIV testing and counseling utilization in Nigeria have been region-specific or hospital-based.[26,34,35,36] However, studies should also consider the high geographic diversity of the Nigeria, which includes 6 regions (also known as geopolitical zones), 36 states, and the Federal Capital Territory, Abuja. The few studies that have used nationally representative data examined only a single endpoint be it HIV testing or HIV counseling. Papers 2 and 3 of this dissertation considers these issues further, and paper 1 provides the first systematic review of the influence of institutional-level findings on ANC-HIV testing utilization in SSA. By including different methodologies (quantitative, qualitative and mixed methods) in the review, paper 1 provided a robust analysis of the influence of institutional-level factors on ANC- HIV testing and counseling utilization.

Paper 2 extends the approach of analyzing utilization of ANC-HIV testing beyond the question "*did you get tested for HIV*?" It examines the individual-level predictors of HIV counseling and testing using a novel conceptualization of the four possible testing and counseling outcomes: *ideal* (counseled and tested); *less ideal* (tested but not counseled); *opted-out* (counseled but not tested) and *missed opportunity* (neither counseled nor tested). In paper 3, in addition to analyzing the influence of institutional-level factors on utilization of ANC-HIV testing, we also examined the influence of these predictors on provision of HIV counseling and testing. Our institutional-level factors

looked beyond the skill-level of the health care providers – the most commonly researched factor on this topic.

Overall, findings from this dissertation suggest that both institutional and individual-level factors place a role in ANC-HIV testing. The biggest institutional-level barriers to ANC-HIV testing and counseling utilization in SSA revolve around resources. Deficiencies were highlighted in three aspects of resources: staffing, availability of supplies, and infrastructure. In Nigeria, the institutional-level factors explored (type of facility and type of providers) shed light on the importance of more PMTCT training targeted towards health providers less-skilled than doctors or nurses, and PMTCT improvements in non-health facilities that are to improve HIV testing and counseling utilization in Nigeria.

The individual-level factors associated with ANC-HIV testing were defined using the Anderson Behavioral Model (ABM), and include predisposing (socio-demographic and cultural), enabling (socio-economic, knowledge and attitudes) and need (risk perception and health behaviors) factors. Findings suggested that women with low socio-demographic and socio-economic factors are more likely to be in the missed opportunity category where they are neither counseled, nor tested for HIV. Public health interventions that focus on these vulnerable populations may go a long way in increasing HIV counseling and testing rates and reducing MTCT of HIV in Nigeria.

This dissertation provides a basis for future studies. First, Nigeria began recognizing the World Health Organization (WHO) recommendation of provider-initiated testing and counseling (PITC) in 2010.[16] PITC is known to improve HIV testing utilization considerably,[10-13,] yet testing rates are still low in Nigeria. Also, as this study

confirms that many women are not offered HIV testing and counseling in the first place. This shows that the implementation of PITC is still lagging behind in Nigeria, 6 years after being included in the national PMTCT guidelines. The challenges of implementing PITC in Nigeria should be explored further to clarify why Nigeria is still lagging behind in the rate of PMTCT utilization[22]. PMTCT services include not only HIV testing and counseling, but also services like Option B+ (where lifelong ART is provided to all pregnant and breastfeeding women who are HIV-positive irrespective of CD4 count or disease stage).[8] Only 30% of HIV-positive women utilized PMTCT services in Nigeria in 2014,[22] a rate that is below the 73% in the SSA countries[4]. Challenges in implementing PITC may be similar to implementing other PMTCT services.

Secondly, this study shows socio-economic and demographic factors still exert a significant influence on the optimization of HIV testing and counseling utilization during ANC in Nigeria. Women who are less educated, younger, poorer, and who live in rural areas are most likely have the lowest HIV testing utilization rates. More educated women are likely to be in the higher wealth quintiles and living in the urban region, where they have access to better trained providers and health care facilities. However, 53% of our study population live in rural areas. For Nigeria and other countries with limited resources, it will take much time to raise the education standard of the general population, especially in rural areas. However, a more effective strategy in the short-time could be to develop policies encouraging skilled providers to practice beyond the urban areas. Also, the implementation of major national PMTCT programs begins in the larger facilities (usually tertiary facilities), before progressing into secondary and primary facilities. This decentralization process is not seamless and many primary health facilities (mostly in the

rural areas) do not benefit from new and improved programs. The Federal Ministry of Health (FMOH) need to ensure proper implementation of programs at all tiers of the health system, and that rural facilities are also brought up to the required standard.

