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Adapting and Applying the Andersen's Behavioural Model to Understand Factors Influencing Uptake of Antenatal-Integrated HIV Testing in Nigeria: A Multilevel Analysis

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Abstract

Background: Despite the integration of HIV testing into antenatal care and its increasing availability in Nigeria, its utilisation remains unacceptably low.

Objective: The primary aim of the study is to understand factors influencing uptake of antenatal HIV (ANC-HIV) testing among pregnant women in Nigeria. To do so, the Andersen behavioural model of health service use is adapted to ANC-HIV testing use (secondary aim) and applied to achieve the study primary aim.

Adapted model: The adapted Andersen behavioural model (AABM) modifies the initial Andersen model by expanding it with HIV stigma and desire for HIV testing variables, fitting the model need variables with HIV risk behaviours and risk perception, and giving room for potential interactions among the model variables based on the past literature.

Empirical method: A multilevel analysis is modelled using the 2013 Nigeria Demographic and Health Survey with a sample size of 5,164 pregnant women who gave birth between 2011 and 2013, attended ANC during the pregnancy and were offered HIV testing. The analysis is based on the AABM used in this study which has four main explanatory measures namely, the predisposing, enabling, need and stigma (PENS) factors.

Empirical findings: Results indicate that ANC-HIV testing use is nested within communities and states and that the determinants of ANC-HIV testing uptake include the predisposing (religion and HIV knowledge), enabling (wealth, bargaining power, partner's education, pre-test HIV counselling and place of ANC visit) and need (HIV risk perception) factors. The results also reveal that HIV stigmatising attitude towards PLWH/A is not an independent determinant of ANC-HIV testing uptake in Nigeria especially when other model factors like pre-test HIV counselling, HIV knowledge, wealth and women's education are controlled for.

Conclusion: The AABM is useful in explaining ANC-HIV testing uptake. The empirical study findings should be adopted into policies which aimed at enhancing the PMTCT programmes in Nigeria.

Keywords: ***ANC-HIV testing, pregnant women, AABM, PMTCT, Nigeria***

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List of Abbreviations

AABM	Adapted Andersen Behavioural Model
AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal care
ART	Anti-Retroviral Therapy
ARV	Anti-Retroviral
DHS	Demographic and Health Survey
eMTCT	Elimination of Mother to Child Transmission of HIV
FCT	Federal Capital Territory
FMoH	Federal Ministry of Health
GNI PPP	Gross National Income
HBM	Health Belief Model
HIV	Human Immunodeficiency Virus
MTCT	Mother to Child Transmission of HIV
NACA	National Agency for the Control of AIDS
NARHS	National HIV/AIDS and Reproductive Health Survey
NDHS	Nigeria demographic and Health Survey
NPC	National Population Commission
PCA	Principal Component Analysis
PENS	Predisposing, Enabling Need and Stigma
PITC	Provider-Initiated Testing And Counselling
PLWH/A	People living with HIV/AIDS
PMTCT	Prevention of Mother to Child Transmission of HIV
PPP	Purchasing Power Parity
PRC	Population Research Centre
PRB	Population Reference Bureau
PSU	Primary Sampling Unit
SMC	Squared Multiple Correlation
STIs	Sexually transmitted infections
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WHO	World Health Organization

CHAPTER ONE
INTRODUCTION

1.1. BACKDROUND TO THE STUDY

Globally, an estimated 35.3 million [32 200 000 - 38 800 000] people across all ages are living with human immunodeficiency virus (HIV), of which 70% reside in sub-Saharan Africa (SSA) only (UNAIDS, 2013). Likewise, despite the fact that 12.7% of the world population reside in the SSA (PRB, 2014), 9 out of every 10 HIV infected pregnant women and children (less than 15 years) are in the African sub-region (WHO, 2011; UNICEF, 2015). The PRB (2014) estimates put Nigeria as the most populous African country, occupying about 19.3% of the total SSA population. This indicates that nearly one out of every four sub-Sahara Africans is a Nigerian.

In Nigeria, the first case of AIDS was officially reported in 1986 and the spread of the HIV has since been growing exponentially. With national prevalence of 3.4 (NACA, 2014), recent report shows that about 3.1 million people are living with HIV in the country (UNAIDS, 2013). Followed by India, Nigeria is therefore ranked second highly HIV burdened country after South Africa in the world (WHO, 2011; UNAIDS, 2013). Likewise, the recent trend estimates show that the total number of HIV positive children in Nigeria increased from 360,000 in 2009 (UNICEF, 2010) to 430,000 in 2012 (UNAIDS, 2013). Besides, with an estimated 51,000 new child HIV infections in 2013, Nigeria is reportedly having the highest number of children who are contracting HIV in the world (UNAIDS, 2014a). About 90% of these positive Nigerian children contract the HIV infection through mother-to-child transmission - MTCT - (Agboghorom et al., 2013) either during pregnancy, birth or lactation period. This is not unexpected since only 27% out of the approximately 190,000 positive pregnant women in Nigeria receive antiretroviral (ARV) drugs to prevent mother to child transmission of HIV (UNAIDS, 2014a), making the risk of MTCT in the country to stand at 26%, the third largest after Democratic Republic of the Congo (29%) and Chad (32%) (UNAIDS, 2014a).

Integration of HIV testing into antenatal care settings and its utilization

To ensure the prevention of mother to child transmission (PMTCT) of HIV, the WHO supported four comprehensive PMTCT prongs which are the "primary prevention of HIV infection among women of childbearing age, preventing unintended pregnancies among women living with HIV, preventing HIV transmission from a woman living with HIV to her infant and providing appropriate treatment, care and support to mothers living with HIV and their children and families." (WHO, 2010, p.6). According to UNICEF (2015), absence of such intervention programmes will expose between 15-45% of new-borns of positive women to HIV infection and about half of them will not live to celebrate their second birthdays.

Incorporation of HIV testing into antenatal care (ANC) settings becomes central to the integration component of 2010 WHO strategy which aims at maximizing the prevention and care programmes for HIV-positive women and children (WHO, 2010). HIV testing is the gateway to accessing PMTCT and antiretroviral therapy (ART) programmes not only in Nigeria (FMoH, 2010; Odimegwu et al, 2013) but also across the globe (Staveteig et al. 2013; UNICEF, 2015). During the antenatal HIV counselling and testing, pregnant women are informed about HIV/AIDS, MTCT, and are offered a HIV test on voluntary and confidential bases. This therefore helps to identify those in need of post-HIV test follow-up for necessary PMTCT prongs and ART services. Hence, scaling up utilization of HIV testing during ANC becomes very crucial for PMTCT programmes especially in the Nigeria.

However, despite the various national and international efforts which aim at reducing the incidence of MTCT by increasing the availability of antenatal HIV testing service and other PMTCT interventions, evidence has shown that utilization of antenatal HIV testing is unacceptably low in Nigeria. Latest findings showed that only 28% of the pregnant women attending ANC were tested for HIV as against 61% who accessed the ANC in Nigeria (NPC & ICF International, 2014). Also, about 30% coverage of PMTCT was estimated in 2014 in the country (NACA, 2014). Both the reported antenatal HIV testing and PMTCT rates remain far short of the 90% desirable targets adopted in the country (FMoH, 2010b;

NACA, 2014). Similarly, the attainment of the United Nations global plan for the elimination of MTCT (eMTCT) which aims at reducing the MTCT rate to 5%, decreasing the paediatric HIV by 90% as well as with a target of 90% coverage of HIV-infected mothers receiving perinatal ARV by 2015 (UNAIDS, 2014a; UNICEF, 2015) in Nigeria is greatly undermined and shrouded in uncertainty. It is therefore necessary to identify the factors responsible for use and non-use of HIV testing offered as part of antenatal care in order to fast tract the attainment of future targets such the 90-90-90 targets by 2020 and 95-95-95 targets by 2030, each of the 90s representing the anticipated coverage on HIV testing, treatment of the positive cases and viral suppression respectively (UNAIDS, 2014b).

In recent years, a handful of studies have focused on understanding the antenatal HIV testing and other MTCT-related issues in Nigeria. Most of them are hospital-based in a particular locality or region of the country and conclusions are mainly drawn from descriptive analyses (Igwegbe, 2005; Ogaji et al., 2008; Moses et al., 2009; Okeudo, 2012; Olugbenga-Bello et al., 2012). The only study, to the best of my knowledge, which used a nationally representative data did not focus on ANC-HIV testing but rather on the Nigerian couples (Lepine et al., 2014). Therefore, considering the demographic and geographical dynamics of Nigeria including the observed wide variations in HIV prevalence across states and regions, there is need to understand the correlates of HIV testing uptake from a truly nationally representative data repository. To fill this gap, data from the most recent 2013 Nigeria demographic and health survey (NDHS) is sourced in this study, using a multilevel mixed effects modelling.

Several theoretical frameworks for explaining health care utilization have been documented in the literature (Ricketts & Goldsmith, 2005; Rebhan, 2011). One of the most inclusive and widely applied is the Andersen behavioural model of health care use (Philips *et al*., 1998; Ricketts & Goldsmith, 2005; Babitsch et al., 2012; Heider *et al*., 2014; Chomi et al., 2014) and is therefore adapted in this study to explain the use of antenatal HIV testing service. The model is conceptualised based on the predisposition, enablement and need for health care use (Andersen, 1995). The predisposing factors usually consists of the personal attributes of an individual which include the demographic (i.e. biological factors e.g. age and sex), social (i.e. education, ethnicity, employment) and health belief (i.e. values, knowledge and attitudes towards health and illness e.g. HIV/AIDs knowledge) characteristics. The enabling factors, which mainly comprises of contextual but sometimes personal characteristics, represents the ability to use health care service such as the availability and accessibility of the service, income level and household bargaining power among others. The need factors pertain to both the perceived and evaluated assessment of one's health status which may inform the need for seeking health care such as risk factors and quality of life among others. Based on the literature reviewed in this study, no previous study has applied this model to examine uptake of HIV testing including the antenatal integrated testing.

This paper argues that the structure and few components of the Andersen model should be modified particularly when adapted to the context of HIV testing service. For instance, a myriad of literature has identified HIV-related stigma as a key barrier factor facing people living with HIV/AIDS (PLWH/A) as well as the use of HIV testing programme (Odimegwu et al., 2013; Ayiga et al., 2013; Lepine et al. 2014) and thus it has been treated as a separate concept in other frameworks (Weiser et al., 2006; Sambisa, 2008). Though, HIV-related stigma can be fitted into the health belief characteristics as a belief or attitudinal factor (health beliefs), doing so may not allow us to fully explore the depth of its impacts which also includes non-attitudinal characteristics such as the observed stigma and discrimination enacted towards people living with HIV/AIDs (PLWH/A) in the society. Also, based on the previous criticism of the framework for lack of showing potential interrelations among the model concepts and more particularly between its concept domains and variables (Bradley et al., 2002), this paper further modifies the model in order to allow for likely interactions among the model concepts and variables. Besides, the need factors are fitted with two HIV risk-related domains (risk behaviour and risk perception) rather than the perceived and evaluated need components in the initial Andersen's model. The model modification is guided mainly through an extensive and scientific review of past related HIV testing studies.

1.2. Research objectives

The aim of this study is twofold. The primary aim of this study is to understand factors influencing uptake of HIV testing as part of antenatal care ("ANC-HIV testing" hereafter) among pregnant women in Nigeria. Guided by the previous literature on HIV testing, this study also secondarily aims to adapt the Andersen behavioural model to the context of ANC-HIV testing uptake. The adapted Anderson behavioural model (AABM) to ANC-HIV testing is then applied to achieve the primary aim of this study.

1.3. Research questions

The central research questions formulated in this study are:

1. What modifications can be made to the Andersen behavioural model of health care use to aid its applications when adapted to explain the use of ANC-HIV testing?
2. What factors influence uptake of ANC-HIV testing among pregnant women in Nigeria using the adapted Andersen behavioural model?

Based on the major concepts in the AABM (which now includes HIV-related stigma), the following sub-questions are also formulated for the main research question 2:

a) What factors predispose the uptake of ANC-HIV testing among pregnant women in Nigeria?
b) What factors enable the utilization of ANC-HIV testing among pregnant women in Nigeria?
c) What are the need factors for the uptake of ANC-HIV testing among pregnant women in Nigeria?
d) What association exists between HIV-related stigma and utilization of ANC-HIV testing among the pregnant women in Nigeria? This includes testing if there is an independent relationship between the two and if not, what are the potential control variables or pathways of the association between them?

1.4. Societal and Academic relevance

Given the observed low uptake of ANC-HIV testing which largely undermines the attainment of any desirable targets of PMTCT programmes in Nigeria, the importance of full or at least a very high coverage of HIV testing among all expectant mothers cannot be over-emphasized. It is therefore instructive to study the factors influencing uptake of ante-natal HIV testing in the country so as to inform the Nigerian government and other concerned local and international stakeholders to devise programmes and policies that will help to scale up the antenatal HIV testing service utilization and thereby enhance the PMTCT programmes in the country. No doubt, progress in PMTCT programmes in Nigeria is essential to MTCT eradication globally.

Globally, many studies have employed the Andersen behavioural model to explain different aspects of health care services. These include studies on use of medical care services for childhood diseases in SSA (Fosu, 1994), long-term care for the elderly in USA (Bradley *et al*., 2002), maternal health care in Bangladesh (Chakraborty et al., 2003) and costs of health care in Germany (Heider et al., 2014) among several others. The model has also been primarily used to study HIV/AIDS-related health care services such as the utilization of antiretroviral therapy (HAART) among HIV-positive adults (Andersen et al., 2000), HIV primary care intervention for recently diagnosed HIV positive persons (Anthony et al., 2007) as well as the use of methamphetamine (meth) and dental problems among HIV-infected adults (Walter et al., 2012), all in the USA. As stated earlier, however, the desk review of previous literature reveals no existing study applying the Andersen behavioural model to the understanding of utilization of HIV testing, particularly, as part of the antenatal care. Also, the adapted model in this study is expected to aid the understanding of not only the Uptake of HIV testing among antenatal attendants (pregnant women) only, but also among the general populace in Nigeria and elsewhere.

1.5. Overview of the thesis

The background introduction to the study and the study objectives are presented in chapter 1. In the second chapter, details about the Andersen behavioural model, literature review, model adaptation and the resultant study conceptual framework (AABM), study hypotheses and definitions of concepts are provided. Chapter 3 contains mainly the study methodology including the brief description of Nigeria.

While the fourth chapter presents the empirical findings from the study, the results of both the model adaptation and empirical models are discussed in chapter 5. The last chapter outlines the study conclusions and provides recommendations.

CHAPTER TWO
THEORETICAL FRAMEWORK

2.1. The Andersen's behavioural model (BM) of health care utilisation

As stated in the previous chapter, this study applies the Andersen model with some modifications. The behavioural model was originally developed in 1968 by Professor Ronald M. Andersen - a US based sociologist and medical expert- primarily to study determinants of acute health care use as part of his doctoral dissertation **(**Babitsch et al., 2011). The model aims to identify both the facilitating and impeding predictors of healthcare use (Andersen, 1995). Though it has witnessed iteration and expansion, the initial 1968 model -the most widely used- captures the scope of this research and thereby adopted. This is mainly because its outcome variable focuses on health care use (see figure 1) rather than consumer satisfaction in the 1970's model (second phase) and health outcomes in the 1980's-1990's model (third phase) (Andersen, 1995). However, as a result of the broad scope of the model outcome variable, Andersen (1995) explained that a more specific and suitable measure should be used when applied to a particular type of healthcare services – i.e. the ANC-HIV testing.

