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Health System Predictors of Antenatal Care Compliance Among Rural Congolese Women

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This is to certify that the doctoral dissertation by

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Walden University
2016

Abstract

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by

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MD, University of Kinshasa, 1990

MPH, University of Kinshasa, 1995

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Fewer rural Congolese women complete 4 antenatal care (ANC) visits than do urban women, despite high maternal and child mortality rates. This quantitative cross-sectional survey applied Andersen's behavioral model of service utilization to examine whether the ANC facility type, provider type, provider gender, time to ANC facility, cost, and number of services can predict ANC compliance among rural women. The study was a secondary analysis of the 2015 Maternal and Child Health (MCH) survey, which comprised 1,280 eligible women selected through stratified random sampling. The analysis included bivariate and multivariate logistic regressions. The findings showed that women seen in private facilities, AOR = 2.220, 95% CI [1.384, 3.561], $p < .01$; women seen by female providers, AOR = 1.407, 95% CI [1.055, 1.877], $p < .05$; and women receiving 7 to 9 ANC services, AOR = 1.680, 95% CI [1.142, 2.472], $p < .05$, were more likely to complete 4 ANC visits. The cost of services and time to the ANC facility had no association with ANC compliance. Further analysis showed that private facilities provided more services (median of 6 vs. 5, $p = .000$) and had more women attended to by doctors (11% vs. 2%, $p = .000$) and female providers (72.9% vs. 58.4%, $p < .001$). These findings suggest that service quality and provider gender play a role in ANC compliance in rural areas. Therefore, Congolese health authorities should establish quality improvement programs and incentives to attract female providers to rural areas. This study contributes to positive social change by identifying ANC access barriers of rural populations and informing future efforts to close the urban-rural gap in MCH outcomes.

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Dedication

All the glory and honor to the Almighty God for fulfilling my lifelong dream. I thank Him for His love, mercies, and provisions.

I thank my dear wife and childhood friend, Mimika, and precious children, Joseph, Sarah, Allen, and Rebekah, for your true love, trust, support, and understanding, without which I would not have completed this thesis.

I am grateful to my brothers and sisters in Christ, friends, and relatives for your spiritual support, prayers, and encouragement.

To you all, I dedicate this thesis with a special feeling of gratitude.

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Finally, I thank Carey Little Brown for proofing, editing, and transforming this dissertation into a readable document.

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Chapter 1: Introduction to the Study

Introduction

The Democratic Republic of Congo (DRC) has the third and fifth largest maternal and neonatal mortality burdens in the world, respectively (UNICEF, 2014a). There are effective interventions delivered during antenatal care (ANC), childbirth, and postnatal care (PNC) that can eliminate almost all preventable maternal and neonatal deaths (Campbell, Graham, & Lancet Maternal Survival Series Steering Group, 2006; Darmstadt et al., 2005). For many women, ANC is a vehicle for providing multiple interventions to prevent, identify, and manage pregnancy-related complications, diseases, and health risks (World Health Organization [WHO], 2009). However, despite 87% of rural Congolese pregnant women starting ANC during pregnancy, only 42% complete the recommended four visits to take advantage of its full benefits (DHS Program, n.d.b). This study was the first in the DRC to investigate how the health system interacts with ANC compliance among rural Congolese women. Its findings may guide the design of interventions to help rural Congolese women and children survive and achieve better health.

Chapter 1 presents background on ANC compliance with a summary of what is in the literature and the remaining knowledge gap. It includes a statement of the problem, its significance to the discipline, the purpose of the study, research questions and hypotheses, and the theoretical foundation underpinning the study. It contains a description of the nature of the study, including its design, variables, and methodology. It presents the study's definitions, assumptions, scope, delimitations and limitations, and implications for positive social change.

Background

High Maternal and Child Mortality in the DRC

Women and children continue to succumb to diseases and conditions that are both preventable and treatable, despite medical and technological advances (Campbell et al., 2006; Darmstadt et al., 2005). The greatest risk of maternal and child death is increasingly concentrating on the poor and deprived populations of sub-Saharan Africa (SSA) and South Asia (UNICEF, 2014a). Many years of colonization, dictatorship, corruption, and civil war have led the mineral-rich DRC to become the second lowest Human Development Index country in the world (United Nations Development Programme [UNDP], n.d.). Its estimated that per capita gross domestic product (GDP) reached US$309 in 2014 (World Bank Group, 2015a). The last 2 decades of war have destroyed both the infrastructure and health system. As a result, maternal and child mortality rates are among the highest in the world: 846 per 100,000 live births and 109 per 1,000 live births, respectively (DHS Program, n.d.). Thus, women and children living in the DRC have 30-fold and 15-fold increased risks of dying when compared with those in the United States (DHS Program, n.d.b; UNICEF, 2014a; WHO, 2014).

Antenatal Care, Maternal Health, and Perinatal Outcomes

Oakley, Gray, Kurinczuk, Brocklehurst, and Hollowell (2009) demonstrated that ANC is an effective intervention that improves maternal health and pregnancy outcomes, in particular in socially disadvantaged populations. It facilitates the identification and timely treatment of conditions related to pregnancy and allows health professionals to identify women at increased risk of pregnancy and delivery complications (WHO, 2009).

Furthermore, access to ANC increases the likelihood of skilled delivery care (Yanagisawa, Oum, & Wakai, 2006) and family planning services (Bbaale, 2011; Yadav & Dhillon, 2015).

Asundep et al. (2014) in Ghana showed that attending fewer than four ANC visits was associated with a higher likelihood of adverse pregnancy outcomes in comparison with attending four or more visits, adjusted OR = 2.55, 95 % CI [1.16, 5.63], $p = .02$. Hawkes, Gomez, and Broutet (2013) conducted a meta-analysis on ANC timing and syphilis transmission. The findings showed that women attending ANC late had a high likelihood of syphilis-related adverse outcomes, OR = 2.42, 95% CI [1.27, 4.59], $p = .003$. These studies established the beneficial effects of ANC on pregnancy outcomes.

Current Status of Antenatal Care in the DRC

In 2013, the DRC government launched the national child survival acceleration plan 2013-2015, which aimed to save 430,000 and 7,900 lives among children under 5 years of age and mothers, respectively (UNICEF, 2013). The plan identified ANC as an effective intervention to help the government achieve its ambitious goal. The vast majority of Congolese pregnant women attend at least one ANC visit. However, compliance with the recommended four visits for uncomplicated pregnancies has remained a major challenge. The DHS 2014 showed that only 48% of women who had given birth in the 5 years preceding the survey reported having attended ANC at least four times (DHS Program, n.d.b). The trend in ANC utilization showed that the proportion of women complying with four or more ANC visits had stagnated below 50%, from 46.7% in the DHS 2007 to 48% in the DHS 2014 (DHS Program, n.d.a).

Both surveys showed a considerable urban-rural gap in ANC compliance with four visits, and coverage has remained lower and stagnated among rural women (42% in 2007 and 2014) in comparison with urban women (53% in 2007 and 60.7% in 2014) (DHS Program, n.d.a, n.d.b). The effectiveness of ANC depends on the interventions provided to prevent, detect, and manage pregnancy-related conditions and health risks (Asundep et al., 2014). Therefore, poor ANC compliance may have resulted in service underutilization and may partly explain the high maternal and perinatal mortality in the DRC.

Knowledge Gap

Repeated surveys in the DRC have shown that ANC compliance with the recommended four visits has stagnated below 50% among rural Congolese women, and previous efforts did not succeed in correcting the situation. There are very few studies of the determinants of ANC compliance with four visits in developing countries. In a study conducted in Vietnam, Trinh, Dibley, and Byles (2007) observed that health system characteristics may influence the adherence of rural women with the recommended number of visits. No study has examined the association between health system characteristics and ANC compliance with four visits in rural DRC. Therefore, it has remained unknown how the experiences of rural Congolese women during ANC affect their adherence to the recommended visits for uncomplicated pregnancies. The current government's efforts to accelerate the reduction of maternal and child mortality have needed the guidance of local evidence. This study was aimed to fill that knowledge gap

by examining the relationship between health system characteristics and the compliance of rural Congolese women with the recommended four ANC visits.

Problem Statement

DRC is among the top five maternal and neonatal mortality burden countries in the world (UNICEF, 2014b). In that context, ANC constitutes an important contact point for communication, pregnancy care, and birth preparedness (Lassi, Haider, & Bhutta, 2010). More than 80% of rural Congolese pregnant women attend at least one ANC visit (DHS Program, n.d.b). However, despite the tremendous efforts of the last decade, ANC compliance with four visits stagnated at a suboptimal level of 42% between 2007 and 2014 (DHS Program, n.d.a, n.d.b). A secondary analysis of WHO's 2001 cluster randomized trial (RCT) showed that fewer ANC visits were associated with increased perinatal mortality (Dowswell et al., 2010, Hofmeyr & Hodnett, 2013). DRC has high rates of both maternal and perinatal mortality, which are much higher in rural than in urban settings (UNICEF, 2014b, 2014c).

Therefore, there is a need to understand how the interactions of rural Congolese pregnant women with the health system may influence their compliance with the recommended focused ANC schedule. To date, reasons for high ANC dropout rates have remained unknown. Few studies have examined the social, demographic, and contextual determinants of ANC use among urban populations (Abel, Françoise, Dramaix-Wilmet, & Donnen, 2012; Aremu, Lawoko, & Dalal, 2012; Feinstein et al., 2013; Jerome, 2015). None have investigated the health-system determinants of ANC compliance among rural Congolese women. This study was aimed to fill this knowledge gap.

Purpose of the Study

The purpose of this quantitative study was to describe the impact of health-system characteristics on ANC compliance with four visits. It used a cross-sectional survey design and applied Andersen's behavioral model of health service utilization as its theoretical framework. The study participants were rural Congolese women aged 18-49 years with a live infant 0-5 months old who attended at least one ANC visit during pregnancy. *ANC compliance* was defined as women's attendance of at least four ANC visits during pregnancy. Health system characteristics included the type of ANC facility, type and gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services. The study controlled for confounders such as the mother's age, mother's education, marital status, number of live births, and gestational age at the first ANC visit.

Research Questions and Hypotheses

Question 1: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the type of ANC facility?

Ho1: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the type of ANC facility.

Ha1: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC facility.

Question 2: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the type of ANC provider?

Ho2: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the type of ANC provider.

Ha2: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC provider.

Question 3: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the ANC provider's gender?

Ho3: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the ANC provider's gender.

Ha3: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the ANC provider's gender.

Question 4: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the time to the ANC facility?

Ho4: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the time to the ANC facility.

Ha4: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the time to the ANC facility.

Question 5: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the costs of ANC services?

Ho5: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the costs of ANC services.

Ha5: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the costs of ANC services.

Question 6: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the number of ANC services?

Ho6: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the number of ANC services.

Ha6: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the number of ANC services.

Theoretical Framework for the Study

This study used Andersen's behavioral model of health service utilization as its conceptual framework for analyzing pregnant women's compliance with ANC services. Anderson (1968) developed the model in the United States in the late 1960s to apply a systems approach in analyzing factors associated with patients' decisions to seek and use health care. The aim was to explain why families use health services, apply that information to define measures of access, and assist in the formulation of policies to ensure equitable access. The model posited that families use health services when they have a predisposition to do so, where services are available and accessible, and when families perceive the need to use them (Andersen, 1968). It identified three categories of variables that, either alone or in combination, influence the use of health care services: individual, environmental, and provider related (Phillips, Morrison, Andersen, & Aday, 1998). The individual variables included socioeconomic and demographic factors such as age, gender, education, occupation, marital status, and residence. Environmental variables encompassed the external environment (e.g., policies and financing),

communities (e.g., social norms), and health care characteristics (e.g., type of ANC facility, number of ANC procedures, cost, distance, and quality; Phillips et al., 1998). The provider variables included provider attributes that interact with patients' characteristics (e.g., gender and attitude; Phillips et al., 1998). The environmental and provider-related variables encompassed the context of health care delivery (Phillips et al., 1998). This study examined how the health system characteristics, as a subset of the environmental variables, relate to women's compliance with four ANC visits.

Nature of the Study

This study was a quantitative cross-sectional household survey using secondary data collected by the DRC Ministry of Public Health between June and July 2015. It compared pregnant women attending at least four ANC visits with those who did not complete the four visits to identify the main predictors of ANC compliance. The need to examine the association between ANC compliance and health system characteristics justified the choice of a quantitative method in this study (Creswell, 2013). There were six independent variables, presented in Table 1 below. The dependent variable was ANC compliance, defined as attendance of at least four ANC visits during pregnancy. The covariates were the mother's age, mother's education, marital status, number of live births, and gestational age at the first ANC visit. The study participants were mothers aged 18-49 years with a live infant 0-5 months old who attended ANC during their last pregnancy. I selected the participants through a stratified random sampling technique and used an interviewer-administered questionnaire to collect the data. The statistical analyses investigated the associations between the six independent variables of interest

and ANC compliance after adjusting for confounders. Chapter 3 provides details about the methodology, including the statistical analyses and tests of statistical significance.

Table 1

Health System Determinants of Antenatal Care Compliance

Category	Variables
ANC availability	1. Type of ANC facility
	2. Type of ANC provider
	3. Gender of ANC provider
ANC accessibility	4. Time to ANC facility
	5. Cost of ANC services
ANC quality	6. Number of ANC services provided during ANC (out of nine recommended in the DRC: weight, blood pressure, blood test, urine test, HIV counseling and testing, iron supplementation, deworming, malaria prevention, and tetanus toxoid vaccination)

Note. These are the six health system characteristics identified as independent variables for the purpose of this study.

Operational Definition of Terms

Antenatal care: Represents the care given to pregnant women before birth by skilled health personnel that includes health promotion, screening of risk factors, and treatment of diseases and pregnancy-related complications (WHO, 2000).

Focused antenatal care: A new model of ANC recommended by WHO that is based on four goal-oriented antenatal visits around 12, 26, 32, and 36 weeks of gestation (Villar & Bergsjo, 2002; WHO, 2009).

Antenatal care compliance: Attendance of at least four ANC visits by women with uncomplicated pregnancies, as recommended in the WHO focused ANC strategy (Villar & Bergsjo, 2002).

Health system: Represents all the activities implemented with the goal of maintaining good health (WHO, 2015b).

Health system determinants: The features that characterize a health system in accordance with the WHO six building blocks framework. These include leadership and governance, human resources, supplies, financing, health information, and service organization (Muldoon et al., 2011).

Type of ANC facility: Characteristic of the health facility providing ANC: public or private (Chen et al., 2013; Tran, Gottvall, Nguyen, Ascher, & Petzold, 2012; Victora et al., 2010).