Thirdly all the institutional-level barriers identified in paper 1 applies to Nigeria as well. However, we have been able to identified the most important barriers as those centering on staffing shortages, availability of supplies, and lack of infrastructure. In Nigeria, PMTCT program implementation has largely depended on donor contributions,[16] particularly for the provision of testing supplies and for supporting staff. The Nigerian government needs to do more to improve its own health care infrastructure. According to the 2014 World Bank estimate, only 3.7% of the country's gross domestic product (GDP) is devoted to health expenditure, a rate that is lower than the average SSA rate of 5.5%.[37] The Nigerian government should devote more of its GDP to improve health expenditure.

Several limitations to this study should be noted. Our data source for papers 2 and 3 is the latest (2013) Nigeria Demographic Health Survey (NDHS), although nationally representative is a cross-sectional survey. Study outcomes were based on self-reported data, potentially susceptible to social desirability and recall biases. Future studies may consider other study designs including longitudinal methods of analyzing the influence of institutional and individual-level factors on ANC-HIV testing utilization.

In addition, we did not explore HIV testing and counseling among pregnant women who did not attend ANC facilities. Almost half of our study population (48.5%) were in the richer and the richest wealth quintiles, i.e. women who could afford to utilize ANC. Further study is required to explore HIV testing and counseling among women who did not utilize ANC.

Lastly, the number of women who were positive when tested for HIV could not be determined. Although HIV testing is the first critical step in the PMTCT cascade, it is also important to explore what happens after women have been tested for HIV. Receiving the HIV test result may not be a major problem (testing is now done rapidly and women are able to find out their status by the end of the ANC visit),[14] but ensuring that HIV-positive mothers adhere to an appropriate ART regime is still problematic in most SSA countries, including Nigeria. Adherence usually begins with post-test counseling, another important PMTCT consideration that could not be explore here. Future study should ideally consider post-test counseling and ART adherence in Nigeria.

This dissertation has provided a detailed analysis of individual- and institutional-level factors shown to exert considerable influence on the utilization of HIV testing and counseling in ANC facilities in Nigeria and elsewhere in SSA. Limitations in both factors considerably influenced the utilization of HIV testing and counseling in both regions. Interventions should address not only important institutional-level factors such as the deficiencies in resource described here, but also seek to improve outcomes for the vulnerable populations that have been identified.

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APPENDIX

INSTITUTIONAL REVIEW BOARD APPROVAL FORM:

EXEMPTION DESIGNATION

IDENTIFICATION AND CERTIFICATION OF RESEARCH PROJECTS

INVOLVING HUMAN SUBJECTS

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Institutional Review Board for Human Use

Exemption Designation
Identification and Certification of Research
Projects Involving Human Subjects

UAB's Institutional Review Boards for Human Use (IRBs) have an approved Federalwide Assurance with the Office for Human Research Protections (OHRP). The Assurance number is FWA00005960 and it expires on January 24, 2017. The UAB IRBs are also in compliance with 21 CFR Parts 50 and 56.

Principal Investigator:	DUROJAIYE, MODUPEOLUWA OYINLOLA
Co-Investigator(s):	
Protocol Number:	**E160422001**
Protocol Title:	*Analyzing Factors that Influence the Outcomes of HIV Testing and Counseling During Antenatal Care in Nigeria: A Multilevel, Multi-Outcome Analyses Approach*

The above project was reviewed on 4/27/16. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services. This project qualifies as an exemption as defined in 45CFR46.101(b), paragraph 4.

This project received EXEMPT review.

Date IRB Designation Issued: 4/27/16

Mary L. Stanfield CIP

Designated Reviewer
Chair Designee

Investigators please note:

Any modifications in the study methodology, protocol and/or consent form/information sheet must be submitted for review to the IRB prior to implementation.