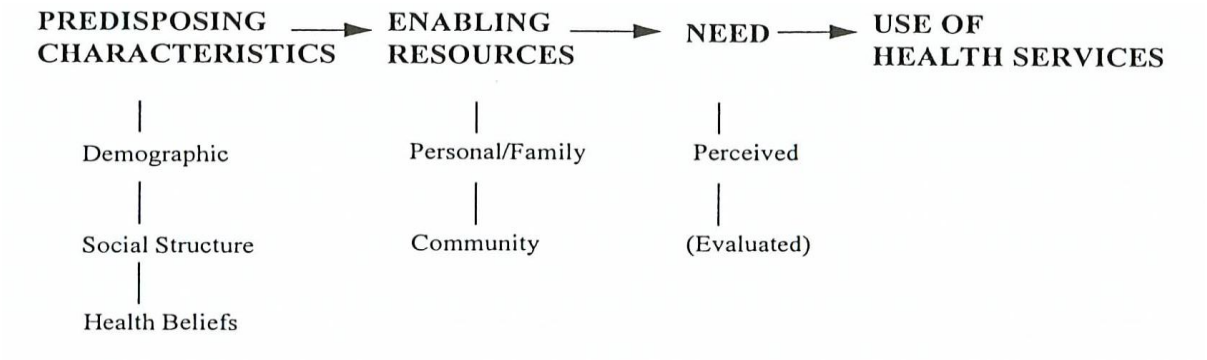

Figure 1: The initial Andersen's behavioural model (BM) of health services use (1968).
Source: Andersen, 1995.

In addition to the earlier description of the model concepts in the previous chapter, Andersen suggests that the three main model concepts – predisposing, enabling and need-based characteristics - may be construed as having independent impact on the outcome variable (Andersen, 1995). This points out the possibility of establishing direct link between health care use and each of the model components. However, the model may also be conceived as having a causal ordering or an explanatory process (Andersen, 1995; Willis et al., 2010*;* Chomi et al., 2014). For instance, while an individual may have the predisposition to use health care services, some certain factors have to be in place in order to enable access to the services and the actual use. Likewise, beyond having the enablement for a healthcare service utilization, an individual must also first conceive the need of it, which is considered the immediate reasons for health care use (Andersen's 1995; Chomi et al., 2014; Heider et al., 2014).

Worth mentioning is also the Andersen model's concept of mutability (Andersen and Newman, 1973; Andersen, 1995). This concept measures the extent to which altering policy variables can bring about expected behavioural changes. As regards the predisposing factors, for instance, while most demographic variables are less mutable or changeable, some social variables i.e. education and employment have relatively higher degree of mutability, though altering them is not feasible for short term policy actions. The health belief variables have average mutability level since changing them can sometimes lead to a viable short-term policy. The author also states that a number of enabling factors are considerable highly mutable and are relatively highly associated with the health care use. Although the need factors are the most direct predictors of health care utilization, they are usually less mutable policy variables (Andersen, 1995). However, according to the author, they can be altered by influencing other mutable variables such education, awareness campaign, income level etc.

2.1.1 Application of the theory in the previous studies

Over the years, the Andersen model has been widely applied in studies related to health care use. Some selected contexts in which the model has been differently used in recent times across the world are summarised in table 1.

Table 1 Some selected previous literature applying the Andersen's model

Author(s) & date	Country/region of Study	Overview of study aim	Data and methods
Fosu (1994)	Sub-Saharan Africa	To study associated factors with the use of medical care services for childhood disease treatment	Secondary DHS data using logistic regression
Andersen et al. (2000)	United State of America	To examine the effects of predisposing, enabling and need factors on the likelihood of receiving highly active antiretroviral therapy (HAART) among HIV-positive people 18 years and older	A nationally representative sample survey using a multistage logit regression model
Bradley et al. (2002)	United State of America	To examine and modify Andersen's model for empirical studies of link between race/ethnicity and long-term care	Focus group discussion using constant comparative method for qualitative data analysis
Chakraborty et al. (2003)	Bangladesh	to study associating factors with the utilisation of maternal health care services	Prospective survey data using Multivariate logistic regression
Willis et al. (2007)	United Kingdom	To understand association between ethnicity and informal support transfer	Secondary (multivariate) analysis of survey data
Nour (2008)	United State of America	To aid understanding of factors related to utilisation of mental health care service	Primary survey data
Brown et al. (2009)	United State of America	To test an expanded Andersen model for the use of complementary and alternative medicine (CAM).	A National Health Interview Survey and logistic regression analysis
Wilkinson-Lee (2008)	United State of America	Assessing how fit is Anderson model in the study of health care use among Mexican, Cuban, and Puerto Rican-American adolescents	National longitudinal study using logistic regression and multi-group factor analysis
Sunderland & Findlay (2013)	Canada	To describe different kinds of perceived needs including information, medication, counselling, and other services, and the extent to which each of them is met	Canadian Community health survey using descriptive and logistic regression analysis
Chomi et al. (2014)	Tanzania	To understand the effect of membership status of health insurance scheme on likelihood of seeking health care and choice of health provider	Household sample survey using chi-square and multinomial logistic regression
Heider et al. (2014	Germany	To analyse the association between costs of health care and factors such as predisposing, enabling, and need factors , as illustrated in the Andersen's model, among Elderly population	Cross-sectional design using multiple Tobit regression models

According to Andersen, there is no strict restriction to what variables should be used to operationalize the three model concepts (Andersen 1995), therefore the variable selection is up to the researcher (Willis et al., 2010) and depends on the types of health care service utilization of focus. Babitsch et al., (2011) carried out a systematic review which aimed to examine how the Andersen model had been applied majorly by studies conducted between 1998 and 2011 in European and Anglo-American countries. The authors observed clear differences in the ways of operationalizing each of model concepts among the studies. The predisposing concept was commonly operationalized to include variables like age, marital status, gender, education, ethnicity, employment status, and number of children among others.

Prominent among variables used as enabling factors include health insurance, social/emotional support, accessibility to care, residence, socio-economic structure of the neighbourhood and availability of health-related information. Others include education and employment which were also usually categorised as predisposing factors in other studies. Common indicators of need-based factors include evaluated health status, perceived health, risk behaviours or factors, experience of pain, anxiety, and health related quality of life among others (Babitsch et al., 2011). The findings of Babitsch et al. (2011) further buttress the earlier position of Andersen about the flexibility of the selection of model variables. Where necessarily or relevant, a few number of how the concepts have been applied in the previous studies are also utilised in this study (see Table 2).

2.2. Literature review and the model adaptation

Introduction

This section presents review of existing studies which also serves as guides for the model modifications and adaptation. It covers review of relevant findings on the utilization of antenatal HIV test and other related studies. The section is arranged based on the three initial Anderson model concepts.

Predisposing factors- HIV stigma

As mentioned earlier, HIV-related stigma constitutes one of the major barrier factors to HIV testing uptake. The stigma factors can be categorised under the health belief component, a "belief and attitudinal" dimension of the predisposing factors, especially when measured as patient's attitudes towards people living with HIV/AIDS (PLWH/A). However, holding this variable as part of the health belief may hinder us from fully capturing other dimensions of HIV-related stigma such as fear of being discriminated against if tested positive (Weiser et al., 2006) as well as having observed enacted stigma towards someone who is suspected of having HIV (Sambisa, 2008), either by the society, family members, partner or the health care givers among others. Therefore, a conscious effort was made to single out **"**HIV stigma" as a separate concept which agrees with how it has been treated in other conceptualizations of HIV testing utilization (Weiser et al., 2006; Sambisa, 2008).

Though HIV stigma is commonly believed as a key barrier factor to HIV testing uptake, recent empirical findings have shown mixed results particularly as regards the different dimensions of HIV stigma as well as the target groups under study. Major dimensions of HIV stigma prevalent in the literature include enacted stigma (i.e. observed or having a stigmatizing towards others), anticipated stigma (from others i.e. partners, family, community etc.), perceived (community) stigma and self-stigma (Weiser et al., 2006; Sambisa, 2008; Turan et al., 2011). Findings have indicated that individuals, in the general public, who stigmatize against people living with HIV/AIDS (PLWH/A) have been found to have less odds of being tested - at 5% significant level - compared to those without such stigmatizing expressions both in Nigeria and elsewhere in the sub-Saharan Africa (Weiser et al., 2006; Ayiga et al., 2013; Lepine et al. 2014). This result is somewhat contradicted by the recent finding in Tanzania among pregnant women attending ANC by Semali et al. (2014), where the effect of stigmatizing attitudes on having being tested for HIV is only marginally significant at 10% level. After controlling for other model variables, a similar study among the pregnant women attending ANC in Kenya however revealed that only the anticipated stigma from male partner remains a strong predictor of antenatal HIV testing (Turan et al., 2011). The same study by Turan et al. (2011) found no association between antenatal HIV testing and perceived community stigma as well as the anticipated stigma from family members and others. Similar findings have also been reported by Kilewo et al. (2001).

Furthermore, the previous empirical findings show that stigmatizing behaviours are lower among people who knew someone with HIV and perceive risk of being infected (Pharris et al., 2011b). Similarly, Smith & Baker (2012) in their studies on participation in community networks found that people who perceived high risk of HIV and had strong stigmatizing attitudes against PLWH/A engaged less in social groups such as Church, sport teams etc. More specifically, in a study using multinomial logistic regression, interaction effect of knowing someone living with AIDS by having observed enacted stigma towards someone who is suspected to have HIV increases the likelihood of being tested for HIV, when offered (Sambisa, 2008). Based on these findings, It thereby also instructive to hypothesize that the need

determinants particularly the HIV risk perception are associated with HIV-related stigma, and have interaction effect on accepting (antenatal) HIV testing service.

Other predisposing factors

The desk review of literature indicated that many studies have associated socio-demographic characteristics of clients with the utilisation of HIV testing in and out of ANC facility. For instance, previous studies have shown increasing positive association between women's levels of education and their odds of being tested for HIV during pregnancy in sub-Saharan African countries (Bajunirwe & Muzoora, 2005; Semali et al., 2014) and India (Sarin et al. 2013). Findings have also revealed relationships between utilization of HIV testing and age of the women (Ayiga et al., 2013, Semali et al., 2014; Lepine et al., 2014), religion (Sambisa, 2008, Lepine et al., 2014) and occupational types (Dandona et al., 2009, Ayiga et al., 2013).

Likewise, various studies have explored relationships between the use of HIV testing service and knowledge of HIV including mother to child transmission (MTCT). A hospital based study in South Africa found high knowledge of HIV among the patients, though a large majority of them still rejected offers for HIV testing (Orisakwe et al., 2012). Another health facility-based study among antenatal care attendants shows that knowledge of mode of mother-to-child transmission of HIV is very low among the women in Southern Ethiopia, though this was not related to their attitude towards HIV testing in the clinic (Asefa & Bayene, 2013). Further, Lepine et al., (2014) in their study among the Nigerian couples, also documented positive link between HIV testing use and the scores of women's knowledge of HIV index.

Enabling factors

HIV testing uptake has been found to be significantly less likely among rural women (Pharris et al., 2011b), the poor (Pharris et al., 2011b; Lepine et al., 2014; Semali et al., 2014) and those who has health insurance or come from a polygamous household (Lepine et al., 2014). Influences of male partner involvement on the utilization of PMTCT services including HIV testing have also been documented (Sarin et al., 2013; Kalembo et al., 2013). Among the Nigerian women attending ANC in a facility based study, the idea of involvement of male partners as well as other important family members are seen as a way of protecting them against HIV-related stigma and ejection from their marital home if tested positive (Moses et al., 2009).

On the other hand, a number of studies have also associated women empowerment with higher odds of the utilization of HIV counselling and testing (Maman et al., 2002; Bashemera et al., 2013). For instance, using DHS data and a multivariate analysis, Bashemera et al. (2013) reported higher odds of being tested among empowered women in Tanzania. Similar study in Nigeria also found positive association between HIV testing uptake and high household bargaining power among women (Lepine et al., 2014). Using domestic violence as another domain of women empowerment, Liu et al., (2007) found positive relationship between women's experience of domestic physical violence and desire for HIV testing and counselling (HTC). Noting that the questions measuring the desire for HTC were asked at the absence of their male partners, the authors therefore expressed doubt on the feasibility of transforming the women's desire for HTC into the actual behaviour. However, findings establishing this link with particular reference to antenatal HIV testing is still scanty.

Semali et al. (2014) showed strong positive association between pre-test HIV counselling and HIV testing during ANC visits. However, poor or complete absence of counselling services received by women has been shown to affect their uptake of HIV testing service (Karamagi et al., 2003) to the extent that there was no significant improvement in their knowledge of MTCT and PMTCT even after receiving counselling (Moth et al., 2005). This shows that it is still very possible for non-usage of the HIV testing and other PMTCT service even when available and accessible (Doherty et al., 2005; Kwapong et al., 2014) but not properly delivered to the patients. Based on the place of ANC attendance, women who attend public or private hospital instead of community health care centres are found to be more probable to be tested for HIV during pregnancy in India (Sarin et al., 2013).

Need factors

The Andersen's model classifies need factors for health care use into perceived need and illness levels or clinically assessed needs. This study argues that the need factors can be operationalized as HIV risk behaviour and risk perception in the context of HIV/AIDs study. De Paoli et al. (2004), in their study which is guided by health belief model (HBM), noted the association between perceived exposure to HIV/AIDS and wiliness for HIV testing acceptance**.** Likewise, in a study among Nigerian couples, indicators of perceived risk of HIV such as knowledge of someone living with HIV, marital duration and having a partner who has been tested for HIV are all found to be important predictors of using HIV testing service (Lepine et al., 2014). Similar results were also documented among women in Zimbabwe (Sambisa, 2008), the traditionally circumcised men in South Africa (Nyembezia et al., 2013) and rural population in Vietnam (Pharris et al., 2011a). However, other perceived risk measures used by Lepine et al. (2014) such as the state HIV prevalence and number of lifetime partners are not significant predictors of HIV testing uptake among the Nigerian couples. Besides, when measured directly, a positive association have also been found between HIV risk perceptions and desire for as well as the actual HIV testing use (Liu &Becker, 2008; Sambisa, 2008; Olugbenga-Bello et al., 2012).

The classification of risky behaviour, as a need factor is in consistent with another Andersen framework expanded by Brown et al. (2009), the opposite term preventive (health) behaviour is used. Recent studies in sub-Saharan Africa showed that being faithful to one partner (Ayiga et al., 2013) and having recent experience of sexually transmitted infection - STIs - (Liu &Becker, 2008; Lepine et al., 2014) among women are significant predictors of HIV testing. Likewise, a study in London found higher uptake of antenatal HIV testing among women who disclosed HIV risk behaviours (Gibb et al., 1998). This paper therefore argues that HIV risk behaviour may also serve as a cue to take or decline HIV testing. The HIV risk taking behaviours could be sex-related - i.e. risky sexual behaviours - or non sex-related - i.e. use of unsterilized needs - (WebMD, 2015).

Generally, dearth of studies showing association between HIV risk behaviour and risk perception have been observed in sub-Saharan Africa (Anderson et al., 2007). This may be as a result of the difficulty in clearly separating the two variables from each other whose relationship has been earlier described as complex (Cleland, 1995). Burkholder et al. (1999) noted that individual's risky sexual behaviour influences his/her risk perception of HIV. However, more recent studies have shown contrary results. For instance, a high positive relationship between perceived risk and condom use at last time sex both among sexually active male and female has been evidenced in Kenya (Akwara et al., 2003) and Lagos state, Nigeria (Lammers et al., 2013). These indicate that the two variables can influence each other in either direction. However, these patterns of the potential interactive effects on HIV test acceptance particularly during ANC visit are not only yet unknown but also could not be guided by the original Andersen model. Therefore, possibility of interactions between the two domains of the need factors are included in the adapted model in this study.