Type of ANC provider: The professional category of the person providing ANC services, whether a doctor, midwife, nurse, or other (Atunah-Jay et al., 2013).

Gender of ANC provider: Indicates whether the health professional who attended to the woman during ANC was male or female.

Cost of ANC services: The amount of money in Congolese Francs the woman paid as the direct cost of ANC services, including consultation, laboratory investigations, and medications (Sambo, Abdulrazaq, Shamang, & Ibrahim, 2013).

Time to the ANC facility: The amount of time in minutes it takes the woman to get to the nearest ANC facility.

Number of ANC services: The number of procedures for the pregnant woman during ANC, including clinical assessments (weight and blood pressure measurements), laboratory investigations (blood and urine tests), and treatments (iron tablets, malaria prevention tablets, deworming tablets, and tetanus toxoid vaccine; Bbaale, 2011; Naariyong et al., 2012).

Mother's age: The length of time of the mother's existence in complete years since birth.

Mother's education: The level of formal education the mother has reached.

Marital status: The woman's condition as single, married, separated, divorced, or widowed.

Live births: The total number of babies born alive in a woman's life.

Gestational age at the first ANC visit: The age of the pregnancy at the time the woman attended her first ANC visit, expressed in months and counted from the woman's last normal menstrual period (LMP).

Assumptions

Assumption 1

The populations of health zones and health center catchment areas may be under- or overestimations of the true populations and may introduce bias in the weighted results. The last population census in the DRC took place about 30 years ago. Since then, the country has experienced repeated instability through civil wars and outbreaks. The

current statistics are based on Central Statistics Office projections and may be far from reality. Using these estimates may have resulted in under- or overestimated results.

Assumption 2

The study participants were representative of the general population of women giving birth in the 93 health center catchment areas included in the study. The process of stratified random sampling with randomization at all levels helped in selecting an unbiased sample of mothers aged 18-49 years with a live infant 0-5 months old. These women had the attributes of all rural Congolese women giving birth in the study districts.

Assumption 3

I assumed that the data were complete and accurate and that the study participants' answers were unbiased. Thus, I assumed that the data quality assurance and verification measures were effective in minimizing the risk of inaccurate information recording, in particular, duplication, wrong coding, and missing data. Additionally, I assumed that the study participants were truthful in their answers and did not provide socially desirable responses.

Scope and Delimitations

This study assessed the relationship between one dependent variable (ANC compliance) and six independent variables (health system characteristics). In line with Andersen's behavioral model of service utilization, the study examined a subset of determinants that could be related to dropouts between the first and fourth ANC visits. For that reason, the selection of the independent variables prioritized the health system characteristics and did not include the individual predisposing factors and external

environment. The choice of the cross-sectional design meant that the analysis aimed to establish the associations, not the cause-and-effect relationships or the reasons for these associations. This study was limited to establishing the relationships between the health system characteristics and women's compliance with four ANC visits.

The study participants were mothers aged 18-49 years with a live infant 0-5 months old who attended ANC during pregnancy. This group was chosen because of its recent experiences with ANC to minimize the likelihood of recall bias. The geographical areas of focus included 93 health center catchment areas in 10 health zones out of the DRC's 8,000 health center catchment areas spread over 515 health zones. The results of this study are generalizable to the women attending ANC in the study areas. However, many years of civil war have left the DRC health system underfunded for a long time. As a result, most of the health facilities in the country face the same challenges, such as lack of funding for operations, essential medicines, portable water, and basic equipment. For that reason, the health system in the 93 health center catchment areas might not differ from that of the rest of the country. Therefore, the results may well be generalizable to the other areas of the country.

Limitations

The study used a cross-sectional survey design that did not allow me to manipulate the independent variables or establish the temporal sequence of events. For that reason, this study design could not establish a cause-and-effect relationship. In addition, the lack of manipulation may have weakened the study's internal validity. However, the randomization of the study participants and the high sample size may have

enhanced the internal and statistical validities, respectively. There may have been a likelihood of recall bias because the study participants had to remember their experiences of ANC that happened several months before the survey. However, the selection of study participants with recent ANC experiences was intended to minimize recall bias. Furthermore, the use of secondary data may have resulted in missing other important variables for the analysis. For example, the husband's education and occupation are important control variables that were not included in the primary study (Bbaale, 2011; Manithip, Sihavong, Edin, Wahlstrom, & Wessel, 2011; Tsegay et al., 2013).

Significance and Implications for Positive Social Change

There is a paucity of evidence on the factors that facilitate or impede ANC compliance among rural pregnant women in the DRC. This study was unique in that it focused on an under researched area of MCH in the DRC. Its findings could make an original contribution to understanding how pregnant women's interactions with the health system affect the use of maternal health services in rural areas. For the first time, there is evidence on the determinants of women's compliance with ANC services. The study has generated new knowledge that could help policy makers and health managers build health systems that are responsive to the needs of vulnerable rural women and children.

DRC has the third lowest health expenditure per capita in the world, after Central African Republic and Myanmar, estimated at US$16 (World Bank Group, 2015b). This study provides useful information to guide the design of evidence-based interventions to optimize the effectiveness of ANC services in rural DRC. The noncompliance of rural pregnant women with ANC is a longstanding challenge repeatedly reported in national

coverage surveys. The information from this study may guide the selection of investment priorities and point to the areas of work that foster changes in policy and practice and inform the MCH research priorities for the DRC.

Every hour, two mothers and 36 children under 5 years of age die in the DRC (UNICEF, 2014b, 2014c). A significant proportion of these deaths occurs among the disadvantaged rural populations in a country where 80% of the population live below the poverty line of US$2 per day (Population Reference Bureau, 2011). The study has generated new knowledge on the ANC access barriers of rural populations to guide the design of interventions to close the MCH outcome gap and foster positive social change.

Summary

DRC is among the top five highest maternal and neonatal mortality burden countries in the world (UNICEF, 2014b). ANC is an effective platform to deliver multiple health interventions to reduce the high maternal and neonatal mortality rates. In that regard, WHO recommends that pregnant women with uncomplicated pregnancies complete at least four visits to reap the full benefits of ANC. However, despite high attendance rates for the first ANC visit, the proportion of rural Congolese women completing four visits has stagnated below 50% over the last decade. The persisting low ANC compliance may have led to underutilization of life-saving interventions during pregnancy, thus partly explaining high maternal and child mortality in the DRC.

There has been a need for new knowledge to understand why the efforts of the last decade have failed to optimize the utilization of ANC despite high rates of maternal and child deaths in the DRC. However, no study has investigated the reasons for high

ANC dropout rates among rural women in the DRC. This quantitative cross-sectional survey examined the health system predictors of rural Congolese women's compliance with four ANC visits. This evidence could guide health policy makers and program managers in their efforts to build a health system that is responsive to the needs of rural women and children to save lives among vulnerable populations.

Chapter 2 presents the literature review, including the literature search strategy, theoretical foundation, literature review related to key variables, and the implications of past research for the current study.

Chapter 2: Literature Review

Introduction

The DHS 2014 showed that over half of rural Congolese women did not attend the minimum of four ANC visits (DHS Program, n.d.b). Therefore, they missed the opportunity to reap the full benefits of ANC in terms of pregnancy outcomes. ANC is a platform to provide effective health interventions to prevent, detect, and manage pregnancy-related complications, diseases, and significant health risks. Malaria, HIV, and hypertension are among the diseases needing careful attention during pregnancy. Adequate ANC has proven to improve maternal and perinatal outcomes (Mbuagbaw & Gofin, 2011; Mishra & Retherford, 2008). However, in the DRC, more than half of rural pregnant women do not comply with the recommended four ANC visits (DHS Program, n.d.b).

Researchers have investigated the reasons for poor ANC utilization and compliance and have found a correlation with women's sociodemographic characteristics, health system factors, and the external environment (Trinh, Dibley, & Byles, 2007). Little is known about the association between health-system characteristics and rural women's compliance with four ANC visits in the DRC. Therefore, the purpose of this study was to investigate the health-system predictors of ANC compliance among rural Congolese women. It focused on six health system determinants: type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services.

This chapter includes the literature search strategy, the study's theoretical foundation, a literature review related to the methodology and key variables, implications of past research for the current study, and summary and conclusions. The literature search strategy lists the databases, key search terms, and combinations of search terms used and describes the scope of the literature review. The theoretical foundation subsection presents Andersen's behavioral model of service utilization as the theoretical framework underpinning the study. I discuss studies that have applied the behavioral model and provide a rationale for its relevance to the present study. The literature review synthesizes the studies related to the research methodology and variables and provides the justification for selecting them. The summary and conclusions provide a concise summary of the major themes in the literature, highlighting what is known and explaining how this study fills the knowledge gap.

Literature Search

Search Strategy

The literature search was conducted using electronic databases available through the Walden University Library. These databases included Academic Search Complete, CINHAL, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Health and Psychosocial Instruments, MEDLINE, PROQUEST, PubMed, and Thoreau. An additional search targeted free online databases such as Google Scholar, the WHO website, the UNICEF website, and the reference lists of some of the retrieved articles. It also included unpublished materials obtained from the DRC Ministry of Public Health and local implementing partners.

Search Terms

The search terms were *antenatal care* and *prenatal care*, used either alone or in combination with words such as *adequacy*, *adherence*, *compliance*, *content*, *correlates*, *Congo*, *cost*, *Democratic Republic of Congo*, *determinants*, *distance*, *drugs*, *gender*, *health facility*, *health system*, *maternal*, *obstetric*, *procedures*, *predictors*, *provider*, *quality*, *rural*, *time*, and *utilization*. It also included search strings such as *antenatal care compliance*, *health system determinants*, and *health system predictors*.

Scope of the Literature Review

The literature review included (a) peer-reviewed studies, encompassing systematic reviews and meta-analysis; (b) studies that examined the association between ANC utilization or ANC compliance with one or more of the health system determinants (type health facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services); (c) studies published between 2005 and 2015; (d) studies published in all languages, and (e) studies published in all regions.

Theoretical Framework

This study used Andersen's behavioral model of health service utilization as its theoretical framework. The model helped to identify the health system determinants that explain and best predict women's compliance with the recommended minimum of four ANC visits. Andersen (1968) developed his model in the United States in the 1960s. It is intended to explain why families use health services, help define measures of access, and facilitate the formulation of policies that foster equitable access.

Theoretical Propositions

The 1960s model posited that families use health services when there is a predisposition to do so, where there are enabling conditions to make services available and accessible, and when families perceive the need to seek healthcare (Andersen, 1968).

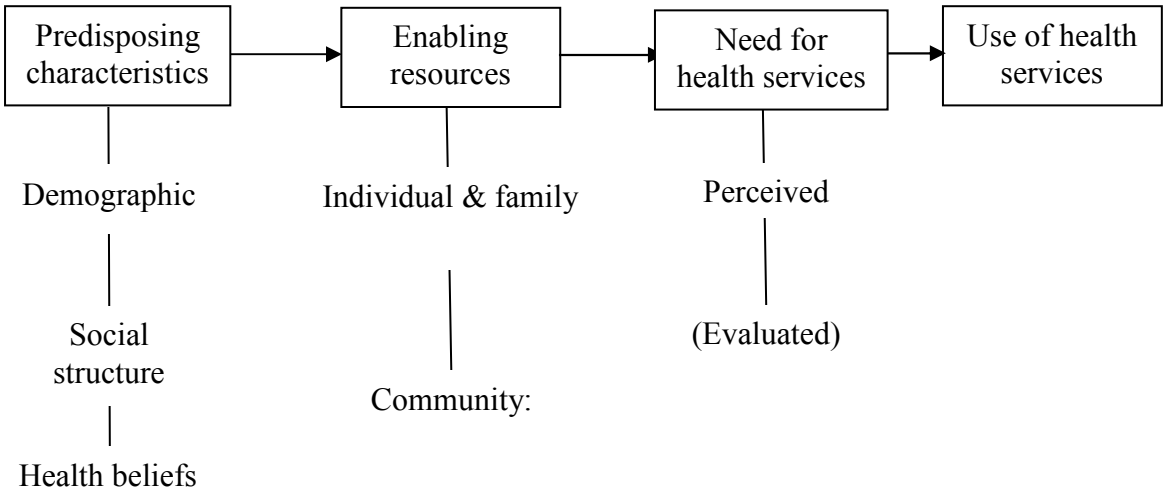

*Figure 1***.** Andersen's behavioral model of health service utilization (1960s). Adapted from "Revisiting the Behavioral Model and Access to Medical Care: Does It Matter?" by R. M. Andersen, 1995, *Journal of Health and Social Behavior, 1,*1-10. Reprinted with permission from Ronald M. Andersen.

This initial model faced challenges in developing appropriate measures of healthcare access at a family level that reflected the potential heterogeneity of family members (Andersen, 1995). These difficulties prompted Andersen to shift the model to focus on healthcare use by individuals instead of families. Accordingly, Andersen (1995) argued that healthcare use by individuals depended on predisposing characteristics, enabling resources, and perceived need for care. The predisposing characteristics included sociodemographic factors (e.g., age, gender, education, marital status, culture, and social networks) and health beliefs. Enabling resources consisted of individual,

family, and community resources that could be mobilized to facilitate access to healthcare, such as transportation, insurance, and income. The need for care included the perceived necessity of those experiencing health problems to seek healthcare and the need for care as evaluated by the attending providers (Andersen, 1995).

The initial behavioral model of service utilization was conceived as a causal pathway (Figure 1). It explained the process through which the predisposing characteristics of the individuals who are experiencing health problems determined their ability to mobilize resources to access health services (Andersen, 1995). In turn, the enabling resources impacted the individuals' perception of the need for care and their ability to seek and use healthcare services. Evidence has shown that sociodemographic characteristics such as age and gender predispose people to experience more medical problems and want health services more than others at some point in their lives (Santoni et al., 2015; Wagner et al., 2013). The social structure determines the position of individuals in the society and influences their ability to handle health problems (Andersen, 1995). People's beliefs about health and healthcare may affect their need for and use of healthcare services (Andersen, 1995). For this reason, Andersen (1995) argued that health beliefs are among the explanations of the way social structure could influence people's perception of the need for and the actual use of healthcare services. Individual and family resources are necessary to access health services. However, Andersen argued, they are not sufficient. Health services need to be available in the community where people live before they use them. Therefore, health system determinants such as type of ANC facility, ANC provider, and health organizations providing health services and type

of services provided influence the (perceived and evaluated) need for care and its actual use.

The behavioral model of service utilization was also conceived to predict the use of healthcare services. In this regard, Andersen (1995) indicated that each component of the model could have an independent effect on the use of healthcare services, depending on the type of services. To this effect, predisposing factors, enabling resources, and need could have differential influences on the use of healthcare services. For example, in severe illnesses requiring hospital services (e.g., heart attack), the need drives the use of healthcare services regardless of the predisposing characteristics. People in severe pain will rush to a hospital regardless of whether they can afford it or not. In the same vein, the social structure would account for most of the variance in the use of preventive care (e.g., dental services) that seem to be optional to many. Andersen (1995) explained that different factors could be independent determinants of the use of healthcare services. However, the factors with the greatest influence are indicators of the level of equity in access to healthcare services. For example, there is inequitable access when the social structure (e.g., ethnicity, income, education) accounts for most of the variance in healthcare use. Conversely, there is equitable access when demographic factors such as age explain most of the variance in access.

Revisions to the Initial Model of Health Service Utilization

Aday and collaborators undertook the first revision of the model in the 1970s to include the healthcare system, expand the measures of access, and add consumer satisfaction as its outcome (Aday & Andersen, 1974; Andersen, 1995). The addition of

the healthcare system with its three determinants—policy, resources, and organization—was one of the most significant improvements in the revised model. In line with these changes, studies have confirmed the association between the health system characteristics and health service utilization (Simkhada et al., 2008; Trinh et al.; 2007). Andersen's revised model expanded the health service utilization measures to differentiate between the type of service, location, purpose, and service delivery time interval. Furthermore, the model added consumer satisfaction as an outcome to acknowledge that the use of healthcare services is just a means to an end (Andersen, 1995).

Andersen and collaborators revised the behavioral model of service utilization again in the 1980s. The model included the external environment to recognize the role of the political, economic, and physical environment in shaping the population and health system characteristics (Andersen, 1995). Also, it expanded the health behaviors to include individual health practices such as physical exercise, healthy diet, and not smoking. These practices influence both the use of health services and health outcomes. The model recognized the ultimate goal of health services, which is to improve the health status of individuals, and added it as one of its primary health outcomes, together with consumer satisfaction. The revised model identified three categories of determinants: population characteristics, health system factors, and external environment. These three work either individually or together to improve health practices, including service utilization, and contribute to a better health status (Andersen, 1995). Figure 2 represents an adaptation of the model to the context of ANC.

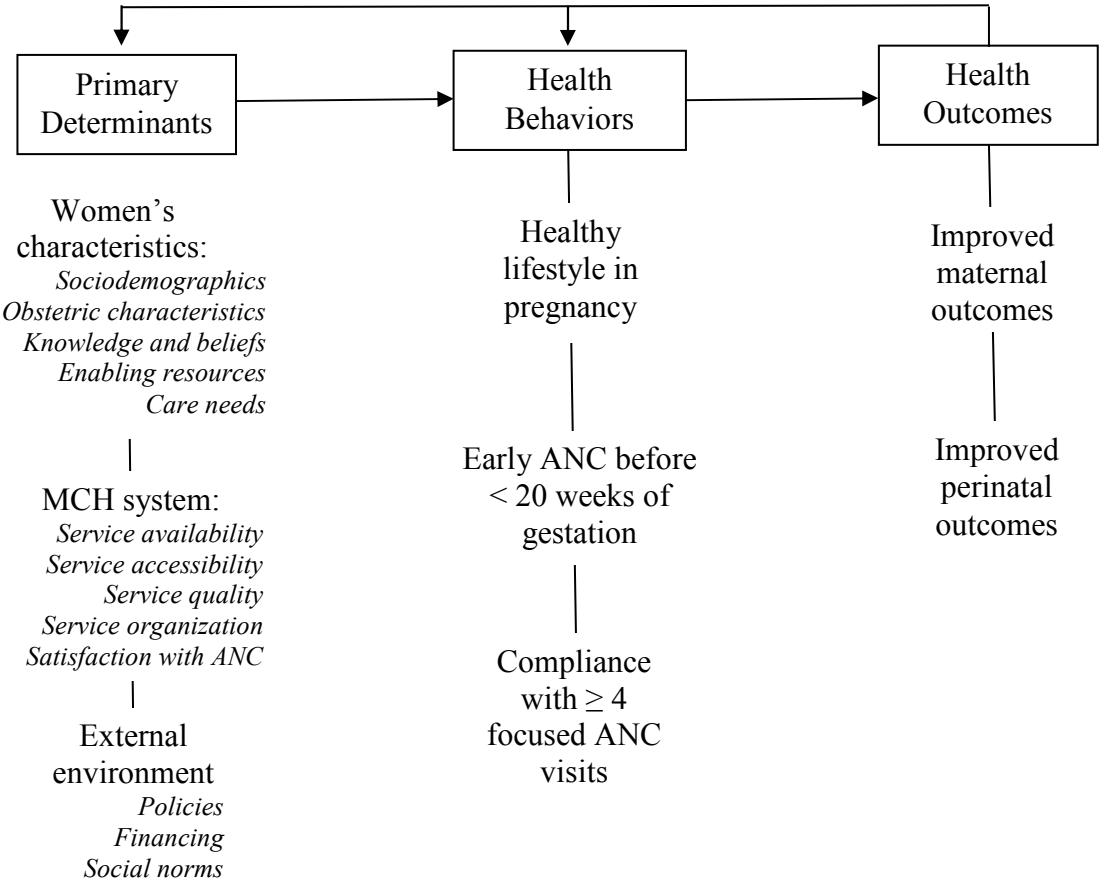

Figure 2. Behavioral model of antenatal care utilization. Derived from Andersen's behavioral model of health service utilization and adapted from the Phase 4 model presented in "Revisiting the Behavioral Model and Access to Medical Care: Does It Matter?" by R. M. Andersen, 1995, *Journal of Health and Social Behavior*, *1,* 1-10.

In this adaptation, women's satisfaction with ANC services is considered an outcome of their interactions with ANC services. In this regard, it is a determinant of their continuity of care and compliance with the recommended ANC schedule, although this finding is inconsistent (Jafari, Eftekhar, Mohammad, & Fotouhi, 2010; Oladapo & Osiberu, 2009).

Past Application of the Behavioral Model of Service Utilization

Several studies have used Andersen's behavioral model of health service utilization as the primary theoretical framework to examine the use of health services. The model has guided research design and analysis and helped to organize findings. Most of the studies using Andersen's model have focused on predisposing demographic and socioeconomic characteristics. The health system and external environment determinants have remained understudied.

Datti and Conyers (2010) applied Andersen's model to examine the predictors of the use of vocational rehabilitation (VR) services among Latino men living with the human immunodeficiency virus (HIV) in the State of New York. Researchers undertook a secondary analysis of the national cross-sectional survey of the vocational and employment needs of people living with HIV. The study participants were 168 Latinos selected through acquired immune-deficiency syndrome (AIDS) service organizations and networks who volunteered to participate. The outcome variable was the use of VR services. The independent variables included the predisposing characteristics (e.g., sexual orientation, ethnicity, and racial identification), enabling resources (e.g., poverty/income, knowledge of VR services, and receipt of public benefits), and need perceived by HIV patients and evaluated by health providers. The analysis included a chi-square test and a hierarchical logistic regression. The findings showed that Puerto Rican ethnicity, $p < .01$; knowledge of VR services, $p < .001$; receipt of public benefits, $p < .05$; and confidence in ability to maintain a job, $p = .01$, were associated with increased VR use. Andersen's

behavioral model helped researchers to identify the predictors of VR use among Latino men living with HIV in the State of New York.

Treanor and Donnelly (2012) used Andersen's behavioral model to conduct a systematic review of the determinants and patterns of health service utilization among cancer-surviving adult patients in Canada, Denmark, France, Netherlands, the United Kingdom, and the United States. The search words turned around the terms *cancer survivors* and *health service utilization*. The search identified 38 studies published between 1950 and 2011 through CINHAL, MEDLINE, PsycINFO, SEER-MEDICARE, and Social Science Citation Index. The outcome variables included health services (e.g., primary care, hospital care, and mental health services) and social services. The determinants of service utilization comprised the predisposing factors (e.g., age, gender, ethnicity, and health beliefs), enabling resources (e.g., residence, type of follow-up care provider, and marriage) and need factors (e.g., cancer resurgence, comorbidities, high depression). The findings showed that younger, White, employed, and student individuals had a higher likelihood of using health services compared to the likelihood of receiving preventive services among older patients. In addition, those with comorbidity, advanced disease, and depressive symptoms were more likely to use health services (Treanor & Donnelly, 2012). The review concluded that Andersen's behavioral model was a useful structural framework. The 38 studies analyzed in the review focused predominantly on population characteristics. The authors acknowledged that the inclusion of health beliefs in the predisposing characteristics was an improvement.

Schomerus et al. (2013) applied Andersen's behavioral model to investigate the correlation between personality traits, resilience, alexithymia, neglect or abuse in childhood, and care seeking among people suffering from depression. The study was a population-based cohort of 395 individuals with a background of major depression. The outcome variable was care-seeking for major depression. The predisposing variables included the age, gender, education, childhood maltreatment, openness, extraversion, agreeableness, consciousness, and neuroticism. The enabling variables comprised the retirement status, income, private health insurance, the source of care, social network, and social support. The need variables included comorbidity and severity of depression. The analysis involved a multivariate logistic regression. The findings revealed that personality-related predisposing factors such as older age, OR = 1.05, 95% CI [1.02, 1.08], $p < .01$; higher education, OR = 2.93, 95% CI [1.31, 6.58], $p < .01$; social support, OR = 1.77, 95% CI [1.15, 2.72], $p < .05$; higher conscientiousness, OR = 1.15, 95% CI [1.04, 1.28], $p < .01$; lower resilience, OR = 0.97, 95% CI [0.95, 0.99], $p < .01$; and more severe depression, OR = 5.97, 95% CI [3.04, 11.73], $p < .01$; were good predictors of the use of professional depression care. The study concluded that using the behavioral model of service utilization produced a model that explained a third of the variance in help-seeking for depression.

Trinh et al. (2007) applied the behavioral model of service utilization to investigate the determinants of ANC use in three rural areas of Vietnam. This study is explained in details in the section on methodology approaches below. It used a cross-sectional design. The participants included 1,335 women who had a childbirth in the 4

years prior to the survey and selected through multistage cluster sampling. The data was collected using a structured questionnaire adapted from previous studies. The study had four main outcome variables: any ANC use, entry into ANC, ANC visits, and overall ANC utilization. In line with Andersen's behavioral model, the independent variables included variables related to the external environment, predisposing characteristics, enabling resources, care needs, and patient satisfaction. The study analysis applied a univariate logistic regression followed by a hierarchical multivariate regression of the independent variables significantly associated with the dependent variables. The study findings showed that the variables related to the external environment, predisposing characteristics, and need were good predictors of any ANC use and the timing of the first ANC visit. However, the number of ANC procedures, patient satisfaction, and healthcare behavior that may have stemmed from the first ANC contacts were the good predictors of the continuation of ANC. This study is one of the few in developing countries that have used Andersen's behavioral model in the identification and analysis of ANC utilization variables.

The Behavioral Model: Its Choice and Relationship With Present Study

This study used the behavioral model of service utilization as its theoretical framework because of its particular focus on service utilization, the comprehensiveness of its determinants, and its proven relevance in previous similar studies. Andersen (1995) developed the model to understand the determinants of healthcare use among individuals faced with health problems. In the evolution of its development, the second revision in the 1980s included an explicit focus on health system related determinants of service

utilization. The revised model expanded to include three primary determinants: the population characteristics (i.e. predisposing factors, enabling resources, and need), health system factors, and external environment (Andersen, 1995). In previous studies using the behavioral model, the health system determinants of service utilization were part of the enabling resources. They included the determinants of service availability (e.g., type of ANC facility), accessibility (e.g., cost of services), and quality (e.g., content of services provided, client satisfaction; Trinh et al., 2007).

The current study examined the association between health system determinants and women's compliance with the focused ANC schedule of four visits for pregnancies with no complications, diseases, or significant health risks. It focused on the type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC, and number of ANC services. It took place in a context where the vast majority of women attend at least one ANC visit, but many do not complete four visits. In this regard, Andersen's behavioral model provided a comprehensive approach to the identification of the determinants of ANC compliance. It helped to identify the most appropriate study variables, formulate research questions and hypotheses, and organize the data analysis and research findings.

Pregnancy and Antenatal Care

Pregnancy is a moment of high vulnerability to diseases and pregnancy-related complications. It is also an opportunity to prevent and manage any disease, complications of pregnancy, and health risks. Evidence has shown that women experience immune alterations during pregnancy that allow the body to tolerate the allogeneic fetus (Pazos,

Sperling, Moran, & Kraus, 2012). The weakening of the adaptive immune responses that occur during pregnancy explains the vulnerability of pregnant women to infections (Kraus et al., 2012). A systematic review conducted by Sappenfield, Jamieson, and Kourtis (2013) showed that pregnancies are associated with increased susceptibility to HIV, Malaria, and Listeriosis, and higher severity of infections due to hepatitis E, herpes simplex virus, influenza, and malaria. Many diseases and conditions that occur during pregnancy have an adverse effect on maternal health and perinatal outcomes. For example, urinary tract infections and periodontal diseases increase the likelihood of preeclampsia (Conde-Agudelo, Villar, & Lindheimer, 2008). Some of the conditions that develop during pregnancy have both immediate and late-life consequences. For example, in the short term, eclampsia is a leading cause of maternal and perinatal mortality (Veloz-Martínez et al., 2010; Yıldırım et al., 2011). In the long term, it may lead to hypertension, coronary artery disease, and stroke (Borna, Neamatipoor, & Radman, 2012). For these reasons, women need adequate care during pregnancy to mitigate the immediate and late-life adverse outcomes of pregnancy.

Antenatal Care and Pregnancy Outcomes

ANC is an effective intervention to prevent, diagnose, and manage diseases and complications of pregnancy. Studies have shown a significant association between ANC adequacy and maternal and perinatal outcomes (Hollowell, Kurinczuk, Oakley, Brocklehurst, & Gray, 2009). For many disadvantaged women, ANC is the main entry point into care. Evidence has shown that women with adequate ANC were more likely to receive malaria interventions such as bednets and malaria preventive therapy (IPTp). In

addition, women that received bednets and IPTp had lower odds of maternal anemia, low birth weight (LBW), and placental parasitemia (Anchang-Kimbi et al., 2014; Feng et al., 2010). Therefore, ANC has demonstrated benefits in reducing the malaria burden in pregnancy and its adverse effects on pregnancy outcomes.