2.3. Conceptual framework

Figure 2 below shows that the proposed adapted Andersen behavioural model (AABM). It schematizes the various pathways through which the model factors can influence the utilization of HIV testing during ANC. Except in few cases, the explanation of the model is similar to original Andersen behavioural model. For instance, the classifications of the predisposing (P) factors into demographic, social and health belief characteristics are retained (see Table 2) as in the 1968 model. However, within the context of HIV testing for instance, the health belief variables can include the knowledge of HIV and MTCT. As evidenced in the theory, literature and as well indicated by the arrows in the adjusted model, these P-variables can influence the ANC-HIV testing uptake directly (research question 2a) and can as well influence it through interaction with the proximate factors such the enabling, need and HIV stigma factors.

The pathway of influence of the enabling (E) factors on the ANC-HIV test uptake has been modified to include possible interactions with the HIV-related stigma variables. For instance, the E-variables such as household wealth or rural residential statuses of a woman can influence her use of ANC-HIV test directly (research question 2b) as shown in the literature. Besides, this relationship can be assumed to

have effects through interrelations with either the need (N) factors or the HIV Stigma (S) factors as indicated by the arrows (see Figure 2).

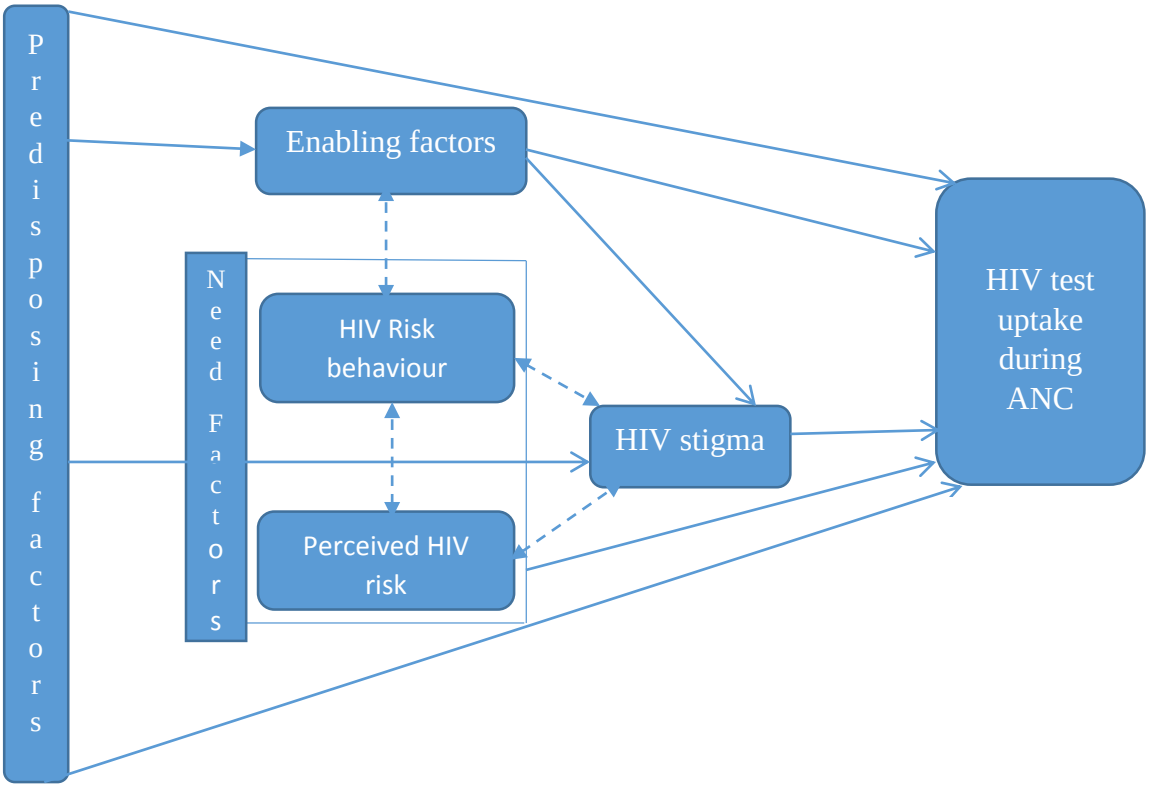

***Figure 2*:** Proposed Adapted Andersen Behavioural Model (AABM) to ANC-HIV testing uptake

Key modifications are made both on the need-factor as well as in the separation of HIV stigma. Within the context of HIV testing studies, two major variable categorizations are prominent in the literature asides from the personal and household characteristics. These variables are conceptualized as HIV risk behaviour and risk perception, both representing the N-variables in the adapted model and can have direct effects on the outcome variable (Research question 2c). The perceived need factors in the original Andersen model is therefore defined as perceived risk of HIV in the context of HIV/AIDS studies. For instance, a pregnant woman who perceives being at risk of HIV may see the need to know her HIV status through testing. Likewise, the evaluated need in the original model is approximated with HIV risk behaviour. However in this case, the risk behaviour may not necessarily be clinically evaluated but rather purely HIV risk behavioural characteristics. However, having a recent history of STIs particularly when clinically diagnosed may be defined as an evaluated need.

Furthermore, though HIV/AIDS stigma variables such as having a stigmatising attitude against PLWH/A can be fitted into the original model under the 'health belief' sub-concept, this key HIV-testing barrier variable reposition to its new location in the adapted model. Considering its likely interrelations with the specified N-factors as could be inferred from the literature, a conscious effort is made to reposition the stigma variable next to the N-variable in a way that can also allow it to as well have direct link with the response variable (Research question 2d). This clearly indicates an expansion of the original Andersen's model. In addition, since no direction of relationship was shown between the perceived and evaluated need factors in the initial model, the above adapted model also fill this gap by showing direction of flows between the two need factors (HIV risk behaviour and risk perception factors). Taking insights from the literature, these two variables can affect each other in either direction as depicted by the two complementary arrows in the model above. This modification will help us to understand not only the individual but also the patterns of interaction influence of the two need factors on the use of HIV testing during ANC visit.

Limited mainly by data availability, the hypothetical links depicted by the solid lines in the adjusted conceptual model (Figure 2) are going to be focused on during the empirical analysis. Though, if necessary, interaction between stigma and any other model factors may be explored (Research question 2d). Summary of dimensions of each concept and some of their selected variable measurement are shown in Table 2. It should be noted that HIV prevalence variable spans categories (environmental factor and risk perception) in the Table 2.

Table 2 Overview of the PENS concepts in the adjusted model

Concept	**Dimension**	**Variable specification (not all inclusive)**
Predisposing factors	Demographic variables	Age, CEB, migration etc
	Social variables	Education level, ethnic group, occupation, religion etc
	Health belief	HIV knowledge, MTCT knowledge**,** ANC attendance, HIV anxiety etc.
Enabling factors	Finance/household	Wealth, health insurance, domestic violence, women empowerment etc
	Environmental factors	Place and region of residence, place of ANC visit, HIV prevalence, community poverty etc
	Health care services	Service availability, pre-test HIV counselling, HIV testing experience etc
Need factors	HIV risk behaviour	STIs, higher-risk sex, multiple sexual partnerships, ever use of condom, unprotected sex with at risk partner etc
	HIV risk perception	Direct measurement
		Indicator measurement i.e. Knows someone living with HIV, spouse has been tested and HIV prevalence
HIV stigma	HIV Stigma measures	Stigmatizing attitudes against PLWH/A or self-stigma, observed enacted HIV stigma, perceived community stigma, anticipated stigma etc.

As depicted in Figure 2 above, the outcome variable of the proposed model is ANC-HIV testing uptake rather than healthcare service use in the initial Andersen model of 1968. This adapted conceptual framework is applied to assess the primary aim of the study which focuses on understanding the determinants of ANC-HIV testing in Nigeria. However, a review of literature shows that there are studies which focused on HIV testing desires rather the actual test as the outcome measure (Liu et al., 2007; Liu & Baker, 2008; Odimegwu et al., 2013). Besides, previous service utilization has been suggested to influence intended future uptake in a qualitative study (Bradley et al., 2002). Based on these observations as well as the theory of planned behaviour (Ajzen, 1991), the Andersen model is further expanded with the concept of desire for (antenatal) HIV testing (see Appendix G).

2.4. Statement of hypotheses

Based on the theory, past literature, and the adapted model (figure 2 above), the following hypotheses are thereby stated:

1. **P:** Pregnant women attending ANC who are older, more educated, Catholic and other Christians, engaged in highly skilled occupation or more knowledgeable about HIV/AIDS are predisposed to utilize ANC-HIV testing in Nigeria.
2. **E:** Pregnant women attending ANC who are wealthy, empowered, urban dwellers, insured, received pre-test ANC-HIV counselling, has an educated partner, attended ANC at government-owned health facilities and who do not experience intimate partner's violence are enabled to utilize ANC-HIV testing in Nigeria.
3. **N:** Pregnant women attending ANC who engage in risk behaviours or perceive risk of having HIV (need factors) have higher likelihood of being tested for ANC-HIV than those who are not exposed to these HIV risk-related factors in Nigeria.
4. **S:** HIV stigmatizing attitude towards PLWH/A is not an independent determinant of the utilization of ANC-HIV testing among pregnant women in Nigeria.

2.5. Definition of key concepts

Predisposing factors: These are " the propensity to utilise health services and include individual characteristics that are not directly related to health care utilisation but rather influence the likelihood of utilisation" (Chomi et al., 2014, p.2). These include demographic, social and health beliefs characteristics.

Enabling factors: This concept is defined as the "ability to access services". Brown et al. (2009, p.2).

Need factors: These are factors that arouse the need for health care (Baxter et al., 2001).

Risk: The term "risk" is defined as "a danger of unwanted and unfortunate events, not just uncertainty about the potential outcomes of an incident" (Rohrmann, 2008, p. 2).

HIV risk behaviour: The term is usually used interchangeably with HIV risk factors and an opposite word for protective behaviours. While the risk behaviour include certain behaviours that have the potential of increasing the risk of contracting the HIV, the protective behaviours have the reverse effects (WebMD, 2015). HIV risk behaviour is an important type of health behaviours in HIV studies. Other health behaviours such as smoking, diet, exercise and alcohol use (Conner, 2002, p.1) may be included in the model as part of health beliefs factors (predisposing factors).

Risky sexual behaviour: This can be defined in terms of the types of sexual orientation and activities, as well as by the types and number of partnerships (Cohen & Trussell 1996; Dixon-Mueller, 1996; Akwara et al., 2003).

Risk perception: This denotes "people's judgments and evaluations of hazards they (or their facilities, or environments) are or might be exposed to. Such perceptions steer decisions about the acceptability of risks and are a core influence on behaviours before, during and after a disaster". (Rohrmann, 2008, P. 1)

HIV stigma: This entails discriminating, prejudicial, discrediting and discounting attitudes expressed towards people suspected to have HIV/AIDS (Herek et al, 1998).

CHAPTER THREE
DATA AND METHODS

3.1. Research design

The adapted Andersen behavioural model (AABM) derived in the previous chapter is used to understand factors influencing utilization of antenatal HIV testing in Nigeria (the primary aim of the study). A nomothetic explanatory research approach is therefore adopted to explain why some pregnant women accepted the HIV test and others refused to be tested based on their selected predisposing, enabling, need and stigma (PENS) characteristics as guided by the theory and literature. Also, a secondary quantitative dataset - 2013 Nigeria Demographic and Heath Survey (NDHS) - is used during data analysis. The 2013 NDHS is a cross-sectional survey, hence the time dimension of this research.

3.2. About the study area

Nigeria is the most populous African country and is currently ranked 7th most populous in the World (PRB, 2014). Likewise, the country is currently rated as the largest economy in Africa (The Economist Newspaper, 2014). It is located in the West-African sub-region and shares borders with countries like Benin Republic, Chad Republic, Niger Republic and Cameroun. It is also majorly a patriarchal country with over 250 ethnic groups and languages. For administrative purposes, the country is divided into six geo-political regions, 36 states including the Federal Capital Territory (Abuja), and 774 local government authority areas (NPC & ICF International, 2014). Details about major development and health indicators in Nigeria are presented in Table 3.

Table 3 Major development and health indicators in Nigeria

Indicator	Value
Surface area (km^2)	932,770
Mid-year total Population (millions)	177.5
Population/km^2	192
Rate of natural increase (%)	2.5
Net migration rate per 1000 population	-0
UNDP Human Development Index	0.504
Rank on Human Development list 2013 (out of 187)	152
GNI per capital, Atlas method (current US$)	2,170
GNI PPP per capital ($US)	5,600
Unban (%)	50
Life expectance at birth (years), both sexes	52
Infant mortality rate/1000 live births	69
Under-5 mortality rate/1000 live births	128
Maternal mortality ratio/100,000 live births	576
Total fertility rate/woman	5.5
HIV prevalence in 15-49 years	3.4
ANC-HIV testing prevalence (%)	28.0

Sources: PRB (2014), UNDP (2014), NPC & ICF International (2014) & NACA (2014).

3.3. Data source

The main data source of this study is the 2013 Nigeria Demographic and Health Survey (2013 NDHS). The 2013 NDHS is the fifth round and the most recent demographic and health surveys (DHS) conducted in Nigeria; the earlier NDHS were carried out in years 1990, 1999, 2003 and 2008 calendar years (NPC & ICF International, 2014). The ultimate aim of the 2013 NDHS was to collect and disseminate latest population and health facts on major areas including fertility (levels and preferences),

family planning, adult and childhood mortality, domestic violence and HIV/AIDS - which includes information on the extent of HIV testing within ANC settings. The 2013 NDHS is a cross-sectional survey covering retrospective information between 2008 and 2013. Unlike the previous surveys in its series where data were collected only at the national and regional levels, with only the exception of 2008 round only, the fieldwork of the 2013 NDHS took place across the 36 states in the country including the federal capital territory (FCT). The 2013 NDHS fieldwork covered 5-month period between February to June 2013 and the final report of the survey was released in June 2014 (NPC & ICF International, 2014). The survey dataset used in this study is retrievable from http://measuredhs.com.

3.3.1 The 2013 NDHS sample design

The 2013 survey is a nationally representative household sample survey which covered the whole population in Nigeria except those residing in institutional homes such as army barracks, hospitals, homeless people lodge etc. Both the usual members (de jure population) and visitors (de facto population) who were between 15-49 years and present a night before the DHS survey in the households were eligible for interview. Due to the high geographical decentralization of the country such as from the national level to regions, states, localities and enumeration areas (EAs), a stratified three-stage cluster sampling design was used during the survey. The list of the EAs used during the survey was mapped out during the latest 2006 population and housing census exercise in the Nigeria.

At the first stage of the sampling design, each state was stratified into urban and rural areas and an independent selection of 893 localities in each stratum was made. At the second stage, a random selection of one EA was made from the majority of the selected localities. However, more EAs were selected in a few bigger localities making a total of 904 EAs (or clusters) in all. The 2013 NDHS regarded each EA as a cluster, which constitute the primary sampling units (PSU). The total of 372 and 532 EAs or clusters were selected in urban and rural areas respectively. Each cluster was made up of at least 80 households. A selection was however made from a contiguous EA in a situation whereby the selected EA had less than 80 households. In the third stage, 45 households were randomly selected each from all the selected rural and urban clusters through a systematic probability sampling.

The 2013 NDHS administered three questionnaires differentiated for households, women and men. The data collected from the three questionnaires were then used to create eight recode files or datasets based on the unit of analysis namely; births, couples, household, individual (women), children, male, household member and geographic datasets (DHS program, 2015). These recode datasets were originally modelled hierarchically before been converted into file formats and sometimes flat data (Rutstein & Rojas, 2006). The file formats for the 2013 NDHS are available in Stata, SPSS and SAS system files (DHS program, 2015). The 2013 NDHS was conducted by the National Population Commission (NPC) of Nigeria with technical supports from ICF Macro International, United States.

Asides, the information on HIV prevalence rate across the Nigerian states including the federal capital territory was obtained from the 2012 final report of the National HIV and AIDS and Reproductive Health Survey (NARHS) and was added to the 2013 NDHS working dataset for analysis purpose. Like the 2013 NDHS, the 2012 NARHS is a nationally representative survey which is conducted in every two years to provide information mainly on HIV & AIDS and reproductive health issues. Further details about the NARHS survey are provided elsewhere (see FMoH, 2013).

3.4. Study population and sampling

A sum of 38, 948 women were covered in the 2013 NDHS (NPC & ICF International, 2014). Though the retrospective and nationally representative information obtained in the survey spanned through a period of five years before the survey (2008-2013), sample selection for this study was first of all restricted to 14,220 women who gave birth in the last two years (2011-2013). The selection criteria are chosen in order to ensure comparability with previous related studies (Staveteig et al., 2013; Semali et al., 2014) and also to minimize the likely recall error on key and sensitive information. Since this study focuses on the utilization of HIV testing as part of ANC, only 9,321 women who attended ANC while pregnant (66%) in the last two years were further selected. Also, since the availability of ANC-HIV

testing usually precedes its uptake, the final sample size used for data analysis in this study included only 5,164 pregnant women (36.32%) who were offered the HIV testing during their ANC attendance for their last birth in the last two years (2011-2013). The sampling selection procedure is depicted in Figure 3. The 27.27% (of the total 14,220 women) who were tested for HIV and received results during ANC in the Figure approximates the 28% reported in the 2013 NDHS. The slight difference is as a result of the study sample restriction to only birth from 2011-2013 as against 2008-2013 used in the 2013 NDHS report.

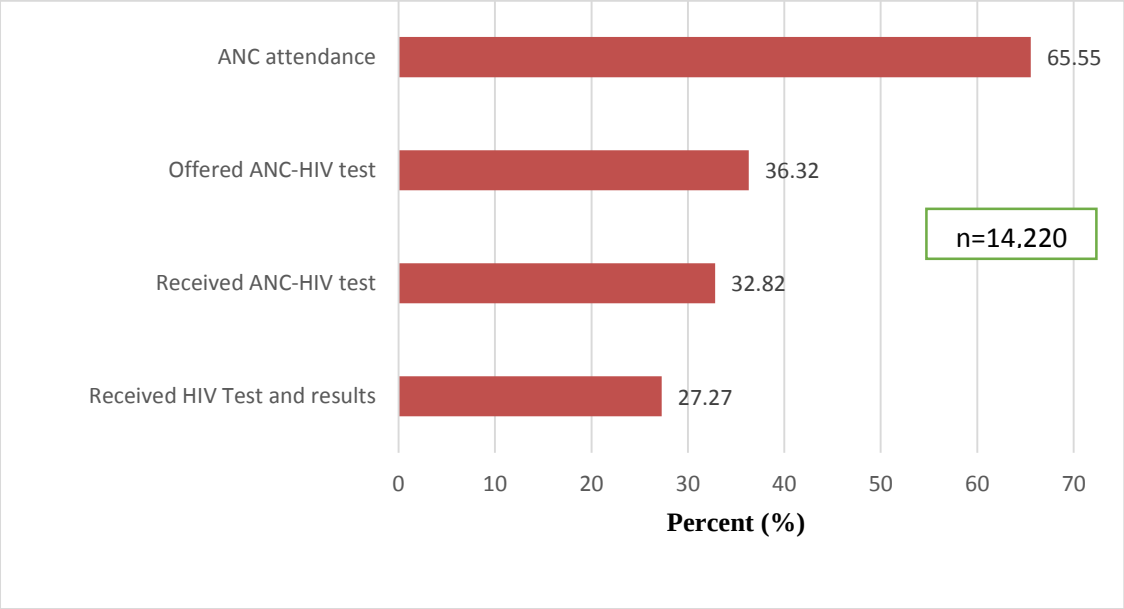

Figure 3: Estimates of ANC coverage and ANC-HIV test services uptake by 14,220 Nigerian women who gave birth between 2011 and 2013.

NB: The common denominator for each % estimate is 14,220.

Data source: 2013 NDHS

3.5. Operationalization of variables

Measurement of outcome variable

The dependent variable for this study is the utilization of HIV testing as part of ANC visit (thereafter refer to as ANC-HIV testing uptake) among pregnant women in Nigeria. In the 2013 NDHS, pregnant women who attended ANC for the most recent birth and were offered HIV test responded to these questions, I don't want to know the results, but (a) were you tested for AIDS virus during any of the antenatal visits? If yes, (b) did you get results of AIDS test? Women who answer 'yes' to these two questions are classified as having been tested for HIV during ANC. Pregnant women who were not tested as part of ANC are those who responded 'no' to either of the two questions (Staveteig et al., 2013; NPC & ICF International, 2014). Women who are tested are coded '1' and those who are not tested are coded '0'' indicating a dichotomous response variable.

Measurement of explanatory (PENS) variables

The independent variables in this study are the adjusted Andersen PENS (i.e. predisposing, enabling, need and stigma) predictors of service use (Refer Figure 2). Based on the theory, reviewed literature and data availability, the following variables were selected and thereby operationalized as shown in Table 4. It should be noted that few of the variables have been re-coded for the purpose of this study. These variables are polygyny, age at first sex and marital duration. For the original coding, refer to NDHS questionnaires (NPC & ICF International, 2014). However, the coding categories adopted in this research are in consistence with previous studies (Liu et al., 2007; Sambisa, 2008; Antai, 2009; Sarin et al, 2013; Lepine et al., 2014; Semali et al., 2014) except for the "home" category of the place of ANC visit which seems to be newly introduced in this study based on the information available in the NDHS.

Table 4 Operational definitions of selected PENS variables

Variable	Operational definition and measurement
Predisposing variables	
Age	Current age in single completed years (self-reported) at the time of survey
Religion	Religious affiliation: Catholic, Other Christian, Muslim, Traditionalist
Women education	Highest educational level attained: none, primary, secondary, higher
HIV knowledge[a]	HIV knowledge index: factor score
Enabling variables	
Wealth	Household wealth index: factor score
Bargaining power[a]	Bargaining power index: factor score
Intimate partner violence[a]	Index of intimate partner violence: factor score
Polygyny	Number of other wives by partner: none, at least one
Partner's education	Partner's highest level of educational attained: none, primary, secondary, higher
Health insurance	Covered by of health insurance: no, yes
Pre-test ANC-HIV counselling	Received HIV test counselling as part of antenatal care (ANC): no, yes
Residence[b]	Place of residence: Urban, rural
Place of ANC[b]	Place of ANC visit during pregnancy: government owned, private owned, home
Community poverty[b]	Average household wealth index in the community: high, middle, low
Community education[b]	Average level of women's education in the community: low, middle, high
Need factors (Risk behaviour)	
Number of lifetime sexual partner	Number of lifetime sex partners a woman has had: numeric
Age at first sex	Age at first sexual intercourse: Classified as <15, 15-19, 20+ (in years)
History of STIs[c]	History of STIs in the last 12 months preceding the survey: no or yes
Need factors (Risk perception)	
Knows someone with AIDS	Knowledge of someone who has or is suspected to have the AIDS virus: no, yes
Marital duration	Length of marriage in : 0-4, 5-9, 10-14, 15+ (in years)
State HIV prevalence[d]	HIV prevalence rate in the state of residence of a woman : continuous
Stigma variable	
Stigmatising attitude towards PLWH/A[a]	Factor score of stigmatising attitude against PLWH/A index

[a]Variables generated through principal component analysis in this study, [b]Community-level variables

[c] STIs= sexually transmitted infections, [d] State-level variable

Although the 2013 NDHS contains information on observed enacted stigma, the variable is excluded from the analysis since it is only limited to the 2012-2013 year interval with a significantly lower observations – 3,622 (result not shown) - compared to the 5,164 for the period of 2011-2013 selected in this present study. The anticipated stigma and self-stigma variables are not available in the 2013 NDHS dataset. The two literature reviewed in this study which used the anticipated stigma adopted a primary data collection technique (Kilewo et al., 2001; Turan et al., 2011)) rather than the secondary (NDHS) data used in this study. The pre-test HIV counselling variable was generated from a combination of three questions in the survey. Women were asked, as part of your ANC visits for your last birth, did anyone discuss with you about (1) mother to child transmission of HIV (2) how to prevent getting HIV and (3) HIV testing. Binary variable of pre-test ANC-HIV counselling was generated , being "1" if answered "yes" to any of the these questions and "0"otherwise.

Consistent with other studies (Liu et al., 2007; Liu & Becker, 2008; Sambisa, 2008), variables like HIV knowledge, bargaining power, intimate partner violence and HIV stigma in this study were constructed from a set of correlated indicators using the principal component analysis (PCA) with varimax rotation. This technique was used to obtain the household wealth quintile in most DHS including the 2013 NDHS (NPC & ICF International, 2014). The PCA is a statistical tool which is used to condense the number of variable dimensions without significant loss of relevant information. Details about the combined indicators used to generate each of the variables including their measures of internal consistencies and validity, which are acceptable, are attached as appendices A, B, C and D. It should however be noted that, while constructing the AIDS stigma index**,** question on *whether the respondent support that HIV infection in a family should remain secret* was excluded from the index due to its relatively low squared multiple correlation (SMC) - result not shown - with all other indicator included. Also, in the case of HIV knowledge index, question on *whether abstinence is a way of reducing risk of getting HIV* was not included due to its absence from the 2013 dataset, compared to the previous survey. Similar cases of omission were also observed when generating index of bargaining power score such as variables on final say on what food to cook as well as on making household purchases daily.

Asides from place of residence and place of ANC attendance during pregnancy, all other contextual model variables were newly generated and/or added to the dataset. For instance, at the community level, these variables are community poverty level and community women's education which are both categorized as parts of the enabling factors. They were constructed based on household wealth index and level of education as reported by the women in the cluster. Like in Antai (2009) and Lepine *et al.* (2014), the clusters which represent the primary sampling units in the dataset were used as proxies for "communities" in the computation and modelling.

3.6. Missing data

Generally, cases of missing data for the selected NDHS variables in this study are very low. This could be attributed to concerted and well-coordinated efforts of the 2013 NDHS team (NPC & ICF International, 2014). A pre-analysis exploration of the 2013 NDHS women dataset shows that the two selected variables used to generate outcome variable - tested for AIDS virus and got result during any of the ANC attendance – have 100% response rate. In the case of the explanatory variables, where exist, none of them account for up to 1% missing values except for Place on ANC attendance (1.17%), recent history of STIs (1.43%), marital duration (3.52%) and polygyny (6.93%). Based on this relatively small proportion of missing cases, it is therefore assumed that they are not systematic (missing completely at random-MCAR) and are treated with a complete-case-analysis approach. With this approach, any variable with missing value is dropped from the analysis.

3.7. Methodology

Multilevel mixed-effect model

The original Andersen model is a contextual or multilevel model (Babitsch et al., 2011) and the adjusted model in this study is not an exception. Like the initial model, the adjusted model also combine an array of variables including those measured at individual and household levels as well as at higher levels such as the community- and state-level variables. In their assessment of previous studies which have applied the Andersen contextual factors, Philips et al. (1998) noted that the integration of contextual variables with individual or patient level variables has implication on the model operationalization and poses analytical challenges such as autocorrelation and loss of power. To overcome these barriers, the authors suggested the use of a multilevel analysis which enables simultaneous measurement of variables at their different levels.

Further, the hierarchical structure of the 2013 NDHS sampling design indicates that the individuals (level 1) were nested in within clusters/communities (level 2), which were also nested within their respective states (level 3). Using such a complex sampling procedures to study individuals as units of analysis requires identifying and controlling for the hierarchical structure as well as the quantification of the extent of the nesting (Akwara et al., 2003). To meet these analytical demands, a multilevel modelling has been recommended (Akwara et al., 2003) and it has been applied using previous DHS data in Nigeria (Antai, 2009; Lepine et al., 2014).

The Nigerian health sector is characterised by disproportionate differences in quality of service deliveries and resources across regions (NPC & ICF International, 2014). Thereby, considering the high decentralised system of government in the country, the tendencies of unequal level of commitment towards various health programmes and policies across all levels cannot be overlooked. As noted by Lepine et al. (2014) in a study among the Nigerian couples, HIV testing utilization may be influenced differently by unobserved community- and state-level heterogeneities in Nigeria. Furthermore, the ethnic cum cultural diversities which are spread across different communities within most states in Nigeria, do not only mirror the sociocultural identities but also differences in attitudes as well as health-seeking behaviours among others (Antai, 2009). Therefore, the observations from the same community and/or state may not be assumed to be mutually independent, which thereby violate the assumption of independence of observations upon which ordinary logistic regressions are based. Therefore, this study adopted the three-level mathematical multilevel model earlier used by Lepine et al. (2014). The model comprises of fixed effects - measures of association - and random effects - measures of variation - in a single equation. This model has however been modified to address the aim of this research using the adapted model PENS variables and is as written in equation 1 as follows:

$$Logit\ \{Pr\ (V_{iphjk} = 1 | PENS_{iphjk}, \zeta^{(2)}, \zeta^{(3)})\} = \beta_1 + \beta_2 PENS_{2iphjk} + \ldots + \beta_n PENS_{nk} + \zeta_{jk}^{(2)} + \zeta_k^{(3)} \quad (1)$$

Where $PENS_{2iphjk} + \ldots\ldots + PENS_{nk}$ represent a range of independent variables - predisposing (P), enabling (E), need (N) and stigma(S) - of the woman *i*, of her partner *p*, of her household *h*, residing in community *j* which is lodged in state *k*. The $\zeta_{jk}^{(2)}$ and $\zeta_k^{(3)}$ represent the random effect terms at the community (level 2) and state (level 3) respectively, which in turn indicates unobserved heterogeneous PENS characteristics at both the community- and state- level. Based on research question 2d which may likely include finding interactions between the stigma and other model variables, the interaction model equation is thereby written as follows:

$$Logit\ \{Pr\ (V_{iphjk}^{t} = 1 | PENS_{iphjk}^{t}, \zeta_t^{(2)}, \zeta_t^{(3)})\} = \beta_1 + \beta_2 PENS_{2iphjk} + \ldots + \beta_n PENS_{nk} + \beta_2^{t}(S*PEN)_{2iphjk}^{t} + \ldots + \beta_n^{t}(S*PEN)_{nk}^{t} + \zeta_{jk}^{t(2)} + \zeta_k^{t(3)} \quad (2)$$

Where $(S*PEN)_{2iphjk}^{t} + \ldots (S*PEN)_{nk}^{t}$ are a range of logical interaction variables – donated by *t* - between stigma (S) and other model variables (i.e. predisposing (P), enabling (E) and need (N). Also, both the random effect terms have carried the notation *t* to indicate that they belong to interaction model. The fixed effects ($PENS_{2iphjk} + \ldots\ldots + PENS_{nk}$) are retained. The left-hand elements represent the probability of uptake of ANC-HIV testing ($V_{iphjk} = 1$ or $V_{iphjk}^{t} = 1$) by the woman, given her PENS characteristics estimated for both the fixed and random effects terms in both the main-effect (equation 1) and interaction (equation 2) mathematical models.