HIV in pregnancy is a common occurrence in countries with generalized HIV epidemics, in particular, among women of low socioeconomic status and women not living with a partner (Da Costa et al., 2013; Kotzé, Visser, Makin, Sikkema, & Forsyth, 2013). The likelihood of HIV seroconversion is higher among pregnant women in comparison with nonpregnant women, and much more in the late stages of pregnancy (Wand & Ramjee, 2011; Kinuthia et al., 2010). Likewise, the risk of HIV transmission to men is higher among pregnant women than among nonpregnant women (Mugo et al., 2011). The high risk of HIV seroconversion during pregnancy and HIV transmission to the male partners underscores the importance of ANC in this vulnerable population. In this regard, ANC provides a conduit for preventing HIV transmission to women, partners,and their unborn babies. ANC has helped pregnant women living with HIV infection to access HIV testing, CD4 testing, and antiretroviral treatment (Schnippel, Mongwenyana, Long, & Larson, 2015). These services have shown to reduce HIV incidence, infant mortality, and maternal mortality (Chopra, Doherty, Goga, Jackson, & Persson, 2010; Kim et al., 2013; Li et al., 2014). Therefore, ANC carries positive benefits for women and children at risk of HIV infection.

Hypertensive disorders commonly complicate the normal progression of pregnancy (Chen, Roberts, Simpson, & Ford, 2012). These conditions are known causes

of maternal and fetal illness and death, and a major reason for obstetric referrals (Shaikh, Shaikh, Channa, & Ghori, 2012). Tukur et al. (2013) showed that simple interventions provided during ANC such as magnesium sulfate and calcium gluconate significantly reduced the case fatality rates of severe preeclampsia and eclampsia. The authors noted that ANC helped to detect preeclampsia and eclampsia. However, the current ANC practice in other developing countries may not be sufficient to prevent eclampsia in under-resourced settings (Urassa, Carlstedt, Nyström, Massawe, & Lindmark, 2006).

Despite these shortcomings, ANC remains an important intervention to improve maternal and perinatal outcomes. Conditions such as hypertension, anemia, and malaria can worsen during pregnancy. Through ANC, these conditions can be effectively prevented, detected, and managed to improve the well-being women and their infants. Other benefits of ANC include a higher likelihood of skilled delivery that is critical for the management of severe complications of pregnancy that manifest around childbirth (Berhan, & Berhan, 2014; Chen, Wen, Yang, & Walker, 2007).

WHO Focused Antenatal Care

In 2002, WHO launched the focused ANC strategy that promoted a reduced ANC schedule with four visits and restricted laboratory tests for pregnant women with no complications, medical conditions or significant health risks (Villar & Bergsjo, 2002; WHO, 2009). WHO focused ANC strategy was informed by the findings of a multicenter cluster RCT that showed that a reduced ANC schedule achieved maternal and perinatal outcomes comparable to those of the traditional long ANC schedule (Villar et al., 2001). Two distinct groups of women were included. The first included women with a normal

pregnancy who were eligible for routine ANC, also called the basic component of ANC. The second included women with complications, medical conditions, or major risk factors who qualified for special care and needed a referral. This group made about 25% of all pregnant starting ANC. Women eligible for the basic component of ANC received care in three general areas. First, they were screened for risk factors likely to jeopardize pregnancy outcomes. Second, they were provided with care and treatment interventions beneficial to the mother and her unborn baby. Third, they were educated about emergencies during pregnancy and helped to prepare for a safe delivery (Villar & Bergsjo, 2002). The specific ANC procedures recommended on each visit are summarized in Table 2.

Table 2

Recommended Procedures in the Basic Focused ANC Component

ANC procedures	Visit 1	Visit 2	Visit 3	Visit 4
Clinical examination	√	√	√	√
Gestational age estimation, uterine height	√	√	√	√
Gynecologic examination		√		
Maternal blood pressure	√	√	√	√
Maternal weight/height	√			
HIV counseling	√	√	√	√
Blood testing for hemoglobin			√	√
Blood testing for syphilis, blood type, and Rh	√			
Urine testing for infections	√	√	√	√
Urine testing for proteinuria	√			
Tetanus toxoid vaccination	√		√	
Iron and folic acid tablets	√	√	√	√
Deworming tablets		√	√	
Intermittent preventive treatment for malaria		√	√	
Instructions for delivery/birth planning			√	√
Detection of breech presentation and referral				√
Complete ANC card				√

Note. Adapted from the ANC procedures recommended in *WHO Antenatal Care Randomized Trial: Manual for the Implementation of the New Model*, by J. Villar and P. Bergsjo, 2002, Geneva, Switzerland: World Health Organization.

The focused ANC strategy recommends that pregnant women start ANC early and complete at least four visits to take the full advantage of ANC interventions (Ouma et al., 2010). The first visit occurs in the first 12 weeks of gestation and the other visits around 26, 32, and 36 weeks respectively (Villar & Bergsjo, 2002). Evidence from developing countries has revealed three main challenges of ANC services: late booking, noncompliance with the recommended number of visits, and inadequate ANC services (United Nations, 2014; DHS Program, n.d.b). Poor ANC compliance is common in developing countries. Recent data showed that only 52% of pregnant women in these countries attended four or more ANC visits. In SSA, the proportion of pregnant women attending four or more ANC visits has stagnated: 48% in 1990 and 50% in 2012 (United Nations, 2014). The situation in the DRC is similar to the rest of SSA. An estimated 88% of pregnant women start ANC, but only 48% complete four visits (DHS, program, n.d.b). This study aimed to investigate why rural women do not comply with the recommended four visits to guide the design of interventions to improve MCH services in rural DRC.

Literature Review Related to Key Constructs, Methodology, and Variables

Studies With Similar Constructs and Methodology

Abel et al. (2012) conducted a population-based cross-sectional survey to investigate the correlates of the use of maternal health services in the city of Lubumbashi in the DRC. The sample included 1,762 women with a birth in the 12 months preceding the survey, selected using a cluster sampling technique. The dependent variables were ANC attendance, skilled delivery, and postnatal care (PNC). The independent variables were the sociodemographic characteristics, ANC services provided, perceived quality of

ANC, and place of delivery. The analysis included student *t*-tests, Mann-Whitney tests, chi-square tests, and logistic regressions. The findings showed that almost all pregnant women (98.1%) started ANC in the city of Lubumbashi. However, only about half of these women attended at least four ANC visits. The regression analysis showed that parity and the desire for pregnancy were statistically significantly associated with ANC use. Although this study was implemented in a city, it showed that the high dropouts during ANC remain a challenge in the DRC.

Feinstein et al. (2013) conducted a population-based cross-sectional survey to examine the care-seeking behaviors and experiences of Congolese women with ANC and delivery services in the city of Kinshasa. The sample included 1,221 women aged at least 18 years who had given birth in the three years preceding the survey, selected using a multistage cluster sampling technique. The analysis included the chi-square tests to compare between health zones. It also comprised logistic regressions to investigate the association between ANC attendance and sociodemographic characteristics and ANC attendance and women's experiences with ANC. The findings showed that 98% of women attended at least one ANC visit, and 76% completed four visits. The regression analysis showed that maternal education, OR = 0.68, 95% CI: [0.59, 0.78]; husband's education, OR = 0.58, 95% CI: [0.51, 0.67]; household assets, OR = 0.56, 95% CI: [0.37, 0.87]; HIV talk, and costs were significantly associated with inadequate use of ANC defined as starting ANC after the first trimester or attending less than four visits. Although not comprehensive, this study showed that the cost may influence the utilization of ANC in a city context.

Jerome (2015) conducted a hospital-based cross-sectional survey to examine the socio-demographic and clinical correlates of ANC among women delivering in the city of Goma in eastern DRC. The sample included 1,152 women who delivered in five hospitals between February and July 2014 who were selected through stratified sampling. The outcome variable was ANC attendance defined as any ANC visit during pregnancy. The independent variables included sociodemographic characteristics (e.g., age, sex, residence, marital status, education level, and occupation) and clinical factors (e.g., parity, history of abortion, stillbirth, and cesarean section; maternal height and weight, and delivery institution). The analysis included Pearson chi-square and Mann-Whitney tests and multiple logistic regressions. The findings showed that primary education, OR = 1.91, 95% CI: [1.03, 3.54], $p = .04$, and delivering at Bethesda private hospital, OR = 0.21, 95% CI: [0.05, 0.86], $p = .03$, were statistically significantly associated with ANC attendance. This study did not focus on ANC compliance. However, it demonstrated a relationship between ANC attendance and the type of facility attended at delivery in a city context.

Aremu et al. (2012) undertook a secondary analysis of data from the DRC DHS 2007 to examine the use of maternal health services in the DRC. The sample included 6,695 women who had a birth in the 5 years preceding the survey selected through multistage stratified cluster sampling. The outcome variables were use of ANC and delivery care during the most recent pregnancy. The independent variables were the individual characteristics (e.g., mother's age, mother's education level, mother's occupation, partner's education level, partner's occupation, and parity) and contextual

factors (e.g., household wealth, place of residence, and neighborhood socioeconomic status). The analysis included multilevel logistic regression of the association between use of ANC and delivery care and individual and contextual factors. The findings showed that the mother occupation, OR = 1.52; partner's occupation, OR = 0.72; and disadvantaged neighborhoods, OR = 0.54; were statistically significantly associated with the use of ANC and delivery care in the DRC. The study did not examine the health system characteristics. However, it demonstrated that individual and community level characteristics may have an effect on the use of maternal health services in the DRC.

Tsegay et al. (2013) used a cross-sectional survey design to investigate the correlates of ANC and delivery care use in the Tigray region of Ethiopia. The sample included 1,115 women of childbearing age (15 to 49 years) with a live birth in the 5 years preceding the survey selected through a cluster sampling technique. The outcome variables were any ANC use and place of delivery. The independent variables were the age, education, marital status, residence, husband's occupation, parity, and history of obstructed labor. The analysis included univariate and multivariate logistic regressions. The findings showed that sociodemographic characteristics were good predictors of ANC use: marital status, OR = 2.68, 95% CI [1.54, 4.69]; maternal education grade 5 to 12, OR = 4.12, 95% CI [2.49, 6.83]; having a health facility in the village, OR = 2.08, 95% CI [1.62, 2.68]; and a nonfarming husband, OR = 2.26, 95% CI [1.43, 3.58].

Mugo et al. (2015) undertook a secondary analysis of the 2010 DHS to examine the determinants of ANC use in South Sudan using the theoretical framework of Andersen's behavioral model of service utilization. The sample included 3,505 women

aged 15 to 49 years with a live birth in the 2 years prior to the survey selected through a stratified multistage cluster sampling technique. The outcome variable was the ANC use that had three categories: no ANC visit or ANC visit by nonskilled providers, one to three ANC visits, and four or more ANC visits. The independent variables included 16 factors grouped into four categories: external environment, predisposing factors, enabling resources, and need for care. The analysis included both the univariate and multivariate logistic regressions with adjustment for the effects of the sample design. The findings showed the following factors associated with a lower likelihood of using ANC services: geographical region (Central Equatorial), AOR = 0.42, 95% CI [0.29, 0.62], $p < .001$; husband's polygamy status, AOR = 1.23, 95% CI [1.00, 1.51], $p = .047$; woman's low education level, AOR = 1.79, 95% CI [1.31, 2.45], $p = .001$, rural areas, 2.46, 95% CI [2.01, 3.03], $p < .001$; older women 35 to 49 years, OR = 1.53, 95% CI [1.08, 2.17], $p = .017$; those who never wanted to get pregnant, OR = 0.52, 95% CI [0.36, 0.75], $p = .001$; and those with no pregnancy-related complications, OR = 2.65, 95% CI [2.20, 3.19], $p < .001$. The study showed that Andersen's behavioral model facilitated the identification of the study variables and analysis of the predictors of ANC use.

Trinh et al. (2007) used a cross-sectional survey guided by Andersen's behavioral model of service utilization to examine the correlates of ANC utilization in three rural areas of Vietnam. The sample included 1,335 women who had given birth in the 4 years prior to the survey, selected through a multistage cluster sampling technique. The study included four outcome variables: any ANC use, entry into ANC, ANC visits attended, and overall ANC utilization. The independent variables included variables related to the

external environment, predisposing characteristics, enabling resources, and care needs. The analysis included univariate and multivariate logistic regressions. The findings showed that factors related to the external environment and women's characteristics had a statistically significant association with any ANC use and the gestational age at the first visit: education level, OR = 4.9, 95% CI [3.0, 8.1], $p < .001$; ethnicity, OR = 0.2, 95% CI [0.1, 0.5], $p < .01$; and number of children, OR = 0.6, 95% CI [0.4, 0.9], $p < .01$. Conversely, factors resulting from women's interaction with ANC services had a statistically significant association with ANC compliance. These factors included the number of ANC services received, OR = 4.9, 95% CI [3.0, 8.1], $p < .001$; having health insurance, OR = 1.4, 95% CI [1.0, 2.0], $p < .001$; and women's satisfaction with ANC services, $p < .001$. The study showed that women's characteristics and external environment were significant determinants of any ANC use while the health system determinants played a role in ANC compliance.

Joshi, Torvaldsen, Hodgson, and Hayen (2014) undertook a secondary analysis of the 2011 DHS that used a cross-sectional household survey design to examine the determinants of ANC attendance of at least four visits and receipt of quality ANC in Nepal. They used a sample of 4,079 women aged 15 to 49 years who had a birth in the 5 years preceding the survey and selected a stratified multistage cluster sampling technique. The two outcome variables were the use of four ANC visits and receipt of quality ANC. The independent variables for the use of four ANC visits were: maternal age at childbirth, maternal education, work status, household wealth, religion, smoking status, decision-making power, media exposure, parity, history of previous pregnancies, whether the

pregnancy was wanted, use of contraceptives, ecological zones, residence, husband's education, and husband's occupation. The independent variables for the good quality of ANC included maternal age at childbirth, maternal education, household wealth, decision-making power, media exposure, reproductive history, ecological zones, residence, place of access to ANC, and type of ANC provider. The analysis applied the univariate and multivariate logistic regressions. The findings showed that higher education levels, $p < .001$; household economic status, $p < .001$; and smoking status, $p = .036$; were good predictors of ANC compliance with four visits and receipt of good quality ANC. In addition, contrary to the findings in Ethiopia, old age, $p = .021$; and high parity, $p < .001$; were significantly associated with ANC compliance with four visits in Nepal. This finding may be the result of the quality of health education during ANC and women's understanding of the risks associated with increasing maternal age and parity. The study demonstrated that women characteristics, reproductive health history, and pregnancy factors were predictors of ANC compliance.