Model building strategy and statistical analysis

A total of five models were estimated. The first model (*model 0*) is an intercept-only model – a variance component model- comprising no covariates. This model helps to show if there are sufficient variance at higher levels and how the total variance is decomposed into community and state components. The outputted variances from this model are then used to estimate the extent of correlation of individual responses within a community and states (intra-class correlation coefficient- ICC). This is used to justify the necessity of multilevel modelling in this study based on the rule of thumb of at least 10% variance at each of the higher levels (Occhipinti, 2012).

All the individual variables are added simultaneously in *model 1*. The individual-level variables in the analysis include all the household-level variables. Since the average number of eligible women in every household is 1.47 (result not shown), the household could not therefore be regarded as another level of analysis. In *model 2*, all the community-level variables were added and adjusted for. The only state-level variable in this study was then included in *model 3*. The results obtained from the *model 3, the main effects model,* were then sufficient to be used in answering *research questions 2a, 2b, 2c* and, to an extent, the *research question 2d.* In order to identify potential control variables of the stigma effects on ANC-HIV testing, if need be (*research question 2d*), a guideline suggested by Rothman & Greenland (1998) is followed. Implicitly, the guideline states that a variable has to be associated with ANC-HIV

testing uptake (p<0.10), with stigma variable (p<0.10) and must have more than 10% effect change on the association. Such control variable can be regarded as meditating if it is positioned with the causal chain or as confounding if it is found outside the causal chain. The third category is classified as having modifying effects if it neither lays within nor outside the causal chain but changes the association but more than 10%. The interaction effects between HIV stigma and all the identified potential controlled variables on the adapted model outcome variable are explored and included in *model 4.*

This study adopted a purposeful selection of model variables - a step-by-step approach- as illustrated by Hosmer et al. (2013). Compared to other traditional methods such as stepwise, the approach allows the researcher to be responsible for the critical model evaluation rather than solely relying on statistical benchmark. Thus, this variable inclusion procedure allows for a theory-driven variable selections and helps to reduce endogeneity due to omitted variable bias. In summary, the method includes running a univariate analyses of all the selected covariate (step1) and including any variable with *p*-value below 0.25 in the first multivariate model (step2). Step 3 pertains to verifying and refitting of the model until we are confident that only non-statistically and/or clinically irrelevant covariates are excluded. At this stage, tests of potential confounders, mediator and effects modifiers are also carried out. A preliminary main effects model is derived in step 4 after careful re-examination and possible re-inclusion of important (i.e. in terms of its presence with other variables) but non-significant variables in the model. Various model assumptions are tested for in step 5 and *interaction variables* are added at step 6 which produced preliminary interaction model. A test of model fitness is performed in step 7 to arrive at final main effect and interaction models.

A multi-collinearity test was carried out using variance inflation factors (VIF) approach. The squared term of the women's age and the interaction variables were excluded from the VIF analysis. The VIF results show the highest VIF as 2.96 (Refer Figure 4) and the mean VIFs as 1.60. These do not show evidence of multi-collinearity. However, some variables could not pass the (multi) collinearity test and were therefore dropped in order to arrive at the best possible model estimates. This includes dropping of region and ethnicity for religion, children ever born for marital duration, occupation for education as well as MTCT knowledge for pre-test HIV counselling (which contains information on MTCT). This indicates that the hypothesised association between the type of occupation and ANC-HIV testing use would not be included in further analysis due to collinearity. The choice of all the selected final variables is based on the observed statistical and/or clinical relevance in the past studies.

All the fixed effects are expressed are as crude odds ratio (OR) in the univariate (unadjusted) models and adjusted odds ratio (AOR) in the multivariate (adjusted) models. A 95% confidence intervals was used (95% CI). The random effects are expressed as variance partition coefficient (VPC) – otherwise known as intra-class correlation coefficient (ICC) - and proportional change in variance (PCV). The estimates of the variance partition coefficient (VPC) is decomposed into intra-state and intra-community correlation coefficients. The adaptive Gaussian quadrature (AGQ), which is available in Stata by default via *xtmelogit*, is used to estimate the log-likelihood (Gutierrez, 2007). The Likelihood ratio (LR) statistic is used to examine the significance levels of the random effects and their precision level are appraised by the standard error (SE). The multilevel model fitness is tested using deviance information criterion (DIC). All analyses, including the PCA, are performed using Stata statistical software (version 13).

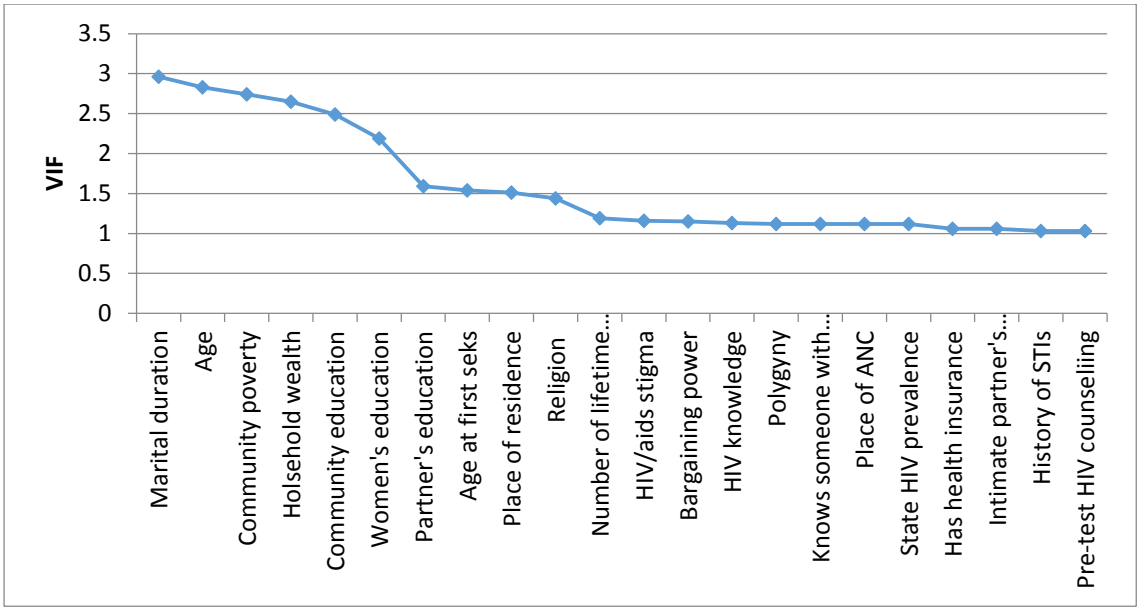

Figure 4: Results of variance inflation factors (VIF) analysis
Data source: 2013 NDHS

3.8. Reflection on the data quality

The 2013 NDHS survey was designed to provide demographic and health estimates at the national, regional, state levels as well as for rural and urban localities (NPC & ICF International, 2014). This enables generalization of findings from the data to the whole study population. Since the 2013 NDHS data is nationally representative, findings made from it can also be compared with other studies across countries. Asides, the response rate for all the eligible women in the study is approximately 98% (NPC & ICF International, 2014), with a very low missing cases, where exist (see section 3.6). Unlike the previous studies which are mostly facility based, the use of the DHS data made available many variables of study interest at national level and also allows use of relatively large sample size, thereby making the study findings to enjoy high statistical power.

However, the data suffer from some limitations. First, the DHS is a cross-sectional survey indicating that cause-effects inferences as well as observation of determinants of ANC-HIV testing overtime are hindered. Also, since the NDHS data is retrospective in nature, the possibility of recall errors cannot be ignored. Examples of vulnerable variables in this study to such errors include pre-test HIV counselling, age at sexual debut, number of lifetime sexual partners, recent history of STIs and marital duration. This forms part of the reasons why only survey information from 2011-2013 were extracted from the whole survey samples covering a period of five years prior 2013. Based on the reviewed literature, information on the anticipated stigma from male partners of the pregnant women could have been the first choice to measure HIV stigma but they are not available in the dataset.

3.9. Ethical consideration

Secondary data, mainly the 2013 NDHS, was used for the data analysis. The DHS had already taken ethical issues into consideration such as the assurance of voluntary participation of respondents, anonymity and confidentiality. The ethical permission for the use of the data in this research was obtained from ICF Macro Inc., USA.

CHAPTER FOUR
RESULTS OF THE EMPERICAL FINDINGS

4.1. Descriptive statistics of outcome and predictor (PENS) variables

The descriptive statistics of all the selected PENS variables and the outcome variable are shown in Table 5. The analysis covered a total of 5,164 women who gave births in the last two years prior to the 2013 NDHS, attended the antenatal care (ANC) and were offered HIV testing as part of the ANC. The descriptive summary (see Table 5) shows that approximately 75% of the 5,164 pregnant women received the ANC-HIV test, indicating that about 1,291 (25%) of the total sampled pregnant women declined the test and perhaps delivered without knowing their HIV status. The percent of ANC-HIV testing uptake (75% of 5,164) shown in Table 5 corresponds to the about 27% of the total 14,220 women who gave births two years prior to 2013 earlier described in Figure 3 (see Section 3.4). Also, as summarized in Figure 3, estimates of ANC coverage between 2011-2013 and ANC-HIV test availability - for those attended ANC – are about 66% (of the 14,220 women) and 55% (of those who attended ANC) respectively.

Table 5 Descriptive statistics of response and outcome variables

Variables	Obs.	Mean	SD	Min.	Max.
Tested for HIV	5164	0.751	0.432	0	1
Predisposing factors					
Age	5164	29.039	6.399	15	49
Age squared	5164	884.182	389.717	225	2401
Religion: Catholic	5142	0.144	0.351	0	1
Religion: Other Christian	5142	0.476	0.499	0	1
Religion: Islam	5142	0.377	0.485	0	1
Religion: Others	5142	0.004	0.059	0	1
Education: None	5164	0.156	0.363	0	1
Education: Primary	5164	0.201	0.401	0	1
Education: Secondary	5164	0.482	0.499	0	1
Education: Tertiary	5164	0.161	0.367	0	1
HIV knowledge	4617	0.000	1.283	-5.418	1.196
Enabling factors					
Wealth	5164	0.438	0.906	-2.121	2.678
Health insurance	5155	0.040	0.195	0	1
Bargaining power	4731	0.000	1.517	-1.873	4.534
Intimate partner's violence	4,112	0.051	1.853	0.619	17.314
Polygyny					
Partner's education: None	4962	0.114	0.318	0	1
Partner's education: Primary	4962	0.182	0.386	0	1
Partner's education: Secondary	4962	0.439	0.496	0	1
Partner's education: Tertiary	4962	0.265	0.442	0	1
Pre-test HIV counselling	5164	0.821	0.383	0	1
Place of ANC: Government owned	5103	0.730	0.444	0	1
Place of ANC: Private owned	5103	0.254	0.436	0	1
Place of ANC: Home	5103	0.016	0.125	0	1
Rural residence	5164	0.426	0.496	0	1
Community education: Low	5164	0.148	0.355	0	1

Table 5 continued

Variables	Obs.	Mean	SD	Min.	Max.
Community education: Middle	5164	0.378	0.485	0	1
Community education: High	5164	0.474	0.499	0	1
Community poverty: Low	5164	0.160	0.367	0	1
Community poverty: Middle	5164	0.348	0.476	0	1
Community poverty: High	5164	0.492	0.499	0	1
Need factors (Risk behaviour)					
Number of lifetime sexual partner	5151	1.649	1.09	1	20
Age at first sex: <15	5157	0.117	0.322	0	1
Age at first sex:15-19	5157	0.518	0.499	0	1
Age at first sex: 20 & above	5157	0.365	0.481	0	1
History of STI	5091	0.039	0.194	0	1
Need factors (Risk perception)					
Knows someone with aids	5119	0.201	0.401	0	1
Marital duration: 0-4years	4982	0.325	0.468	0	1
Marital duration: 5-9years	4982	0.281	0.449	0	1
Marital duration: 10-14years	4982	0.186	0.389	0	1
Marital duration: 15years plus	4982	0.208	0.406	0	1
State HIV prevalence	5164	3.434	3.219	0.2	15.2
Stigma factor					
HIV stigma towards PLWH/A	5148	0.000	1.484	-1.666	3.033

SD: Standard Deviation, N=5,164
Data source: 2013 NDHS

Also in Table 5, the summary analysis of the predisposing characteristics shows that the sampled women had an average of 29 years with a range of 15-49 years. Also, about half of the women had secondary education and were Christians (excluding the Catholics). 37% of the women were Muslims and less than 1% were traditionalists. The score generated for HIV knowledge index has a minimum of -5.418 and a maximum of 1.196 with approximately mean of 0 (see Appendix 2). The distribution of women by the enabling factors reveals that about 44% of the women came from a relatively wealthy household and about the same proportion had partners with secondary education. Though a slightly more women (48%) than their partners (44%) had secondary education, more of their partners/husbands (26.5%) proceeded to obtain tertiary education compared to the women (16.1%). Women who were never married (3.52%) were exempted in the DHS from responding to question regarding partner's level of education. While only 4% had health insurance, about 43% of the women resided in rural areas and at least seven out of every ten women attended ANC at government or public health facilities. Slightly more than 80% of the women received HIV testing information (pre-test counselling) during their ANC visits. Also, about half of the sampled women resided in a community with high level of education (47%) and high level poverty (49%).

With respect to the measures of HIV risk behaviours employed in this study, the analysis result shows that about half of the women had had at least two sexual partners including their current partners. Likewise, at least half of these women initiated sexual activity between 15-19 years. About 4% of them had recent history of sexually transmission infections (STIs), precisely within the last one year prior to the survey. The descriptive statistics of the women by four measures of HIV risk perception were also displayed in the table. Two out of every ten women knew someone living with AIDS**.** The percent distribution of marital duration decreased from about 30% for women who had married for less than 10 years and to about 20% for those who have been in marriage for at least 10 years. The mean state prevalence rate of HIV was 3.4 which corresponds to the national prevalence rate earlier shown in Table 3. The lowest and highest HIV prevalence rate among the 36 states including the Federal captain territory were 0.2 and 15.2 respectively. The descriptive results of the relationship between HIV

prevalence and ANC-HIV testing prevalence per state are mapped out in Figures 5 and 6. As depicted in the figures, uptake of ANC-HIV testing is high in most of the Nigerian states where HIV prevalence is high, an indicative of a positive association which corresponds to the results of the logistic models in Appendix E and Table 6.