Manithip et al. (2011) used a cross-sectional survey to investigate the determinants of ANC utilization in the rural Lao People's Democratic Republic (PDR). The sample included 460 women with 32 weeks or more of gestation or a live birth in the 12 months prior to the survey selected through a multistage cluster sampling technique. The study applied Andersen's behavioral model of service utilization as its theoretical framework. The outcome variable was ANC ever-use, defined as at least one ANC visit or contact with a Traditional Birth Attendant (TBA) during pregnancy. The independent variables included predisposing characteristics (e.g., mother's age, ethnicity, religion, and

education), enabling resources (e.g., accessibility to a health facility, service availability, waiting time, and satisfaction) and the need for care. The analysis included univariate and multivariate logistic regressions. The findings showed that a significant association between ANC use and women with salaried employed husbands, AOR = 2.66, 95% CI [1.45, 4.88), p = .002; women younger than 18 years at first pregnancy, AOR = .56, 95% CI [0.28, 0.97), p = .041; women's awareness of ANC services provided, AOR = 3.30, 95% CI [2.08, 5.23), p = .000; and women that perceived ANC as useful, AOR = 2.88, 95% CI [1.26, 6.61), p = .012. The study showed that women's characteristics and health system factors were good predictors of ANC use in rural Lao PDR.

Methodology Approaches

The achievement of good MCH requires improvements in socio-economic conditions, lifestyle, and access to quality healthcare services (Crockett, Avery, & Blanchard, 2015). ANC is an entry point of women into care, especially the most deprived and vulnerable populations. However, despite almost all women attending at least one ANC visit at some point during pregnancy, many do not fully comply with the recommended number of visits (UNICEF, 2015). Researchers have used qualitative, quantitative, and mixed methods studies to understand why women do not optimally use ANC (Simkhada et al., 2008). Qualitative studies have primarily employed ethnographic designs. Quantitative studies have included primary or secondary data analyses of RCTs, cohort studies, retrospective studies, and cross-sectional surveys (Simkhada et al., 2008).

Qualitative ethnographic studies. Mrisho et al. (2009) used a qualitative study to understand the perspectives of women and healthcare providers on the use of ANC and

postnatal care (PNC) in rural Tanzania. They applied an ethnographic study design. The data was collected through interviews with healthcare providers and village-based informants (VBI) and focus group discussions (FGDs) with pregnant women and mothers of less than 1-year-old children. The study participants included 74 women aged 15 to 42 years recruited from eight villages in the two districts of Lindi Rural and Tandahimba. There were eight FGDs with six to eight women and eight interviews with healthcare providers and VBIs respectively. The FGDs and interview questions focused on the timing of and services received during ANC and PNC, women's perceptions about the added value of ANC and PNC, and barriers and possible solutions to adequate use of ANC and PNC. The study team included experienced moderators who facilitated the discussions and note-takers. They took handwritten notes and recorded all proceedings with an MP3 recorder. Also, they typed the transcripts and exported the data in the NVivo software.

The analysis triangulated the responses from interviews and FGDs to draw the common themes. The findings showed that, overall, women had a positive attitude towards ANC and PNC. However, the barriers to the use of ANC included the avoidance of multiple visits to the clinic, road security due to the fear of wild animals, and lack of money. Likewise, the fear of a caesarian section was the reason for not using delivery care; as was the lack of staff, equipment, and supplies for the nonuse of PNC. Researchers did not discuss the limitations. Nevertheless, few are worth mentioning. First, the constant changes that happen in the physical and cultural contexts often make it difficult to apply the findings of an ethnographic study to the same setting at a different

time or to a different setting any time (Rudkin, 2002). Second, the data transcription and translation processes may cause some information loss due to the misunderstanding of language and distortion of meanings. Third, ethnographers are subjective beings, and their experiences may influence the interpretation of the truth. Fourth, the world of ethnography does not follow the traditional verification means used in quantitative studies because contexts change in different places and time. Besides, no one can claim the ownership of an ethnographic study data because it is intersubjective and does not belong to the researcher or reader (Rudkin, 2002). Despite these limitations, the study identified some key barriers to ANC and PNC access such as the geographical, financial, and cultural barriers.

Kwambai et al. (2013) conducted a qualitative study to explore the perspectives of men on the utilization of ANC and delivery care services in rural Kenya. The study applied an ethnographic design using FGDs with eight to 10 participants. The participants comprised native Luo speaking men aged 20 to 65 years and married to a woman who is either pregnant or was pregnant in the 5 years preceding the survey. Researchers used a purposive sampling technique to select 68 men grouped in eight homogenous groups among those residing around the Lwak Mission Hospital in Asembo district. The study stratified the groups by age (20 to 40 years and 41 to 65 years) and distance from the hospital (within two kilometers and beyond two kilometers). A trained Luo moderator facilitated the discussions in the local language using a topic guide, and a principal investigator served as a note taker. The discussion topics included the knowledge of ANC and delivery care, males' perceptions in influencing service

utilization, men's role in ANC and delivery care, and obstacles to their participation in ANC and delivery care. The note taker recorded all the proceedings with a digital voice recorder. They wrote down and translated the text from Luo to English and exported the transcripts into QSR NVivo 9 software (QSR International Pty Ltd).

The data analysis followed the thematic framework approach that combined deductive and inductive techniques. The findings showed that men had a positive attitude towards ANC and delivery care and encouraged their wives to use the services. They identified three cultural barriers. First, pregnancy support was seen as a woman's responsibility. The men's role was reduced to that of a supplier. Second, health workers had negative attitudes towards men's involvement in ANC and delivery care. Third, the ANC and delivery care infrastructures were not male friendly. The study had limitations related to the generalizability of findings, loss of information during translation and transcription, and stronger gender influence. Its findings may not apply to populations living in different cultural and health system contexts and socioeconomic conditions. Besides, the process of data transcription and translation from the local language to English may cause the loss of useful information or its original meanings. Furthermore, the fact that the interviewers and interviewees were all males may have exaggerated the sense of manliness and introduced a bias in the observations. The study elicited the men's positive attitudes towards ANC and delivery care, albeit not translated into practice. This information is useful to guide the efforts to improve men involvement.

Overall, qualitative studies of ANC use are useful to obtain different views of the issues from the beneficiaries' perspectives by triangulating data from multiple sources

(Creswell, 2013). However, they are expensive and labor intensive, involve small samples that restrict the use of statistical tests, and cannot be generalized to other places and times (Creswell, 2013).

Quantitative cohort study. Tran et al. (2011) conducted a cohort study in two surveillance locations (one rural and one urban) to examine the pattern of ANC use and adequacy among rural and urban Vietnamese women. The participants included 2,132 pregnant women recruited through a census of all pregnant women surveyed in the two locations from April 2008 to December 2009. The data collection used a structured questionnaire that gathered information on the timing of ANC, frequency of ANC visits, place of care, the content of ANC, and cost of services. The study participants received three-monthly follow ups until the termination of pregnancy. The outcome variables were the number of ANC visits, timing of the first visit, and content of ANC. The independent variables were maternal age, occupation, education, marital status, number of children, and high-risk pregnancy.

The analysis included chi-square and *t*-tests to compare the group proportions and means respectively. The findings showed that almost all women attended ANC at some point, but there were disparities in the timing, number of visits, and adequacy of ANC. On average, women in urban settings had more ANC visits, $M = 7.7$ (95% CI [7.5-7.9]; than women in rural settings, $M = 4.4$, 95% CI [4.2-4.57.7], $p < .0001$. Besides, women in urban settings had 4.2 times more health consultations, started ANC earlier, $p < .001$; and received more ANC services, $p < .001$; than women in rural settings. One significant limitation of this study was that the two surveillance sites were different from the rest of

Hanoi. Besides, the study may have suffered from selection bias due to the loss to follow-up. For these reasons, the findings may not be generalizable to other settings. Cohort studies have the disadvantage of being long and expensive. However, they have a significant advantage that they indicate the temporal sequencing of events between independent and outcome variables to understand the cause-effect relationship.

Quantitative retrospective study using health facility data. Bilenko, Hammel, and Belmaker (2007) used a retrospective study to compare the utilization of ANC by a seminomadic Bedouin Arab population before and after the opening of a local clinic. The study used a retrospective before and after study design. The study sample included 45 women who registered their newborn at the MCH clinic A in the 2 years following the opening of the local clinic and had a birth prior and after the opening of the clinic. Researchers reviewed the records to compare ANC utilization by the same woman during the two pregnancies. The dependent variables included: any ANC use, three or more visits to the public health nurse, one or more visits to the obstetrician, gestational age at first ANC visit, compliance with screening tests, birthweight, and gestational age at birth. The independent variables comprised maternal age, maternal education, husband's education, birth order of the child, consanguineous marriage, and polygamy.

The analysis involved chi-square and *t*-tests to examine the categorical and continuous variables respectively among women who had ANC and those who did not. They used the paired *t*-test to compare the content of ANC among the women who had ANC before and after the opening of the local clinic. The findings showed significant increases in the proportion of women receiving ANC after the opening of the local clinic

from 31.8% to 57.6%, $p = .0004$; women who received at least one examination by a doctor from 27% to 45%, $p = .003$; women with at least 3 visits by nurses from 25% to 39%, $p = .011$; and in adhering to the screening tests. However, there was no effect on the gestational age at birth and birth weight. The study had few limitations such as the lack of a comparison group, limited information availability, and selection bias. With over 40% of the study population not using ANC, it is difficult in the absence of a control group to ascertain whether improvements in ANC utilization were due to factors other than the opening of a new clinic. Besides, the records may not have captured all the information with adequate quality since they were not designed for the study. Furthermore, the study participants were all recruited from one clinic and may not represent the general population. In that context, selection bias cannot be ruled out since the reasons for these women to register at the MCH clinic remain unknown.

Overall, retrospective studies have some distinct advantages when they are well designed. They are less expensive and take less time because they take place when both the exposure and outcomes have already occurred.

Quantitative randomized controlled trials. Jafari et al. (2010) conducted a cluster RCT to investigate the effect of group prenatal care on ANC satisfaction and utilization in Iran. The study involved 14 health centers with a minimum of 12 new ANC registrations per month. These facilities were stratified by geographical area and randomly assigned to the intervention (n = 7) and control groups (n = 7). The intervention consisted of group ANC sessions. Each session gathered eight to 10 pregnant women and lasted about 90 to 120 minutes. Each group of women met 10 times during pregnancy.

The control group continued the standard individual ANC. The study participants were 678 low risk pregnant women attending ANC between May and July 2010, recruited before 24 weeks of gestation, who have no serious medical conditions requiring individual care. They collected the data using a structured questionnaire administered to women after exposure to ANC at 34 to 36 weeks of gestation. The outcome variable was the satisfaction with ANC measured as a continuous variable with scores ranging from 24 to 96. The independent variables included maternal age, literacy, parity, body mass index (BMI), gestational age, reproductive health history, number of ANC procedures, timing of the first visit, and frequency of visits.

The analysis included the chi-square and *t*-tests to assess the differences between groups. The generalized estimating equations model helped to calculate the OR, 95% CI, and *p*-values. The findings showed that pregnant women receiving group ANC were more satisfied, mean score = 3.8, SD = 0.20; than women receiving the standard individual ANC, mean score = 3.01, SD = 0.31, $p < .000$. This pattern was similar in all measures of satisfaction assessed including the information received, relationship with a provider, coordination of care, and quality of care. In addition, although almost all women initiated ANC with 4 months of gestation in both groups, 70.3% of women receiving group ANC complied with the recommended number of ANC visits compared with only 37.3% of women receiving individual ANC, counseling, $p < .000$. This study had few limitations. The interviews took place in the health facilities and participants might have provided socially desirable answers to avoid criticizing health workers in their territory. The study targeted women of low-risk. Its findings may not be

generalizable to women in other risk categories. Despite these limitations, RCTs have a unique advantage of minimizing the risk of selection bias through randomization. This study helped to establish the correlation between ANC satisfaction and ANC utilization.

Quantitative cross-sectional health facility survey. Qi et al. (2015) conducted a cross-sectional health facility survey of pregnant women attending ANC to examine the risk and protective factors of ANC utilization among migrant women in Shanghai. The study participants included migrant women who had lived in Shanghai for more than 6 months and given birth between August 2009 and February 2010. Qi et al. implemented the study in two general hospitals: Punan Hospital (PNH) and Changning District Center Hospital (CNH). They recruited all eligible women within 10 and 42 days of childbirth in Punan and Changning respectively. The outcome variables were the use of any ANC, timely use of ANC in the first 12 weeks of gestation, and adequate use of five ANC visits or more. The independent variables were the socio-demographic characteristics (e.g., age, residence, education, income, and health insurance), pregnancy and delivery history, and opinion of ANC.

The analysis included bivariate and multivariate regressions to investigate the associations between women's characteristics and ANC use. The findings showed that 90.1% of migrant women had at least one ANC visit, but only 19.7% and 49.7% started ANC in the first trimester and completed at least five ANC visits respectively. The main factors associated with adequate ANC use were maternal age 25 to 30 years, AOR = 2.2, 95% CI [1.4, 3.5]; maternal age 30 and above, AOR = 1.9, 95% CI [1.1, 3.2]; husbands holding a Shanghai residency status, AOR = 4.9, 95% CI [2.2, 10.9]; more than 10 years

of education, AOR = 1.8, 95% CI [1.2, 2.9]; history of miscarriage or abortion, AOR = 2.2, 95% CI [1.3, 3.8]; and high-income households, AOR = 1.6, 95% CI [1.0, 2.5]. In addition, women from high-income households were more likely to initiate ANC earlier, AOR = 3.5, 95% CI [1.7, 5.5]. This cross-sectional health facility survey design had three limitations. First, it included only women who delivered in legal health facilities. In that regard, its findings cannot be generalized to women who delivered outside or returned to deliver in their hometowns. Second, the cross-sectional design did not allow for causal inference. Third, asking women after delivery to remember what happened months back during ANC may have introduced recall bias. Nevertheless, this cross-sectional health facility survey was useful to identify the best predictors the ANC satisfaction and use.

Quantitative cross-sectional household HIV/AIDS survey. Fagbamigbe and Idemudia (2015) conducted a secondary analysis of data from the 2012 National HIV/AIDS and Reproductive Health Survey to investigate the barriers to ANC use in Nigeria. The primary study was a cross-sectional household survey using a multistage cluster sampling technique. First, rural and urban localities were selected from the States. Second, clusters were identified among selected rural and urban localities. Third, 30 households were selected from in each cluster. Fourth, study participants were selected from households. The sample included 2,199 women who had given birth in the 5 years prior to the survey who did not attend ANC at the last pregnancy. The outcome variable was women who did not attend ANC. The independent variables included demographic and socioeconomic characteristics such as maternal age, marital status, education attainment, employment status, household wealth, religion, residence, geopolitical zones,

and tribe.