As stated in Chapter 3, four of the PENS variables (HIV knowledge, bargaining power, intimate partner's violence and stigma) are generated using principal component analysis (PCA) in this study. Details of the general characteristics of the variables used in computing the scores for these variables are attached as Appendices A, B, C and D. It should further be noted that some of the total number of observations per variable description are somewhat lower than the study sample size of 5,164 women. This was due to the observed cases of missing responses regarding those variables which have has earlier been discussed in the previous chapter**.**

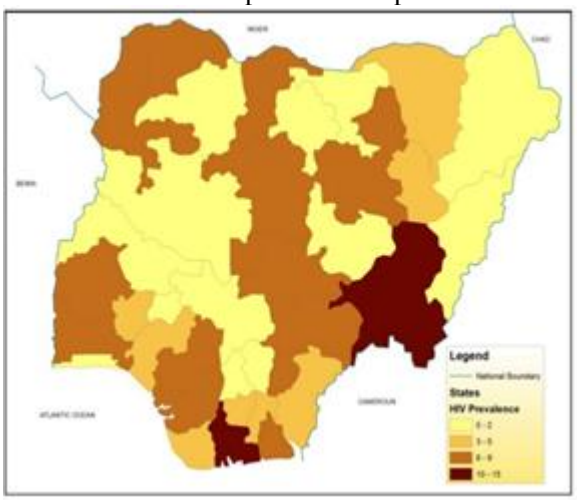

Figure 5: HIV prevalence (%) per state

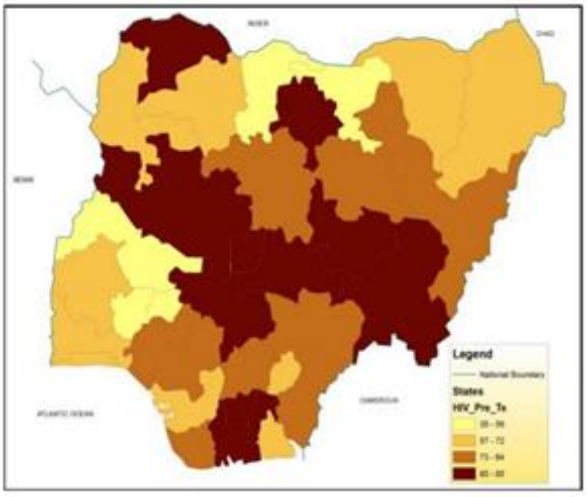

Figure 6: ANC-HIV testing prevalence (%) per state

4.2. Bivariate logistic regression analysis of ANC-HIV testing uptake

The crude association between the PENS factors and the outcome variables are examined at bivariate level of analysis. The result of the bivariate analyses are presented in Appendix E. The results show that all the four predisposing factors (women's age, women's education, religion and HIV knowledge) were significantly associated with ANC-HIV testing. Asides from polygyny and intimate partner's violence (IPV), all other enabling factors included in the analysis were also significantly associated with the ANC-HIV testing uptake ($p<0.05$). These variables are household wealth, bargaining power, health insurance, partner's level of education, pre-test HIV counselling, place of residence, place of ANC visit as well as community education and poverty.

Among the Need factors, only one of the risk behaviour indicators (age at first sex) and all the measures of HIV risk perception (knows someone with AIDS, marital duration and State HIV prevalence) had significant relationships with ANC-HIV testing use. Also at the bivariate model, the effect of the only stigma variable in the study shows that women who stigmatized PLWH/A were significantly less likely to be tested as the odds of utilizing ANC-HIV testing declined with a unit increase in the HIV stigma score. In the Appendix E, it is observed that three variables – namely the intimate partner's violence, multiple sexual partnering and history of STIs - had p-values which are higher than the benchmark of 0.25 (see Section 3.7) and should not ordinarily be considered for multivariate analysis. However, statistical and theoretical evaluations showed that these variables were are very important and attempt to omit them from the multivariate analysis would bias the model estimates, thus making their inclusion necessary.

4.3. Multilevel (multivariate) logistic regression models of ANC-HIV testing uptake

First, as discussed earlier in Chapter 3, the associated total variances in the utilization of ANC-HIV testing with higher level contexts examined in this study were estimated from the Model 0, an empty model with no covariates (see Table 6). This estimate helped to partition the total variance into

community-level and state-level variances which in turn produced the intra-class correlation coefficients (ICC), otherwise known as variance partition coefficients (VPC) for the two levels. The variation in the uptake of ANC-HIV testing across communities ($\tau = 0.69$, $p<0.001$) and states ($\tau = 0.79$, $p<0.001$) were both significant. Based on the estimated variance partition coefficient, the intra-community and intra-state correlations were 31% and 17% respectively. These indicate the extent of variability in the utilization of ANC-HIV testing represented at community and state levels respectively. The outputted ICCs, which are higher than the threshold of 10% signalled that both the community and state levels examined in the model equation have design effects and thereby justifies the use of multilevel logistic regression and further modelling as proceeded below.

All the individual and household level variables were included into Model 1 (see Table 6). Among the predisposing variables included, religion and HIV knowledge were found to be significantly associated with the outcome variable. For instance, the result in model 1 shows that women who practised traditional religion had 77% lower likelihood of been tested for HIV during ANC visit (AOR = 0.23, 95% CI = 0.06-0.87) compared to the Catholic women. Likewise, women with higher HIV knowledge were more likely to be tested for ANC-HIV as a unit increase in HIV knowledge score increased the odds of being tested by 9% points (AOR = 1.09, 95% CI = 1.01-1.18). Also, among the enabling factors, ANC-HIV testing uptake was significantly related to household wealth, household bargaining power and partner's education. A unit increase in the score of household wealth index increased the likelihood of using ANC-HIV testing by over 40% points (AOR = 1.43, 95% CI = 1.19-1.70). After controlling for intimate partner's violence, an increase in the bargaining power score of women increased the ANC-HIV testing uptake by 9% points (AOR = 1.09, 95% CI = 1.01-1.17).

Also in Model 1, the likelihood of ANC-HIV testing uptake was found to be 52% higher among women whose partner had primary education (AOR = 1.52, 95% CI = 1.00-2.31), 63% higher for secondary education (AOR = 1.63, 95% CI = 1.09-2.44), and 70% higher for tertiary education (AOR = 1.70, 95% CI = 1.09-2.67) compared to women whose partners had no education. Further, women who received pre-test HIV counselling during ANC visit were found to have slightly more than two times higher odds of being tested for ANC-HIV (AOR = 2.25, 95% CI = 1.71-2.95), compared to those who were not counselled. Among all the need factors introduced in Model 1, knowing someone with AIDS was found to be significantly associated with uptake of ANC-HIV testing. The odds of being tested for HIV during ANC visit was 40% higher for women who knew someone living with AIDS (AOR = 1.40, 95% CI = 1.00-2.31), compared to women without any knowledge. When other (individual) variables were controlled for in model 1, HIV stigma towards PLWH/A showed no significant association with uptake of ANC-HIV testing (AOR = 1.03 95% CI = 0.95-1.10).

In comparison to Model 0 (the empty model), the variation in the utilization of ANC-HIV testing remained significant across communities ($\tau = 0.72$, $p<0.001$) and states ($\tau = 1.02$, $p<0.001$). The variances of the community- and state-level factors in Model 1 were both higher than those in Model 0, which shows that the inclusion of individual-level variables reinforced both the community and state variances. The proportional change in variances (PCVs) in the odds of ANC-HIV testing uptake of 4% across communities and 29% across states were explained by individual-level characteristics. This shows that the composition of individual characteristics explained part of the nesting of ANC-HIV testing uptake within communities and states. The intra-community and intra-state variances were 34.6% and 20.2% respectively.

Similar patterns of analysis results for odds of ANC-HIV testing uptake obtained in Model 1 - as discussed above - were also observed in model 2. All the enabling community-level variables were controlled for in Model 2. The model result indicates that the odds of utilizing ANC-HIV testing was approximately 50% lower for women who received antenatal care at their homes or other homes for their last birth (AOR = 0.48, 95% CI = 0.25-0.91), compared to those who received antenatal care at government health care facilities. Compared to Model 1, the variation in utilization of ANC-HIV testing remained significant across communities ($\tau = 0.69$, $p<0.001$) and states ($\tau = 1.02$, $p<0.001$). The inclusion of the community level variables only reduced the variance across community from 0.72 to 0.69 ($p<0.001$), leaving the state variance constant. The PCvs of the likelihood of ANC-HIV testing

uptake of 34% across communities and approximately 0% across states were explained by the community-level factors, indicating that part of the nesting of ANC-HIV testing within areas was associated with only the community composition by community-level factors. The intra-community and intra-state variances were 34.3% and 20.5% respectively.

In Model 3, a state level variable - HIV prevalence - was introduced and having controlled for all other PENS variables in the model, it remained significantly related to the use of ANC-HIV testing. The outputted fixed effects from Model 3 are approximately the same with the previous models (1 and 2) except for the variable measuring women bargaining power whose p-value increased to 0.05 (CI= 0.99-1.16) thereby making it to be statistically marginally significant at 5% level. The model also indicates that the likelihood of receiving ANC-HIV testing was higher in states with higher HIV prevalence (AOR = 1.13, 95% CI = 1.02-1.25). Compared to Model 2, the intra-community variance remained appropriately the same and significant ($\tau = 0.69$, $p<0.001$). However, the inclusion of the state level variable reduced the state level variance from 1.02 ($p<0.001$) in Model 2 to 0.88 ($p<0.001$) in Model 3 and also remained significant. Interestingly, this indicates that the addition of the state-level variable only reduced the state variance over the previous model (from 1.02 to 0.88, $p<0.001$). About 0% and 14% of the PCVs across communities and states were due to state HIV prevalence. This suggests that, to an extent, part of the nesting of the utilization of ANC-HIV testing could be attributable to differences in HIV prevalence rates by states. The intra-class correlation coefficients in the model 3 were 32.4% and 18.1% across communities and states respectively.

The outputs of the model 3 are sufficient to answer research questions 2a, 2b, and 2c as well as, to a large extent, research question 2d. However, the interaction model was included mainly to explore the pathways through which HIV stigma is associated with ANC-HIV testing use (research question 2d). For instance, the effect of stigmatising attitude towards PLWH/A was found to be significantly associated with ANC-HIV testing in the bivariate model (see Appendix E). However, when the effect of the other individual variables (Model 1) as well as community (Model 2) and state (Model 3) variables were controlled for, the HIV stigma was no longer significantly associated with the uptake of ANC-HIV testing. Effort was made to identify the potential effect modifiers of the association between stigma and ANC-HIV testing utilization. As shown in appendix F, variables like women's level of education, HIV knowledge, wealth and pre-test HIV counselling were identified to modify the HIV stigma effect on ANC-HIV testing uptake by more than 10%, while they remained significant. Each of these variables found to have significant effects in Model 3 were then interacted with HIV stigma variable to establish their effects on ANC-HIV testing. The results as shown in Model 4 (Table 6) revealed that none of the interaction variables had significant effects on the ANC-HIV testing use.

In all the five estimated multivariate models in Table 6, intra-community correlation coefficients were always higher than the intra-state correlation coefficients, indicating that observations from women from the same community were more homogeneous than those from the same state. The **s**uccessive reduction in Deviance Information Criterion (DIC) from Model 0-3 demonstrates a better fit model over every previous one in Table 6. The lowest deviance for Model 3 compared to the three previous multivariate models indicated that the model fitted the most. Also, as showed by its estimated DIC value of 3196, the interaction model fit better than the previous model.

Table 6 Results of multivariable multilevel mixed-effect modelling of ANC-HIV testing uptake in Nigeria

Variable	Model 0		Model 1		Model 2		Model 3		Model 4	
	Empty model		Individual variables		Community variables		State variable		Interaction variables	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Fixed effects										
Constant	3.84	2.82-5.23	0.93	0.11-7.84	1.26	0.14-11.20	0.85	0.09-7.73	**0.82**	**0.09-7.55**
Predisposing factors										
Age			1.03	0.89-1.189	1.02	0.89-1.17	1.02	0.89-1.18	1.03	0.89-1.18
Age squared			0.99	0.99-1.00	0.99	0.99-1.00	0.99	0.99-1.00	0.99	0.99-1.00
Religion: Other Christian (RC: Catholic)			0.84	0.59-1.19	0.84	0.59-1.19	0.83	0.59-1.19	0.85	0.59-1.21
Religion: Muslim			0.79	0.52-1.22	0.82	0.53-1.27	0.83	0.53-1.27	0.85	0.55-1.31
Religion: Traditionalist			0.23*	0.06-0.87	0.23*	0.06-0.86	0.22*	0.06-0.84	0.22*	0.06-0.83
Education: Primary (RC: None)			0.82	0.56-1.20	0.81	0.55-1.20	0.81	0.55-1.19	0.81	0.54-1.19
Education: Secondary			0.99	0.67-1.47	0.97	0.65-1.46	0.97	0.65-1.46	0.97	0.65-1.46
Education: Tertiary			1.17	0.71-1.93	1.13	0.68-1.88	1.13	0.68-1.88	1.06	0.63-1.78
HIV knowledge			1.09*	1.01-1.18	1.09*	1.01-1.18	1.09*	1.01-1.18	1.11*	1.02-1.20
Enabling factors										
Household wealth			1.43***	1.19-1.70	1.48***	1.21-1.81	1.47***	1.21-1.81	1.47***	1.20-1.80
Health insurance			1.54	0.85-2.75	1.50	0.83-2.69	1.50	0.83-2.69	1.45	0.81-2.60
Bargaining power			1.09*	1.01-1.17	1.08*	1.00-1.16	1.07+	0.99-1.16	1.08+	1.00-1.16
Intimate partner's violence			1.00	0.95-1.06	1.00	0.95-1.06	1.00	0.95-1.06	1.01	0.95-1.06
Polygyny			1.09	0.82-1.46	1.12	0.84-1.50	1.13	0.84-1.51	1.12	0.84-1.50
Partner's education: Primary (RC: None)			1.52*	1.00-2.31	1.61*	1.05-2.45	1.61*	1.05-2.45	1.58*	1.04-2.42
Partner's education: Secondary			1.63*	1.09-2.44	1.73**	1.15-2.61	1.73**	1.15-2.60	1.71*	1.14-2.58
Partner's education: Tertiary			1.70*	1.09-2.67	1.77*	1.12-2.79	1.77**	1.12-2.78	1.75*	1.11-2.76
Pre-test HIV counselling			2.25***	1.71-2.95	2.24***	1.70-2.95	2.24***	1.71-2.96	2.21***	1.67-2.91
Place of ANC: Private owned (Govt. owned)					0.99	0.77-1.28	0.99	0.78-1.28	1.01	0.79-1.30

Table 7 continued

Variable	Model 0		Model 1		Model 2		Model 3		Model 4	
	Empty model		Individual variables		Community variables		State variable		Interaction variables	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Place of ANC: Home					0.48*	0.25-0.91	0.47*	0.25-0.91	0.48*	0.25-0.91
Rural residence					0.87	0.63-1.18	0.85	0.62-1.17	0.86	0.63-1.18
Community education: Middle (RC: Low)					1.11	0.71-1.74	1.09	0.69-1.71	1.08	0.69-1.69
Community education: High					1.27	0.71-2.26	1.23	0.69-2.21	1.22	0.69-2.18
Community poverty: Middle (RC: High)					0.71	0.47-1.07	0.70	0.46-1.06	0.71	0.47-1.07
Community poverty: Low					0.63	0.36-1.11	0.63	0.35-1.10	0.64	0.37-1.12
Need factors (Risk behaviour)										
Number of lifetime sexual partner			1.00	0.91-1.11	0.99	0.90-1.10	0.99	0.90-1.10	0.99	0.89-1.10
Age at first sex: 15-19 (RC: <15)			1.02	0.72-1.44	1.02	0.72-1.45	1.02	0.72-1.43	1.00	0.71-1.41
Age at first sex: 20 & above			0.98	0.97-1.47	0.96	0.64-1.45	0.96	0.64-1.44	0.96	0.63-1.45
History of STI			0.89	0.53-1.49	0.89	0.53-1.45	0.88	0.52-1.48	0.88	0.52-1.49
Need factors (Risk perception)										
Knows someone with aids			1.40*	1.03-1.89	1.44*	1.06-1.95	1.42*	1.05-1.93	1.42*	1.06-1.93
Marital duration: 5-9years (RC: 0-4years)			0.99	0.76-1.30	0.99	0.76-1.29	0.99	0.75-1.30	0.98	0.75-1.29
Marital duration: 10-14years			0.93	0.65-1.35	0.93	0.64-1.35	0.93	0.65-1.35	0.93	0.64-1.35
Marital duration: 15years plus			0.88	0.54-1.45	0.85	0.51-1.39	0.85	0.52-1.39	0.84	0.51-1.39
State HIV prevalence							1.13*	1.02-1.25	1.13*	1.02-1.25
Stigma factor										
HIV stigma towards PLWH/A			1.03	0.95-1.10	1.03	0.96-1.08	1.03	0.96-1.11	0.99	0.76-1.28
Stigma vs. Women's education (primary)									0.96	0.75-1.21
Stigma vs. Women's education (secondary)									0.99	0.79-1.25
Stigma vs. Women's education (tertiary)									0.79	0.58-1.06
Stigma vs. HIV knowledge									0.97	0.93-1.02
Stigma vs. Household wealth									1.01	0.92-1.11

Table 8 continued

Variable	Model 0 Empty model	Model 1 Individual variables	Model 2 Community variables	Model 3 State variable	Model 4 Interaction variables	
Stigma vs. Pre-test counselling					1.09	0.93-1.33
Random effects	**Empty**	**Individual**	**Community**	**State**	**Interaction**	
State-level						
Variance(SE)	0.79(0.21)***	1.02(0.14)***	1.02(0.28)***	0.88(0.25)***	0.88(0.25)***	
ICC=VPC (%)	16.6	20.2	20.5	18.1	18.2	
PCV (%)	Reference	29.1	0.0	13.7	0.0	
Community-level						
Variance(SE)	0.69(0.11)***	0.72(0.15)***	0.69(0.15)***	0.69(0.15)***	0.69(0.15)***	
ICC=VPC (%)	31.0	34.60	34.3	32.4	32.2	
PVC (%)	Reference	4.30	4.2	0.0	0.0	
Model fit statistics						
DIC	5225	3255	3212	3207	3199	
N	5164	3377	3345	3345	3345	

Abbreviations: SE= Standard Error, ICC= Intra-class correlation coefficient, CI= Confidence Interval, DIC= Deviance information criteria, VPC= Variance partition coefficient, PCV= Proportional change in variance, AOR: Adjusted odds ratios (derived from multivariate models where all variables were entered in the models simultaneously).