The analysis included bivariate analyses using Pearson chi-square to examine the relationships between women's characteristics and the reasons for not using ANC. In addition, multiple response data analysis techniques helped to identify and prioritize the many reasons for not using ANC. The findings revealed that 85% women who did not use ANC resided in rural areas, 57.3% had no education, 93% were either married or living with a partner, and 50.6% were of the Fulani tribe. Furthermore, 42.1% resided in the North East compared with only 3.6% in the South East. The main reasons for not using ANC were financial (e.g., lack of money) and logistic (e.g., distance and lack of transport) for 56% and 44% of the nonusers respectively. Other reasons included the shortage of health workers, staff attitudes, and family-related factors such as the inability to go alone or obtain permission. This secondary analysis of a household cross-sectional survey design had three limitations. First, the cross-sectional design did not allow for the interpretation of causality. Second, there was a risk of recall bias because the study collected data about births that occurred 5 years prior to the interview. Third, the secondary analysis missed some variables not included in the primary study. Nevertheless, secondary analysis studies have the advantage of being cost and time-saving. The study helped to identify the women's characteristics most associated with ANC nonuse.

Quantitative cross-sectional household surveys. Bbaale (2011) used a secondary data analysis of the Uganda DHS 2006 to examine the factors that influence the content of ANC. The Uganda DHS 2006 was a cross-sectional household survey of

8,531 women aged 15 to 49 years identified through a stratified multistage cluster sampling technique. The first stage selected 368 clusters in all the regions. The sample had an adequate urban-rural representation to allow for separate estimates at national levels for rural and urban areas. The second stage selected the households in each cluster from the master listing of households. The third stage identified the individuals in each household. The data was collected using the DHS women's questionnaire, which included questions on the demographic and socioeconomic factors, reproductive history, pregnancy history, and services received during ANC. The outcome variable was the content of ANC with seven categories representing the number of ANC services received. The independent variables included birth history, maternal age, maternal education, husband's education, husband's occupation, residence, religious affiliation, household wealth, availability of and accessibility to a health facility, and ownership of the health facility.

The analysis included a community fixed effects regression methodology to examine the association between independent and outcome variables. The findings showed that 89% of women sought professional ANC care, but only 16% received the full content of ANC. Uptake of ANC investigations indicated that 12% had a urine test, 28% a blood test, and 53% a blood pressure checkup. The uptake of treatments showed that 27% received deworming tablets, 50% two doses of tetanus toxoid vaccines, and 63% iron tablets or syrup. The main predictors of a high number of ANC procedures included maternal education, husband/partner education, socioeconomic status, residence, timing and frequency of ANC, type of ANC facility used, nature of the health facility

visited, media exposure, family planning, and utilization of professional care, $p < .01$. The study had few limitations. First, it lacked the basis for weighting different components of the ANC procedures. Second, its cross-sectional design did not permit the analysis of causal inferences. Third, recall bias could have occurred since women had to remember what happened in the last 5 years preceding the interview. The secondary data analysis of DHS showed a useful, fast and economical approach to establishing the best predictors of the number of ANC procedures and ANC use.

Quantitative multilevel analysis of health facility and household surveys. Kyei, Campbell, and Gabrysch (2012) conducted a multilevel analysis of data from the health facility census (HFC) 2005 and DHS 2007 to examine the effect of distance and level of service provision on ANC utilization in rural Zambia. The HFC included 1,400 public and semipublic health facilities. It assessed the number of days of ANC services per week and the package of services provided. The DHS 2007 included 7,146 women aged 15 to 49 years with a birth in the 5 years prior to the survey. The data was collected using a structured questionnaire to gather information on the frequency of ANC visits, gestational age at the first visit, and ANC procedures. The outcome variables were the completion of four ANC visits, ANC visit in the first 3 months, and access to quality ANC. The authors defined quality ANC as the completion of four or more visits and receiving at least eight ANC procedures. The independent variables were the distance to the nearest health facility and ANC services provided during ANC. The confounding variables were maternal education and household wealth. The study linked the geomapping information with the health facility and household data.

The analysis used a multivariate multilevel logistic regression to investigate the factors most associated with ANC use. The findings showed no significant association between the distance to the nearest health facility and the frequency of ANC visits, AOR = 0.87, 95% CI [0.72, 1.06], p = .018; and between the level of service provision and the frequency of ANC visits, AOR = 0.91, 95% CI [0.75, 1.12], p = .39. However, there was a significant association between the distance to the nearest health facility and quality of ANC received, AOR = 0.76, 95% CI [0.57, 1.00], p = .05. Every 10 km increase in the distance to the nearest health facility reduced the Odds of receiving quality ANC by a quarter. Conversely, an increase in the level of ANC provision increased the Odds of receiving quality ANC. The study had few limitations. It is difficult in a multi-level analysis to compare the snapshot situation of health facilities in 2005 with the births that occurred over a five-year period 2002-2007. Also, the exclusion of urban populations and movers significantly reduced the sample size, limited the scope of the analysis, and may have introduced selection bias. Besides, the difference between the estimated distance using the straight geo-mapping lines and the real distances by road could have underestimated the distance and biased the findings. Furthermore, as it is often the case in secondary analysis, the HFC did not collect other relevant variables for this study (e.g., hours of operation, number and skills of health staff, and patient satisfaction). Nevertheless, this multilevel analysis provided a unique of linking health facility information with household data to understand some of the health system determinants of ANC utilization.

Mixed methods study. Mumtaz and Salway (2005) conducted a secondary mixed methods study of the association between women's mobility patterns and the use of contraceptive and ANC services. This quantitative study used data from the Pakistan Fertility and Family Planning Survey 1996–1997 (Hakim & Cleland, 1998). The sample included 7,582 ever married women aged 15 to 49 years selected through a multistage cluster sampling technique. The analysis used the bivariate and multivariate logistic regressions. The findings revealed that women's mobility remained limited in Pakistan. However, life-cycle characteristics (e.g., age and number of sons) and acquired characteristics (e.g., education, socioeconomic status, and professional employment) were good predictors of unaccompanied mobility and accompanied mobility respectively, $p < .001$. In addition, further analysis showed that accompanied mobility was associated with increased use of ANC at the national level. The qualitative study used data from a large ethnographic study of the relationships between gender systems and women's reproductive health conducted in Pind village located in Punjab province in Northern Pakistan. The analysis followed the ground theory process and was done through daily meetings. The findings confirmed that women had restricted mobility for reasons including the honor code and risk of sexual harassment. In Pind village, unaccompanied mobility was regarded as a result of the lack of social resources, not a sign of women's freedom as it is the case in developed countries. The combination of a cross-sectional survey with an ethnographic study added more insights in a way not possible with a single design (Creswell, 2013).

Rationale for Study Variables

Dependent variables. This study's dependent variable was ANC compliance defined as the attendance of at least four ANC visits during pregnancy. DRC has adopted the Focused ANC strategy. Under this new strategy, each visit has a specific set of well-defined interventions to prevent, detect, and manage pregnancy-related complications, medical conditions, and significant health risks (See Table 2). The focused ANC yields its maximum benefits on improving maternal and perinatal outcomes when these interventions are taken together (Villar & Bergsjo, 2002). For that reason, ANC compliance with a minimum of four visits is essential for women to take the full benefits of the focused ANC. Studies have shown that women who comply with four ANC visits had a higher likelihood of delivering in a health facility, being assisted by a skilled worker at birth, and having a normal weight baby (Ahmed, Khoja, & Tirmizi, 2012; Brown, Sohani, Khan, Lilford, & Mukhwana, 2008; Mbuagbaw & Gofin, 2011).

Independent variables. The study examined six independent variables grouped into three categories: ANC availability (three), ANC accessibility (two), and ANC quality (one).

The variables of ANC availability included the type of ANC facility, type of the ANC provider, and gender of the ANC provider. The type of ANC facility in this study was a public or private facility. The public ANC facilities were those owned by the government and faith-based organizations affiliated with government. Private ANC facilities were those that belonged to nongovernmental organizations and not affiliated with government, whether for-profit and not-for-profit. Few studies have shown a

correlation between the type of ANC facility and women's satisfaction (Chemir, Alemseged, & Workneh, 2014), service quality (Victora et al., 2010), and service utilization (Chen et al., 2013). The type of ANC provider comprised doctors, nurses and midwives, and others. An ANC provider was any qualified person who provided care to pregnant women to prevent, detect, or manage complications; diseases, and health risks. Few studies have shown an association between the type of ANC provider and the quality and utilization of ANC services (Atunah-Jay, Pettingell, Ohene, Michael Oakes, & Borowsky, 2013). The gender of the ANC provider was either male or female. Few studies have shown that, in some cultural contexts, women have gender preferences as to who should provide maternal health services (Faye, Niane, & Ba, 2011).

The variables of ANC accessibility were the time to the ANC facility and cost of ANC services. The time to the ANC facility is defined as the number of minutes it takes the woman to reach the health facility providing ANC services. Few studies have examined how the distance relates to the use of ANC (Gupta et al., 2014). The cost of ANC services was defined as the sum of the direct costs of ANC services paid by the women to receive the consultation, laboratory investigations, and drugs during ANC. The indirect costs (e.g., transportation) were not included in the dataset. Few studies have shown an association between the cost of ANC services and ANC use (Feinstein et Al., 2013; Mason et al., 2015).

The variables of ANC quality included the number of ANC services. The number of ANC services was defined as the number of procedures the woman received during ANC out of the nine recommended through the focused ANC. They included weight and

blood pressure measurements, blood tests, urine tests, HIV counseling and testing, iron supplementation, deworming, malaria prevention, and tetanus toxoid vaccination. Past research has demonstrated a correlation between the number ANC services and ANC utilization (Bbaale, 2011).

Confounding variables. This study included data on factors such as the mother's age, mother's education, marital status, parity, and timing of the first ANC visit that could influence ANC use (Joshi et al., 2014; Tsegay et al., 2013). It hypothesized that maternal age, maternal education, marital status, number of live births, and timing of the first ANC visit could influence ANC compliance with four visits (Joshi et al., 2014; Tsegay et al., 2013). The analysis included these variables as confounders to control for their possible effect ANC compliance.

Studies Related to Key Variables

Type of ANC facility and ANC compliance. Few studies have examined the relationships between the type of ANC facility and ANC compliance. The definition of ANC compliance varied in different contexts and included the attendance of at least three, four, five or more visits. The results have shown a mixed pattern.

Jerome (2015) conducted a hospital-based cross-sectional survey to investigate the relationship between socio-demographic characteristics and clinical factors and the use of ANC among urban women delivering in the city of Goma in the DRC. The study included 1,152 women from four private and one public hospitals. One of the outcome variable was ANC attendance defined as the attendance of at least one ANC visit during pregnancy. The independent variables included sociodemographic characteristics of

women (e.g., age, sex, residence, marital status, education level, and occupation) and clinical factors (e.g., parity, history of abortion, stillbirth, and cesarean section, maternal height and weight, and delivery institution). The analysis included multiple logistic regressions to identify independent variables most associated with ANC attendance. Of the variables analyzed, delivering in one of the private hospitals, Bethesda private hospital, was associated with a lower likelihood of attending ANC during pregnancy, OR = 0.21, 95% CI [0.05, 0.86], $p = .03$; in comparison with the public hospital. This study showed an association between the type of delivery institution and ANC attendance. It did not include the type of ANC facility attended during pregnancy.

Chen et al. (2013) conducted a cross-sectional household survey to investigate the quality of ANC in the public and private sectors in rural Hebei, China. The sample included 1,079 women selected through multistage cluster sampling. The data collection used a structured questionnaire. The outcome variables were the place of receipt of ANC (public or private), attendance of any ANC, attendance of four ANC visits, receipt of ANC in the first trimester, and ANC content. The independent variables included the public and private sectors. The public sector comprised government-owned health facilities. The private sector included nongovernment owned, for-profit, and not-for-profit health facilities. The analysis used chi-square and Fisher's exact tests to compare the quality of ANC between groups.

The findings showed low levels of ANC compliance of 47% and 53% in the public and private sectors respectively that were not statistically significant, $p > .05$ (Chen et al., 2013). In addition, the ANC content was poor in both public and private

sectors, $p = .425$. The study had few limitations. First, it may have introduced a selection bias by excluding the permanent residents who were absent for 6 months. For this reason, its findings may not be generalizable to the general population of immigrants. Second, asking women to self-report may have led to recall bias. Nevertheless, the study showed no correlation between the type of ANC facility and ANC compliance. As the authors observed, the poor quality of ANC in both sectors may have been a reason.

Victora et al. (2010) conducted a cross-sectional survey to compare the quality of maternal health care in public and private health facilities in Pelotas, Brazil. The sample included 4,244 women with a birth in a maternity ward and recruited by a census. The eligibility criteria included women who had a live birth or a stillbirth with at least 500g or 20 weeks of gestation. Researchers administered a structured questionnaire after delivery to collect information on the demographic, socioeconomic, and behavioral characteristics, reproductive history, and healthcare utilization. They gathered additional information on the ANC procedures received during pregnancy as recommended by the Brazilian Ministry Health. The outcome variable was ANC quality defined as the number of ANC procedures received during pregnancy. It used a simple additive score ranging from 0 to 11. The independent variables included the demographic, socioeconomic, behavioral, and biological characteristics; reproductive health history, and service utilization. The analysis included a comparison of the mean scores. The findings showed that the private sector provided significantly more procedures than the public sector (9.3 vs. 8.1, $p < .001$). These differences remained even after adjusting for maternal characteristics and attendance patterns. The analysis also showed that women using the private sector

facilities had significantly more ANC visits than those in the public sector (10.7 vs. 7.7, $p < .001$). This study may have suffered from recall bias as women were asked to remember after delivery what happened during pregnancy. However, this study demonstrated a correlation between the type of health facilities and number of ANC visits, and type of ANC facility and ANC quality.

Tran et al. (2012) conducted a cohort study to investigate the factors associated with ANC adequacy in two rural and urban surveillance locations in Vietnam. The participants included 2,132 pregnant women selected during routine surveys and followed until termination of pregnancy. The data was collected through quarterly interviews using a structured questionnaire. The outcome variable was ANC adequacy defined as early ANC attendance in the first trimester, at least three ANC visits, and sufficient ANC content. The independent variables were the demographic and socioeconomic characteristics including residence and type of ANC facility, reproductive history, and current pregnancy. The analysis separated rural from urban areas and conducted bivariate and multivariate regressions to investigate the associations between independent and dependent variables.