*******p<0.001; ******p<0.01; *****p<0.05.

+ marginal significant at 5%

Data source: 2013 NDHS.

CHAPTER FIVE
DISCUSSION

Model adaptation to ANC-HIV testing uptake

Due to the gross nature of the outcome measure (use of healthcare service), Andersen (1995) suggested that more contextual-specific measure should be used when adapting the model to a specific type of healthcare service, hence the uptake of ANC-HIV testing in this study. The proposed adapted Andersen behavioural model (AABM) in this study modifies the 1968 Andersen model (Andersen, 1995) in three major ways. Firstly, the 1968 model is expanded with the concept of HIV stigma and desire for HIV testing. The stigma variable is separated from its default place in the 1968 model as part of the predisposing health beliefs factors to form the fourth model explanatory concept (which are now denoted as PENS variables) together with the predisposing, enabling and need factors. The separation is as a result of the observed impacts of the HIV stigma on HIV testing uptake in the literature (Sambisa, 2008; Ayiga et al., 2013; Lepine et al., 2014) and its usual separation as an individual concept in other related frameworks (Weiser et al., 2006; Sambisa, 2008).

Also, though not included in the empirical models of the present study, a desire for HIV testing variable is added as a new concept to the model (see Appendix G). However, unlike the stigma, the HIV testing intention factor could serve as either the outcome (Liu et al., 2007; Liu & Baker, 2008; Odimegwu et al., 2013) or predictor (Ajzen, 1991; Bradley et al., 2002; Ayiga et al., 2013) variable. Furthermore, in a related study, Bradley et al. (2002) suggested that the direction of the relationship between the intended and actual use of healthcare service could be the either way. The possibility of the counter flows of relationships between the two variables is also included in the AABM as depicted in Appendix G. Like the stigma and the intension variable in this study, similar expansions of the Andersen model have been made in the past for variables like disease states (Brown et al., 2009) and ethnicity (Willis et al., 2010).

The second key model modification involves fitting the model need factors with two HIV risk-related variables; the risk behaviour and risk perception rather than the perceived and evaluated need classifications in the initial model. This is based on the premise that ANC patients who engage in HIV risky behaviours and/or perceive risk of having contrasted HIV are more likely to have cue for taking the ANC-HIV test. The classification of the risk behaviours and risk perception as need factors agrees with previous studies (Brown et al., 2009; Babitsch et al., 2011). Thirdly, unlike the 1968 model, the adapted model suggests the pathways through which the PENS factors and their measures can be interrelated while taking decision about the use of antenatal HIV testing service. This is as a result of the earlier criticism by Bradley et al. (2002) concerning the weakness of the original model to fully explain how its domains, and variables can be interrelated.

Results of the empirical analysis

The 75% in ANC-HIV testing prevalence found in this study should not be directly compared with the 28% ANC-HIV prevalence estimated in the 2013 NDHS final report (NPC & ICF International, 2014). This is because the denominator which produced the NDHS report estimate includes women who did not attend ANC while pregnant rather than the sampling criteria employed in this study which excludes those who did not attend ANC or attended but not offered the HIV testing. Since the third-quarters of the pregnant women who met the present study sample were tested for HIV, compared to the slightly more than one-quarter among the general pregnant women population (regardless of whether they received ANC or not), concerted efforts are therefore required to scale up ANC attendance (which is found to be 65% in this study) as well as availability of ANC-HIV testing (which is only 55% of the total number of the ANC attendants) as they both clearly serve as prerequisites for the utilization of the service. This observation is consistent with earlier findings by Larsson et al. (2009).

One of the major strengths of this study is the use of multilevel mixed-effect modelling approach which has been described as highly appropriate for such a complex dataset like the 2013 NDHS (Akwara et al., 2003; Antai, 2009) and for a contextual theoretical model like the AABM (Philips et al., 1998). The results of the multilevel modelling show that the utilization of ANC-HIV testing was clustered within

communities as well as within states and as one would have expected, the observations from women from the same community were more homogeneous than those from the same state. This is not unexpected due to the high ethno-cultural diversities in Nigeria which, to a large extent, serve as markers of cultural and attitudinal identities, socio-economic status and health beliefs (Antai, 2009).

After controlling for the unobserved community- and state-level heterogeneities as well as other PENS variables selected for the multivariate analysis, the study findings show that the enabling factors were the most dominant predictors of uptake of ANC-HIV testing in Nigeria. This is expected since, according to Andersen (1995), the use of healthcare services which are considered to be highly optional or at will (like the uptake of ANC-HIV testing which is voluntary) is likely to be explained more by the enabling factors as well as social and health beliefs characteristics. Five enabling factors (household wealth, bargaining power, partner's level of education, pre-test HIV testing and place of ANC visit) were found to be associated with ANC-HIV testing in Nigeria. Consistent with the previous studies (Semali et al., 2014; Lepine et al., 2014), the study results indicate a positive linear relationship between household wealth and ANC-HIV testing uptake. One possible explanation is that, since higher household wealth could be indicative of higher number of educated household members, women from such household would have higher likelihood of making sound healthcare decision (Kalule-Sabiti et al., 2014; Semali et al., 2014). Though the ANC-HIV test is free in Nigeria, wealthy household could have increased access to healthcare including the ease of transportation to the testing centres (Semali et al., 2014; Lepine et al., 2014) and in this case, the ANC-HIV testing clinics.

Women's bargaining power in the household was also found to be marginally positively associated with the uptake of ANC-HIV testing. This finding supports another study among Nigerian married women which also revealed marginal effect of women's bargaining power on HIV testing - though not necessarily among the pregnant women attending ANC - (Lepine et al., 2014). In line with another finding by Semali et al. (2014), this study found strong association between uptake of pre-test ANC-HIV counselling and uptake of ANC-HIV testing as pregnant women attending ANC who received the comprehensive HIV counselling were found to be more than twice likely to be tested compared to their counterparts who did not receive the HIV counselling. The pre-test HIV counselling which included information of MTCT in the 2013 NDHS could be argued to enable the antenatal attendants to have improved knowledge of how to prevent MTCT and hence the HIV testing uptake.

However, incongruent with other studies (Bajunirwe & Muzoora, 2005; Ayiga et al., 2013; Semali et al., 2014), the woman's level of education was not associated with use of ANC-HIV testing but rather the education level of their male partners. This could be as a result of the highly multivariable analysis adopted in this study as against the lack of control for partner's education by Ayiga et al. (2013) and Semali et al. (2014), and bivariate analysis used by Bajunirwe & Muzoora (2005). Intuitively, this result is not unexpected since on the average, Nigerian men are more educated than their women (Lepine et al., 2014). The effects of women's education status particularly in a largely polygamous country like Nigeria could be expected to be taken over by that of their partners. Despite the facts that only small proportion (about 2%) of the study sample received antenatal care and ANC-HIV testing offers at their homes or other homes, the multivariate analysis results showed that the ANC-HIV testing uptake was generally low among this subgroup compared to their counterparts who received the ANC at government-owned clinics or hospitals. This study seems to be the first to establish this relationship. As earlier stated in Chapter 2, enabling factors are usually highly mutable for short-term policies. This points to the advantage of the dominant influence of the enabling factors over the predisposing, need and stigma factors on the use of ANC-HIV testing in this study.

Among the predisposing factors, both religion and HIV knowledge were associated with ANC-HIV testing uptake. Previous literature has indicated common attribution of illness among traditional religion followers to divine affliction, witchcraft, anger of the ancestors, affliction from sorcerers and infringement on taboos (Aguwa, 2010). This explains the present findings which showed low uptake of ANC-HIV testing among pregnant women attending ANC who practised traditional religion compared to the catholic women. Similar findings have been previously documented in Nigeria (Lepine et al., 2014) and Zimbabwe (Sambisa, 2008). Also consistent with the previous study by Lepine et al. (2014),

positive relationship was indicated between HIV knowledge score and the likelihood of taking the ANC-HIV test. This pattern of relationship could be expected as HIV knowledge is generally high among antenatal attendants in Nigeria (Igwegbe et al., 2005).

Furthermore, HIV risk perception, operationalized as knowing someone living with AIDS and state HIV prevalence, served as the need factor for ANC-HIV testing uptake. Similar to this finding, HIV testing utilization among Nigerian women in general has also been associated with knowing someone living with AIDS (Lepine et al., 2014). However, unlike the same study by Lepine et al. (2014), state HIV prevalence was found to be an important need predictor of ANC-HIV testing in this present study. This could be as a result of the continued and improved HIV/AIDS campaign programmes over the years in Nigeria (Osonwa et al., 2013; Adegoke et al., 2014; Martins et al., 2015) which in turn could have increased the HIV/AIDS prevalence awareness between 2008 when the NDHS data used by Lepine et al. (2001) was collected and 2013, the year the data used in this study was gathered.

The negative impacts of HIV-related stigma on HIV testing uptake have been documented in the literature (Sambisa, 2008; Ayiga et al., 2013; Lepine et al., 2014). However, findings showing association between HIV stigmatizing attitudes towards PLWH/A (one of the HIV stigma measures) and HIV testing use among pregnant women attending ANC is scanty. The attempt in this present study revealed no significant association between these two variables. This finding is somewhat similar to previous finding in Tanzania - by Semali et al. (2014) -, where the effect of the stigmatising attitude only approached but could not quite reach the traditional significance level criterion of 0.05 (AOR=1.29, p=0.103). However, when anticipated stigma from male partner (another HIV stigma measure) was used as an indicator of HIV stigma, Turan et al. (2011) documented its strong negative effects on the use of ANC-HIV testing among the pregnant women attending ANC, after adjusting for other individual variables. Turan et al. (2011) explained that since the pregnant woman is usually the first to be tested for HIV in a family which is perhaps through the provider-initiated testing and counselling (PITC) in health facilities, she may be afraid of suffering from severe negative consequences from her male partner after the disclosure of her new HIV status, if tested positive. This association could not be examined in this present study due to lack of information on the anticipated stigma from male partner in the secondary data used.

However, since the effect of having stigmatizing attitudes towards PLWH/A on ANC-HIV testing uptake was strong in the unadjusted model of the present study, effort was made to identify the potential effect modifier(s) between the two variables. Using the guideline proposed by Rothman & Greenland (1998), four variables were identified as important effect modifiers of the independent association between HIV stigma and ANC-HIV testing uptake observed earlier in the unadjusted model. These variables are HIV knowledge, household wealth, pre-test HIV counselling and women's level of education. Of all the identified variables (potential effect modifiers), only the women's level of education was controlled for by Semali et al. (2014) and thus the possible reason for the observed marginal effect of the stigmatising attitude on the uptake of ANC-HIV testing in their study. The present study findings can be possibly explained by the earlier suggestion by Ow & Lee (2012) that externalization and group identification have potential effect on Stigma. Inferably, this could indicate that the pregnant women who are educated, more knowledgeable about HIV/AIDS or come from wealthy family and/or who go out for ANC and received HIV counselling (which includes information on MTCT), are likely to have reduced or insignificant effect of stigmatising attitudes towards PLWH/A on their uptake of ANC-HIV testing in Nigeria.

Limitations of the study findings

The study empirical findings are not without some limitations, most of which are largely due to either the nature of the variables used or their complete absence from the dataset. Firstly, the 2013NDHS (women data) only contained information on individual woman's stigmatising attitude and observed enacted stigma towards PLWH/A. However, only the information on the former is usable for this present study (see section 3.5). The absence of information on the other dimensions of HIV stigma especially the anticipated stigma from partner in the dataset dented greatly the study efforts to support the importance of this key barrier variable - HIV stigma - in the adapted model (AABM) for the ANC-HIV testing in this study. As preciously explained, the anticipated stigma from partner, rather than most of the other HIV stigma dimensions, was found to influence strongly the use of antenatal HIV testing in a previous study (Turan et al., 2011).

Secondly**,** the 2013 NDHS did not include information on the HIV status of the women which has been suggested to have potential impact of some of the model variables like the HIV knowledge and stigma (Lepine et al., 2014). Similar cases of absence of variables from the dataset were observed for variables like ever use of condom, prior HIV testing, knowing whether partner has been tested or not, non-sex related HIV risk behaviour, and intended future use of ANC-HIV testing. Though, the information available on the history of STIs is limited to 2012-2013 year interval rather than the 2011-2013 covered in this study, STIs variable was however included in the analysis after a sensitivity test was run and yielded no conspicuous difference. Likewise, absence of direct variable measuring HIV risk perception prompted the use of its proxy measures. However, the presence of its direct measure in the dataset might have helped to easily examine the proposed interactions with Stigma and risk behaviour in the AABM. As previously noted by Andersen et al. (2007), the use of cross-sectional data makes it difficult to unravel the causal relationship between risk behaviours and risk perceptions. Furthermore, there could have been cases of misreporting of HIV testing due to recall errors. Besides, since the data is self-reported, some of the information could have been underreported particularly on sensitive information such risky sexual behaviour.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

Two main objectives are addressed in this study namely; 1) To adapt the Andersen behavioural model to the context of ANC-HIV testing uptake (the secondary aim of the study) and, 2) To understand factors influencing uptake of ANC-HIV testing among pregnant women in Nigeria (the primary aim of the study) using the adapted Andersen behaviour model. Based on the research findings, the following conclusions can be made:

Conclusion on the model adaptation to ANC-HIV testing studies

This study is the first to apply the Andersen behavioural model to the utilization of antenatal HIV testing and it has described how the initial model, which was originally designed to study healthcare service use, can be adapted to explain uptake of ANC-HIV testing as the outcome measure. Based on the reviewed literature in this study, the following three major modifications are concluded to be made to the initial Andersen model in order to improve its applicability particularly when adapted to ANC-HIV testing studies:

1. In addition to the predisposing, enabling and need factors, the model can be expanded with other two concepts namely, the HIV stigma and desire for HIV testing.
2. The need factors can be operationalized as measures of HIV risk behaviour and risk perception.
3. Possible interactions among the model concepts and variables including the newly introduced ones can be incorporated into the model.