The findings showed that, in comparison with the public sector, women using exclusively the private sector had a lower ANC adequacy in the rural areas, AOR = 0.26, CI 95% [0.11, 0.64]; and urban areas, AOR = 0.44, CI 95% [0.22, 0.88]. Despite the higher number of ANC procedures in the public sector, there was no significant difference in the frequency and timing of ANC visits. The study had a limitation. The study sites had a better socioeconomic situation compared to the rest of Vietnam.

Therefore, its findings might not be generalizable to all places in the countries. Nevertheless, the study showed no association between the type of ANC facility and ANC compliance. The authors explained that women might have continued with ANC in the private sector despite the low content and high cost because of their interest in specific procedures such as an ultrasound.

These studies showed that the relationship between the type of ANC facility and ANC compliance is context specific and differs across and within countries. Besides, it may or may not be linked to the quality of ANC services. The study in the DRC focused on the delivery facility instead of the ANC facility. The study in China showed no relationship. In Vietnam, there was a significant positive association in one study (Trinh et al., 2007) and no association in the other study (Tran et al., 2012), despite differences in the quality of ANC provided. In Brazil, there was a significant positive association between the type of ANC facility and ANC compliance. There was also a significant positive relationship between the type of ANC facility and quality of ANC services, not explained by ANC compliance and maternal characteristics. None of these experiences came from SSA. Besides, there is no published study on the association between the type of ANC facility and ANC compliance with four visits among rural pregnant women in the DRC.

Type of ANC provider and ANC compliance. Few studies have examined the relationship between the type of ANC provider and women's compliance with four ANC visits. The results were mixed.

Atunah-Jay et al. (2013) conducted a secondary analysis of the Ghana DHS 2008 to investigate the relationship between the type of ANC provider and maternal care use in Ghana. The participants were 1,367 rural women aged 15 to 49 years selected through multistage cluster sampling technique. The eligibility criteria included a history of live birth in the 5 years preceding the survey. The study analyzed 18 outcome variables, including ANC attendance of four or more visits. The independent variable was the type of ANC provider that had four categories: doctor, midwife, community health officer (CHO) and other. The covariates were the standard demographic and socioeconomic characteristics. The analysis included the bivariate chi-square tests to compare the groups and multivariate logistic regression to investigate the relationship between the type of ANC provider and outcome variables. The findings showed that women attended by doctors and midwives had a three-time higher Odds of reporting a comprehensive maternal care package when compared with those attended by CHOs, $p < .01$. In addition, there was a statistically significant association between the type of ANC provider and ANC compliance with four or more visits, $p < .01$. Furthermore, there was a statistically significant association between ANC provider type and ANC quality. This study had limitations. First, its cross-sectional design did not allow causal inferences. Second, it could not adjust for all possible confounders because some variables were not collected. Third, the collection of data on events of the 5 years prior to the survey may have introduced recall bias. Nevertheless, this study showed that the type of ANC provider was a good predictor of the quality and quantity of ANC in Ghana. The restricted breath

of CHO practice could explain the low ANC quality and utilization observed in this group of ANC providers (Atunah-Jay et al., 2013).

The study by Trinh et al. (2007) described above also examined the association between the type of ANC provider and ANC use in three rural areas of Vietnam. The findings showed that the proportion of women who attended three or more ANC visits was 59% and 56% of those seen by doctors/midwives and assistant doctors/nurses respectively, $p > .05$. Besides, the proportion of women who achieved sufficient utilization (entered ANC within 4 months and attended more than three ANC visits) was the same in the two groups, $p > .05$. The study showed that there was no statistically significant association between the type of ANC provider and ANC compliance in the three rural areas of Vietnam.

These two studies showed that the relationship between the type of ANC providers and ANC compliance did not follow the same pattern in different contexts, with a significant positive association reported in Ghana and no association in Vietnam. There is no published study on the association between the type of ANC provider and ANC compliance with four visits among rural pregnant women in the DRC.

Gender of the ANC provider and ANC compliance. There is a paucity of research on the relationship between the gender of ANC providers and ANC use. Few published studies from Senegal showed that Black African women have gender preferences for the delivery of maternal health services.

Ndiaye et al. (2005) carried out a cross-sectional health facility survey to examine the socio-cultural factors associated with delayed initiation of ANC in the Richard-Toll

district in Senegal. The study participants were 351 pregnant women aged 15 to 40 years selected from a census of all women who attended ANC in the district from March to April 2003. The outcome variable was the gestational age at the first ANC visit with two categories: early ANC if started in the first trimester and late if started after the first trimester. The independent variables comprised the mother's age, marital status, education, husband's occupation, parity, and ethnicity. The analysis included bivariate chi-square and Fisher's exact tests to examine the determinants of late ANC initiation. The findings showed that 68% of pregnant women started ANC after the first trimester. Half of pregnant women who started ANC late did not want to be examined by a male health professional. There was a statistically significant association between late ANC initiation and the refusal of an examination by a male health professional, $p = .04$. Furthermore, half of the women refusing to be examined by a male health professional were illiterate. There was a statistically significant association between the refusal to be examined by a male health professional and illiteracy, $p = .02$. The authors observed that illiteracy and religious beliefs were possible explanations of the refusal of women to be examined by a male ANC provider.

Faye et al. (2011) conducted a cross-sectional study to investigate the determinants of home delivery in Gossas Health District in Senegal. The study participants included women who gave birth between July 2006 and June 2007 and had at least one institutional delivery in the 5 years prior to the survey. The sample included 373 women selected through a multistage stratified sampling technique. The dependent variable was the place of delivery with two categories: home delivery and health facility

delivery. The independent variables were adapted from Andersen's behavioral model of service utilization. They included the demographic and socioeconomic characteristics, enabling resources, and factors related to the previous health facility delivery; including the gender of the ANC provider. The analysis included an initial univariate analysis to pre-select the factors with $p < .25$ to include in the regression model. A multivariate logistic regression followed to identify the factors that best predict home delivery in women with a previous birth in a health facility. The findings showed that 34% of women attended four or more ANC visits and 22% gave birth at home. The regression analysis showed a statistically significant association between the male gender and home delivery, OR = 3.9 95% CI [2.30, 6.65]. Besides, there was also a statistically significant association between the satisfaction with the quality of health facility birth and home delivery, OR = 2.52 95% CI [1.36, 4.65]. The authors concluded the quality of care and the person providing the services are two important determinants of service use.

There is a paucity of studies on the association between the gender of the ANC provider and ANC compliance. In a developed country context, Carrejo, Balla, and Tan (2007) conducted a cross-sectional study to investigate the gender preferences of patients in the management of erectile dysfunction (ED) in the United States. Most patients felt that male and female providers were equally qualified to manage ED and had no gender preference. Therefore, health worker gender preference is context-specific and could be linked to the culture and literacy level. The few data available point to the preference of African women for female providers in the delivery of maternal health services, including

ANC. There is no published study on the association between ANC provider's gender and ANC compliance with four visits among rural pregnant women in the DRC.

Time or distance to the health facility and ANC compliance. Many studies have examined the impact of time or distance on women's access to care. Most of the studies showed that women residing further away from the health facility were less likely to comply with the recommended minimum of four ANC visits. Some of the studies also showed that the time or distance to the health facility had no effect on ANC use and frequency.

Simkhada et al. (2008) conducted a systematic review of the literature on the factors affecting the use of ANC in developing countries. The design integrated quantitative with qualitative studies to capture all relevant factors involved in the use of ANC. It applied the systematic review methodology developed by the Cochrane Collaboration and the National Health Service (NHS) Center for Reviews and Dissemination (CRD). The study designs included a combination of randomized controlled trials (RCT), cross-sectional surveys, cohort studies, case control studies, and qualitative studies. The search methods included all studies published between 1990 and 2006 in the English language. The searched databases were ASSIA, Cochrane Collaboration, CINHAL, EMBASE, JSTOR, MEDLINE, PubMed, ScienceDirect, Scopus, and Web of Science. The search found 3,986 articles, of which only 28 were retained and included in the review after completing the reading and quality assessment. Two reviewers assessed the quality of the papers and synthetized the data following the CRD's guidance for systematic reviews. The findings showed that the time or distance to

the nearest health facility had a significant association with ANC use and frequency, but had no association with the timing of the first visit.

Brown, Sohani, Khan, Lilford, and Mukhwana (2008) conducted a cohort study to examine the relationship between ANC and perinatal outcomes (e.g. stillbirth, LBW) in Kwale district, Kenya. The study participants were women who had a birth between August 2004 and July 2005. The data was collected through continuous registration during the four-monthly visits. It included information on household members, socioeconomic characteristics, births, deaths, migration, child growth, family planning, and ANC and delivery for pregnant women. The outcome variables were the number of ANC visits and pregnancy outcome (baby alive or dead) and baby's weight (LBW if < 2,500g, normal weight if ≥2,500g). The independent variables included the distance, socioeconomic status, education, age, parity, delivery, and use of insecticide-treated bednets. The analysis included an initial bivariate logistic regression to eliminate all independent variables with a p value > .05, followed by multivariate analysis to identify the associations with outcome variables. The findings showed that women residing beyond 5 km of a health facility had a lower likelihood of attending ANC, OR = 0.29, 95% CI [0.22, 0.39]. Besides, there was a statistically significant relationship between the distance to the health facility and number of ANC visits, OR = 1.46, 95% CI [1.33, 1.60]. This study showed that the distance to health facilities affected both ability of women to attend ANC services and the number of ANC visits.

Kyei et al. (2012) investigated the influence of distance on ANC use in rural Zambia. They used a multilevel analysis of the 2007 DHS and 2005 Health Facility

Census to link data from the health facility and household surveys to assess how the distance influences the timing and number of ANC visits. This study's methodology is fully explained in the section on methodology approaches above. The findings showed that an increase in the distance to the closest ANC facility was associated with a reduction in the quality of ANC defined as at least four ANC and eight ANC procedures, AOR = 0.76, 95% CI [0.57, 1.00].

Anastasi et al. (2015) conducted a mixed methods study in Uganda to examine key factors contributing to the loss of women between ANC and delivery services and make policy and program recommendations. The study included structured and semistructured interviews with women, health workers, and policy makers, and FGDs with women, men, and Traditional Birth Attendants (TBAs). The findings showed that the time to the health facility had no association with the use of ANC and delivery services.

O'Meara, Platt, Naanyu, Cole, and Ndege (2013) conducted a community-based survey of pregnant women in western Kenya to examine the demand-side factors of ANC use. The sample included 6,200 pregnant women enrolled in a home-based HIV counseling and testing project. The data collection included ANC attendance, demographic and socio-economic characteristics, and GPS coordinates. The dependent variable was ANC attendance. The independent variables included the individual, household, and village level factors. The analysis included spatial correlations and multivariate logistic regressions. The findings showed that no association between the distance to the health facility and ANC attendance.

These studies showed that the relationship between the time or distance to the health facility and ANC attendance is context specific with some studies reporting a significant association (Brown, Sohani, Khan, Lilford, & Mukhwana, 2008; Gupta et al., 2014; Kyei et al., 2012) while others did not (Anastasi et al., 2015; O'Meara, Platt, Naanyu, Cole, & Ndege, 2013). There is no published study on the association between the distance to the health facility and ANC compliance with four visits among rural pregnant women in the DRC.

Cost of ANC services and ANC compliance. The direct and indirect costs of care remain a major barrier to women's optimal utilization of maternal health services, in particular among the poor populations (Mubyazi et al., 2010). Studies have examined the relationship between service costs (e.g. consultation, tests and transportation) and ANC utilization (Feinstein et al., 2013; Simkhada et al., 2008).

Feinstein et al. (2013) used a population-based cross-sectional survey to investigate the use of and experiences of urban Congolese women with ANC and delivery services in the city of Kinshasa in the DRC. Researchers recruited 1,221 women aged at least 18 years who had given birth in the three years preceding the survey through multistage cluster sampling. Logistic regression analyses were used to investigate the association between ANC attendance and sociodemographic characteristics and ANC attendance and women's experiences with ANC. The findings showed that women who paid for their own expenses had a lower likelihood of completing four ANC visits. In addition, 20% of women reported that the cost of care was the main reason for choosing where to attend ANC and 17.7% reported missing ANC services at some point because of

their inability to pay. This study showed that the cost of care may influence women's ability to use ANC services and complete the required number of visits.

Sambo et al. (2013) conducted a cross-sectional descriptive survey to examine the household costs of ANC and delivery services in the Fatika community, Kaduna State in Nigeria. The study participants were pregnant women and women in the six-week postpartum period. The sample included 135 women, representing all consenting women attending ANC at the Village Health Facility between 28 March and 25 May 2011. Researchers used a structured questionnaire to collect information on demographic and socioeconomic characteristics, pregnancy, utilization, and costs of ANC and delivery services. The study variables included the sociodemographic characteristics, monthly income, and the costs of registration, laboratory investigations, drugs, and transportation. The analysis included chi-square tests to examine the association between categorical variables. The findings showed that over half of the breadwinners earned less than two dollars a day. The average cost of four ANC visits was US$12.4, and there was a statistically significant relationship between the household head's income and ANC attendance, $\chi^2 = 2.451$, df = 2, $p = .048$. The study showed that the cost was an important determinant of ANC utilization, in particular in low-income communities.

Simkhada et al. (2008) systematic review explained above included the cost of ANC services as a variable assessed for association with the use of ANC in developing countries. The findings showed that financial barriers were a common determinant of ANC nonuse, and 21 studies reported a relationship between economic factors and ANC utilization. The main ANC cost drivers responsible for the nonuse included the

laboratory tests and transportation. This review reported that the implementation of user-free abolition or reduction strategies increased the utilization of ANC among poor populations.

These studies confirmed the importance of cost as a key determinant of women's access to maternal health services and ANC utilization in the DRC and elsewhere, in particular among poor populations. However, there is no published study on the association between costs and ANC compliance with four visits among rural pregnant women in the DRC.

Number of ANC services provided and ANC compliance. The focused ANC strategy recommended a set of evidence-based services provided at each of the four visits (Villar & Bergsjo, 2002). These services make the content of ANC an important determinant of the quality of maternal health services during pregnancy. Few studies have investigated the association between the number of services provided during ANC and likelihood of completing at least four ANC visits.