The adapted Andersen behavioural model (AABM) developed in this present study does not only have high explanatory power but also a useful and highly integrated framework to study the predictors of antenatal HIV testing. Due to the nature of the reviewed literature and theories which serve as guides for the model modifications to suit its adaptation to ANC-HIV testing, the AABM can also be adopted to study HIV testing outside antenatal care vicinity as well as in other geographical spaces. Any major concern is likely to be largely empirical (especially on the operationalization of HIV stigma) rather than theoretical.

Conclusion on the empirical findings

This study is also the first attempt to examine the uptake of antenatal-integrated HIV (ANC-HIV) testing in Nigeria using a nationally representative data. To do so, the adapted model (AABM) in this study is applied. It is observed that three quarters of the expectant mothers attending ANC received HIV testing, while the remaining one quarter who refused adds to the vulnerability circle of MTCT. Based on the empirical findings, while bearing in mind their limitations as discussed in the previous chapters, the study can thereby conclude that among the pregnant women in Nigeria:

1. Both religion and HIV knowledge predispose the use of ANC-HIV testing.
2. Household wealth, bargaining power, partner's level of education, pre-test HIV counselling and place of ANC visit during pregnancy are the enabling factors for the uptake of ANC-HIV testing.
3. HIV risk perception - as measured by knowing someone with AIDS and state HIV prevalence- are found to be important need factors for uptake of ANC-HIV testing.
4. Stigmatizing attitude towards people living with HIV/AIDS is not associated with the use of antenatal HIV testing especially when variables like household wealth, HIV knowledge, women's level of education and pre-test HIV counselling are adjusted for. The study finding also reveals that though HIV/AIDS stigma is a barrier factor to HIV testing services, it does not have an independent effect on the utilization of antenatal HIV testing in Nigeria when measured with stigmatizing attitude among the pregnant women in Nigeria.

Among the model (PENS) variables, the enabling factors dominated the predictors of ANC-HIV testing uptake in Nigeria. Both the antenatal care attendance and ANC-HIV testing availability are gateways to the utilization of ANC-HIV testing. Besides, on the basis of the observed variances in the ANC-HIV testing use, this study can also conclude that there are significant contextual dissimilarities in the utilization of antenatal HIV testing across the Nigerian states and communities.

6.2. Recommendations for policy actions

No doubt, the possibility of Nigeria achieving the 90% target for antenatal HIV testing coverage by 2015 (NACA, 2014; UNAIDS, 2014a) is very slim. As at 2013, the national ANC-HIV testing prevalence was 28% (NPC & ICF International, 2014), an estimate which ignores ANC attendance and the extent of ANC-HIV testing availability. Even in this study where these two conditions are controlled for, the ANC-HIV prevalence (75%) is still sort of the desirable target. Therefore in order to make up for the failures of the past and fast track the attainment of future 90-90-90 targets (UNAIDS, 2014b) in Nigeria, the following policy actions are suggested:

1. The enabling factors – Wealth, bargaining power, partner's education, pre-test counselling and place of ANC visit- dominated the predictors of the utilization of ANC-HIV testing in this study. These are largely mutable factors for short-term policies and should be given priority in the future policy actions. For instance, though HIV testing is free in Nigeria, government may consider giving incentives (in cash or kind) to ANC-HIV testing utilizers. Furthermore, programmes that target on women empowerment, incorporation of male partners during ANC visit of their wives, and improved comprehensive pre-test HIV counselling coverage can also be instituted and/or supported. Likewise, as showed in this study, ANC-HIV testing uptake is high among pregnant women attending antenatal care and who were offered HIV testing service as part of ANC. Hence, pragmatic policies are needed to scale up the coverage of antenatal care and HIV testing offers during ANC visit in Nigeria. In order to reach pregnant women who are not attending ANC – which were about 35% in this study -, house-to-house ANC services which will include HIV counselling and testing are suggested.
2. In order to improve the comprehensive HIV knowledge which is a relatively mutable predisposing health belief factor, far-reaching media and other campaign strategies suitable for each community or state are advocated for. Such awareness campaigns should target more the traditional religious groups but also the rural dwellers and the less educated.
3. Based on the Andersen model's concept of mutability, successes in (1) and (2) above would bring about informed HIV risk perceptions (which its self has low mutability for short-term policies) and serve as cue for taking the ANC-HIV testing.
4. Improved HIV knowledge, pre-test HIV counselling services, poverty eradication and other women empowerment programmes are suggested as tools for mitigating against the impacts of the stigmatizing attitude towards PLWH/A on the use of antenatal HIV testing in Nigeria.
5. Lastly, policies intervention programmes should focus not only on the individual context but also on the community and state contexts when implementing above recommendations in any of their efforts to achieve the future policy targets.

6.3. Recommendations for further research

Despite the several fascinating findings documented in this study, there are still rooms for further research. The identified areas for further studies include both the conceptual and empirical specific issues.

The conceptual-specific recommendations for further research

1. In order to establish the importance of the HIV stigma factors on the ANC-HIV testing uptake in the adapted model (AABM), future studies should explore other dimensions of stigma measures – such as the observed enacted stigma, anticipated stigma and self-stigma -, rather than just the stigmatising attitude towards PLWH/A used in this study. When applied to ANC-HIV testing context, preference may be given to the anticipated stigma from partners. It is further suggested that all the four identified effect modifying variables of the HIV stigmatizing attitude effects on ANC-HIV testing uptake should also be controlled when using any of the other HIV stigma dimensions.
2. This present paper could not study the link between intended and actual uptake of ANC-HIV testing mainly as a result of data limitation. This is a gap for future research to fill using the adapted Andersen behavioural model proposed in Appendix G. This will help us to access how well does the desired uptake translates into the actual uptake of ANC-HIV testing and vice versa.

3. Aside from its use in the ANC-HIV testing studies, future related research should also test the applicability of the AABM with focus on HIV testing among other population groups such as the youth, men, couples etc. The AABM also needs to be applied in other geographical spaces.
4. Lastly, the proposed capability of using the adapted model to examine interrelations among the model variables requires to be tested.

The empirical-specific recommendations for further research

1. Qualitative studies and/or primary data collection design are needed for better conceptualizations and/or direct measurement of HIV risk perceptions and risk behaviours particularly among the childbearing women. The concept of risk behaviour may include engagement in sex with casual or risky partners, current and past sexual behaviour of the partner, HIV status of the sexual partner, untreated STIs (Akwara et al., 2003) and other non-sexual risk behaviour such as sharing of unsterilized needles. This will also enable us to examine the proposed interrelations among the adapted model variables.
2. It is strongly suggested that future studies on the utilization of ANC-HIV testing should explore other dimensions of HIV stigma (such as enacted stigma and anticipated stigma either from partner, other family members, healthcare givers, and the community at large) in their analysis. As shown in the literature, special attention may be given to the anticipated stigma from partner in the future.
3. As recommended by Philips et al. (1998), more contextual variables should also be included when applying the Adapted model in the future. These may be at the health facility, household, community, state or country level among others.
4. Very importantly is the inclusion of information on respondent's HIV status in the future empirical modelling or during data collection. Since this information is also lacking in the 2013 NDHS and given the prevalently high HIV rate in Nigeria, this study thereby suggests that the DHS program may need to consider conducting AIDS Indicator Survey (AIS) in the country like it is being done in other countries such as Tanzania, Uganda, Mozambique, Congo etc. (DHS program, 2015). Unlike the DHS, the AIS survey usually include variable on HIV prevalence, which may have impacts on stigma, HIV knowledge and even ANC attendance. The DHS may also need to consider gathering information on other dimensions of HIV stigma such as self and anticipated stigma as part of its survey.

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Appendices

Appendix A Result of principal component analysis for HIV/AIDS stigma

Variable	Observations(n)	Mean	Sd	Min.	Max.	Factor loading
Willing to care for relatives with AIDS	5162	0.75	0.43	0	1	0.36
A female teacher with AIDS should continue teaching	5160	0.69	0.46	0	1	0.49
Would buy vegetables from vendor with AIDS	5162	0.58	0.49	0	1	0.45
People with AIDS should be ashamed of themselves	5158	0.61	0.49	0	1	0.48
People with AIDS should be blamed for bringing the disease to the community	5160	0.59	0.49	0	1	0.44
Eigenvalue of the first component						2.2
Difference between first and second eigenvalues						0.95
Proportion of variance explained by the first component						0.44
Kaiser-Meyer-Olkin measure of sampling adequacy						0.64
Rho						0.69
Number of observations included in PCA						5148

Data source: 2013 NDHS

Appendix B Result of principal component analysis for HIV Knowledge

Variable	Observations(n)	Mean	Sd	Min.	Max.	Factor loading
Reduce HIV risk by always using condom during sex	5154	0.76	0.43	0	1	0.24
Reduce HIV risk by having one negative sexual partner only	5161	0.91	0.28	0	1	0.30
Can get HIV from mosquito bites	5159	0.77	0.42	0	1	0.5
Can get HIV by sharing food with person who has AIDS	5159	0.87	0.33	0	1	0.51
A healthy looking person can have AIDS	5134	0.81	0.39	0	1	0.18
Can get HIV by witchcraft or supernatural means	5156	0.74	0.44	0	1	0.49
Drugs to avoid HIV transmission to baby during pregnancy	4668	0.83	0.38	0	1	0.27
Eigenvalue of the first component						1.65
Difference between first and second eigenvalues						0.32
Proportion of variance explained by the first component						0.24
Kaiser-Meyer-Olkin (kmo) measure of sampling adequacy						0.62
Rho						0.43
Number of observations included in PCA						4617

Data source: 2013 NDHS

Appendix C Result of principal component analysis for Bargaining power

Variable	Observations(n)	Mean	Sd	Min.	Max.	Factor loading
Final say on own health care	4,817	0.58	0.62	0	2	0.56
Final say on making large purchases on the household	4,816	0.59	0.62	0	2	0.54
Final say on visits to families or relatives	4,825	0.73	0.65	0	2	0.51
Final say on what to do with the husband's salary	4,755	0.4	0.58	0	2	0.38
Eigenvalue of the first component						2.3
Difference between first and second eigenvalues						1.5
Proportion of variance explained by the first component						0.58
Kaiser-Meyer-Olkin measure of sampling adequacy						0.74
Rho						0.58
Number of observations included in PCA						4753

Data source: 2013 NDHS

Appendix D Result of principal component analysis for intimate partner's violence

Variable	Observations(n)	Mean	Sd	Min.	Max.	Factor loading
Ever been pushed, shook or thrown with something by husband	4,127	0.08	0.27	0	1	0.41
Ever been slapped by husband	4,129	0.15	0.36	0	1	0.39
Ever been punched with fist of hit by harmful object by husband	4,126	0.04	0.19	0	1	0.42
Ever been kicked or dragged by husband	4,127	0.06	0.24	0	1	0.4
Ever been strangled or burnt by husband	4,126	0.01	0.08	0	1	0.25
Ever been threatened with knife/gun /other weapon by husband	4.128	0.01	0.07	0	1	0.17
Ever been physically forced into unwanted sex by husband	4,128	0.05	0.22	0	1	0.25
Ever been forced into other unwanted sexaul acts	4,127	0.02	0.12	0	1	0.2
Ever had arm twisted or hair pulled by husband	4,126	0.03	0.17	0	1	0.37
Eigenvalue of the first component						3.28
Difference between first and second eigenvalues						2.03
Proportion of variance explained by the first component						0.36
Kaiser-Meyer-Olkin (kmo) measure of sampling adequacy						0.81
Rho						0.62
Number of observations included in PCA						4112

Data source: 2013 NDHS

Appendix E Result of bivariate logistic regression analysis of ANC-HIV testing uptake

variable	OR	95% CI	p-value
Predisposing factors			
Age	1.17***	1.07-1.28	0.000
Age squared	0.99***	0.98-1.00	0.000
Religion: Other christian (RC: Catholic)	0.81	0.61-1.06	0.127
Religion: Muslim	0.65**	0.47-0.91	0.012
Religion: Traditionalist	0.24**	0.08-0.71	0.010
Education: Primary (RC: None)	1.00	0.85-1.43	0.467
Education: Secondary	1.57***	1.22-2.02	0.000
Education: Tertiary	2.71***	1.98-3.71	0.000
HIV knowledge	1.23***	1.15-1.30	0.000
Enabling factors			
Household wealth	1.79***	1.59-2.01	0.000
Health insurance	2.07***	1.31-3.29	0.002
Bargaining power	1.09***	1.02-1.15	0.006
Intimate partner's violence	0.99	0.94-1.03	0.534
Polygyny	0.82*	0.67-1.01	0.057
Partner's education: Primary (RC:None)	1.59***	1.18-2.14	0.002
Partner's education: Secondary	2.07***	1.57-2.72	0.000
Partner's education: Tertiary	3.01***	2.24-4.03	0.000
Pre-test HIV counselling	2.33***	1.93-2.82	0.000
Place of ANC: Private owned (Govt. owned)	1.10	0.91-1.34	0.337
Place of ANC: Home	0.48***	0.28-0.81	0.007
Rural residence	0.63***	0.51-0.79	0.000
Community education: Middle (RC:Low)	1.22	0.89-1.67	0.012
Community education: High	1.73***	1.25-2.42	0.000
Community poverty: Middle (RC:High)	1.33*	0.99-1.78	0.053
Community poverty: Low	1.69***	1.25-2.29	0.001
Need factors (Risk behaviour)			
Number of lifetime sexual partner	1.02	0.95-1.09	0.621
Age at first sex: 15-19 (RC: <15)	1.20	0.95-1.52	0.127
Age at first sex: 20 & above	1.37**	1.06-1.77	0.015
Resent history of STI	1.11	0.73-1.68	0.621
Need factors (Risk perception)			
Knows someone with aids	1.43***	1.15-1.79	0.002
Marital duration: 5-9years (RC: 0-4years)	1.11	0.28-92	0.284
Marital duration: 10-14years	0.87	0.69-1.08	0.210
Marital duration: 15years plus	0.76**	0.62-0.94	0.011
State HIV prevalence	1.13***	1.04-1.23	0.004
Stigma factor			
HIV/AID stigma	0.91***	0.86-0.95	0.000

Data source: 2013 NDHS

Appendix F Identifying the effect modifying variables of the association between stigma and ANC-HIV testing

Model	Variable	β	SE	z-score	p-value
A	Stigma	*-0.099*	0.027	-3.690	0.000
B	Stigma	*-0.068*	0.027	-2.490	0.013
	Education: primary (RC: None)	0.108	0.133	0.810	0.419
	Secondary	0.436	0.128	3.400	0.001
	Higher	0.947	0.161	5.870	0.000
C	Stigma	*-0.059*	0.030	-1.970	0.049
	HIV knowledge	0.184	0.033	5.610	0.000
D	Stigma	*-0.052*	0.027	-1.900	0.057
	Wealth	0.556	0.060	9.230	0.000
E	Stigma	*-0.084*	0.027	-3.060	0.002
	Pre-test HIV counselling	0.819	0.098	8.380	0.000

Data source: 2013 NDHS

Appendix G Proposed Adapted Andersen Behavioural Model (AABM) to ANC-HIV testing uptake