Conrad et al. (2012) conducted a multi-country cross-sectional health facility survey to investigate the compliance of health workers with focused ANC services. The study took place in three rural districts of Burkina Faso, Uganda, and Tanzania. The study variables included the duration of the ANC visit, provision of information, clinical examinations, laboratory testing, and distribution of drugs. The analysis was descriptive to estimate the proportion of ANC services provided by health professionals and the time taken on each service. The findings showed that ANC services were not adequately performed on all women in several health facilities. In addition, many health facilities

lacked drugs and laboratory reagents, in particular, iron and folic acid tablets, and hemoglobin, blood grouping, syphilis and malaria tests. The authors argued that the lack of supplies may have contributed to many health facilities failing to perform key ANC procedures.

Wilunda et al. (2015) conducted a cross-sectional health facility survey to assess the availability, utilization, and quality of maternal and neonatal health services in Uganda. The sample included 384 pregnant women selected through systematic sampling of ANC exit interviews and ANC client record reviews respectively. The study variables included the availability of infrastructure, equipment, supplies and drugs, utilization of ANC, delivery and PNC, quality of care received, including the Emergency Obstetric Care (EmOC) status, and case fatality rate. The data analysis was mainly descriptive. The findings showed that none of the 11 health facilities assessed performed all the signal functions required to qualify as a basic emergency obstetric and newborn care (EMONC) facility. One of the reasons was the lack of drugs. More than 50% of health facilities lacked basic supplies for normal deliveries such as scissors, needles, and sutures. The study also revealed an underutilization of ANC services: only 31.7% and 27.7% of expected pregnant women attended four ANC visits and received the intermittent malaria preventive treatment respectively. The study showed that the lack of essential supplies was associated with poor quality of care that may have affected the utilization of these health facilities. These findings were supported by Kiwanuka et al. (2008) systematic review that showed that perceived poor quality of care and lack of drugs were key determinants of service underutilization among poor populations in Uganda.

Naariyong et al. (2012) conducted a cross-sectional study to assess the effect of the Community-Based Health Planning and Services (CHPS) Program on the utilization and quality of ANC services in Ghana. The study participants included 600 women (300 in the CHPS program areas and 300 in the control areas) with a child aged 0 to 18 months who have resided in the district for at least 2 years. The selection of the study participants used a multistage cluster sampling technique. The outcome variables were the health services received during ANC, HIV testing, administration of anti-malaria prophylaxis, and knowledge of the danger signs of pregnancy. The health services included the measurement of weight and blood pressure, blood tests, urine tests, iron supplementation, and tetanus toxoid vaccination. The independent variables comprised demographic, socioeconomic, and accessibility factors. The analysis included the Cronbach's alpha coefficients and multivariate logistic regression to assess the reliability of indices and association between independent and outcome variables respectively. The findings showed that women in the CHPS program areas had a higher likelihood of receiving the full content of ANC, OR = 2.73, 95% CI [1.68, 4.43]; anti-malarial prophylaxis, OR: 3.73, 95% CI [1.73, 8.04]; and HIV testing, OR = 4.49, 95% CI [2.37, 8.51]; than women in nonCHPS program areas. Nevertheless, the high number of ANC services received was not associated with a higher attendance of four ANC visits: 75% in CHPS program areas and 72% in nonCHPS program areas, OR = 1.32, 95% CI [0.86, 2.02]. The study showed that an improvement in the content of ANC does not always translate into improved ANC utilization.

Gupta et al. (2014) conducted a secondary analysis of the DHSs 1999, 2004/2005 and 2010 to examine the factors associated with ANC compliance with four visits in Tanzania. The study participants included 8,085 women 15 to 49 years with the most recent birth in the 2 years preceding each of the three surveys. The sample was selected using a multistage cluster sampling technique. The outcome variable was the use of at least four ANC visits from a skilled health provider. The study used Andersen's behavioral model of service utilization as its theoretical framework. Based on this framework, the independent variables included four categories: predisposing characteristics, enabling resources, health system determinants, and external environment factors. The analysis included bivariate and multivariate regressions. The findings showed a statistically significant association between ANC content and ANC compliance with four ANC visits for women given information on pregnancy complications, AOR = 1.20, 95% CI [1.04, 1.38); women tested and counseled on HIV prevention, AOR = 1.28, 95% CI [1.07, 1.54); and women who had two or more doses of Sulphadoxine-Pyrimethamine for malaria prophylaxis, AOR = 1.67, 95% CI [1.44, 1.93). The authors observed that improvements in ANC compliance might be a reflection of positive systemic changes in the health system resulting from significant investments in HIV and malaria programs.

The study by Bbaale (2011), already described above, was a secondary analysis of the Uganda DHS to examine the factors that influence ANC utilization and content in Uganda. The sample included 8,531 women aged 15 to 49 years with a birth in the 5 years preceding the survey. The study participants were selected through a multistage

cluster sampling technique. The outcome variable was the ANC content constructed as a numerical seven-item variable representing the number of ANC procedures received. The seven items were the weight, blood pressure, iron supplements, blood test, urine test, at least two tetanus toxoid vaccinations, and deworming drugs. The analysis included a multivariate linear regression to examine the determinants of ANC content. The findings showed a statistically significant association between the number of ANC visits and ANC content, $p < .01$. More (21%) women with at least four ANC visits received the full ANC content compared with only 11% among those with less than four ANC visits.

The studies by Conrad et al. (2012) and Wilunda et al. (2015) on the availability of drugs at ANC indicated that the shortage of essential medicines and supplies is a common challenge in many developing countries and may be associated with a reduction in the quality and utilization of services in some contexts. However, Bbaale (2011), Gupta et al. (2014), and Naariyong et al. (2012) showed that the association between the number of ANC services provided and the likelihood of completing at least four ANC visits was context specific. In countries such as Uganda and Tanzania, the content of ANC had a positive relationship with ANC compliance. However, in Ghana, improvements in ANC content were not followed by increases in ANC compliance. Kiwanuka et al. (2008) observed in Uganda that the content of care is only a determinant of utilization when it improves the clients' perception of the quality of care. There is no published study on the association between the number of ANC services and ANC compliance with four visits among rural pregnant women in the DRC.

Implication of Past Research on Current Study

There is limited research on the association between health system determinants and ANC attendance of four or more visits in developing countries in general and in rural DRC in particular. Two studies conducted in the DRC took place in urban settings and addressed only one variable each: cost and type of ANC facility (Feinstein et al., 2013; Jerome, 2015). The other studies conducted in SSA included only one to two health system determinants each (Atunah-Jay et al., 2013; Bbaale, 2011; Brown et al., 2008; Conrad et al., 2012; Faye et al., 2011; Gupta et al., 2014; Kyei et al., 2012; Ndiaye et al., 2005; Medhanyie et al., 2012; Sambo et al., 2013; Wilunda et al., 2015). Only one study conducted in Vietnam outside SSA examined the relationship between six health system factors and ANC compliance. These factors included the type of ANC facility, time to the ANC facility, satisfaction with the closest facility, availability of a family planning worker, ANC content, and type of ANC provider (Trinh et al., 2007). My study has filled an important knowledge gap in the literature by conducting an analysis of the health system predictors of ANC compliance among rural women in the DRC. It has expanded on the health system variables examined in past research to include the ANC provider gender.

Quantitative studies have shown to be most useful for statistical analysis. They have investigated the determinants of ANC utilization and compliance using randomized controlled trials, cohort studies, retrospective studies, and cross-sectional studies. Jafari et al. (2010) conducted a cluster RCT to investigate the effect of group prenatal care on ANC satisfaction and utilization in Iran. The findings showed that pregnant women

receiving group ANC were more satisfied than women receiving the standard individual ANC on all measures of satisfaction assessed such as the information received, relationship with provider, coordination of care, and quality of care. Besides, women receiving group ANC had a higher compliance with the recommended number of ANC visits than women receiving individual ANC. RCTs have a high internal validity and are the best design to establish a cause-effect relationship. However, they have a weak external validity as the results may not be generalizable to the real-life situation.

Tran et al. (2011) used an observational cohort study to investigate the pattern of ANC use and adequacy between rural and urban women in Vietnam. The findings showed that urban women used ANC more and earlier than rural women. Cohort studies have the advantage of allowing the examination of the temporal sequencing of events. However, the participants in this study were those followed in sentinel sites who may not be representative of the larger population. In addition, cohort studies may be expensive and suffer from a differential loss to follow-up that may introduce selection bias and limit the generalizability of the results.

Bilenko et al. (2007) used a retrospective study to investigate the effect of a new clinic on ANC utilization in Israel. The study showed that more women used ANC after the opening of the new clinic than before. However, there was no effect of the timing of the first visit. Retrospective studies are less costly and take less time to implement. However, the data may be incomplete and of poor quality if the records were not designed for the study. In this study, there was no data quality assurance during

recording. Furthermore, the findings may not be generalizable as the study was limited to the 60% of pregnant women who attended ANC in the health facility.

Cross-sectional surveys are a popular design in the studies of ANC utilization. Qi et al. (2015) and Kyei et al. (2012) used cross-sectional health facility surveys to examine the factors affecting ANC utilization. The two studies showed that women's demographic characteristics (e.g., migrants) and health system determinants (e.g., distance, level of service provision) were associated with the timing and frequency of ANC visits. Bbaale (2011), Mugo et al. (2015), Naariyong et al. (2012), Oladapo and Osiberu (2009), and Trinh et al. (2007) used cross-sectional household surveys to investigate the determinants of ANC utilization and quality. The findings showed an association between women's characteristics and ANC utilization, ANC quality or both. Cross-sectional studies are inexpensive in comparison with cohort studies. They take less time to conduct and do not suffer from the loss to follow-up. However, they don't allow causal inferences and the snapshot situation they provide may change at a different time.

My study used a quantitative cross-sectional household survey commonly used design in social sciences to investigate the relationships between six health system characteristics and ANC compliance with four visits. The six characteristics included the type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services.

Summary and Conclusions

DRC has one of the highest burdens of maternal and neonatal mortality in the world (UNICEF, 2014b, 2014c). The government adopted the focused ANC as a strategy to prevent, identify and manage health problems and major risks related to pregnancy. Available evidence indicates that the focused ANC is an effective strategy to improve perinatal outcomes such as stillbirths, LBW, and neonatal mortality (Anchang-Kimbi et al., 2014; Feng et al., 2010). However, the opportunity of this strategy has not been fully utilized in the DRC. More than half of rural women do not complete four ANC visits (DHS Program, n.d.b). The reasons for noncompliance remain largely unknown. Besides, there is a paucity of research on the determinants of ANC compliance in rural DRC.

Available studies have used research designs including RCTs, cohort studies, retrospective studies, and cross-sectional studies. Of these, developing countries have extensively used cross-sectional survey designs. Also, researchers have applied Andersen's behavioral model of service utilization to understand why individuals use health services. The model includes three main categories of determinants: the user characteristics, health system factors, and external factors. The health system factors and external environment have remained under-researched. The only comprehensive study conducted in developing countries was by Trinh et al. (2007) in Vietnam. It showed that user characteristics and external environment influenced the initiation of ANC while the interaction with the health system played a prominent role on the continuity of ANC.

This cross-sectoral household survey used Andersen's behavioral model to investigate the relationship between six health system characteristics and ANC

compliance in rural DRC. The study has provided useful evidence never generated before on women's compliance with ANC in rural DRC. Besides, it was the first study to apply Andersen's behavioral model of service utilization on ANC compliance in rural DRC.

The next chapter describes the research design and methods, including the study population, sampling technique, selected variables, data collection, statistical analysis, and ethical considerations.

Chapter 3: Research Method

Introduction

The purpose of this quantitative cross-sectional survey using secondary data collected by the DRC Ministry of Public Health was to investigate the association between health system characteristics and ANC compliance in rural DRC. Andersen's behavioral model of health service utilization served as its theoretical framework. The dependent variable was ANC compliance, defined as pregnant women's attendance of at least four ANC visits. The independent variables were type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services. The control variables were the mother's age, mother's education level, marital status, number of live births, and gestational age at the first ANC visit. This study's findings may guide the design of interventions to improve women's adherence to the focused ANC schedule and optimize maternal and perinatal outcomes.

This chapter describes the research design and rationale, including the study variables, the design's connection to the research questions, and constraints related to the chosen design. It includes the methodology—in particular, the study population, sampling technique, procedures, measurement instruments, and data analysis plan. It highlights the threats to internal, external, construct, and statistical conclusion validity. It describes the ethical procedures followed, including Institutional Review Board (IRB) approvals, agreements obtained to gain access to the data, and ethical concerns related to data collection and confidentiality.

Research Design and Rationale

This study was a quantitative cross-sectional survey using secondary analysis collected by the DRC Ministry of Public Health between June and July 2015. It investigated the association between health system characteristics and pregnant women's compliance with four ANC visits. A cross-sectional survey is a commonly used research design in social sciences (Frankfort-Nachmias & Nachmias, 2008). Its advantages include ease of administration through face-to-face and telephone interviews, online platforms, mobile devices, mail, email, or computer kiosks. It allows the collection of large amounts of data to increase statistical power and allow more sophisticated analysis. It is cost effective when compared with experimental and cohort studies (Rossetti, 2015). The cross-sectional survey design has some limitations. It does not allow researchers to manipulate the independent variables or sequence the occurrence of events. For that reason, it does not permit researchers to make causal inferences and before-and-after comparisons (Frankfort-Nachmias & Nachmias, 2008). Further, it may introduce recall bias when one is collecting information from the past (Rossetti, 2015). Despite these limitations, the cross-sectional survey design remains popular in the social sciences. It was appropriate for this nonexperimental study of the relationship between health system characteristics and pregnant women's compliance with four ANC visits. The use of secondary data analysis facilitated cost and time savings and enhanced the study participants' privacy, as I was not involved in the primary investigation (Frankfort-Nachmias & Nachmias, 2008).

Study Variables

The study aimed to investigate the nature of the association between health-system characteristics (the independent variables) and pregnant women's compliance with four ANC visits (the dependent variable). Frankfort-Nachmias and Nachmias (2008) defined dependent variables as those for which researchers work to explain change, and independent variables as those that explicate change in the dependent variables. The outcome variable was ANC compliance, defined as the pregnant woman's attendance of at least four ANC visits. The independent variables were the health-system characteristics that may influence women's ANC-seeking behavior and their ability to attend at least four ANC visits. Six health system characteristics were investigated in this study: type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services. The analysis controlled for five confounders shown in previous studies to be associated with ANC visits: mother's age, mother's education, marital status, number of live births, and gestational age at first visits (Gupta et al., 2014; Joshi et al., 2014; Mugo et al., 2015).

Table 3

Variable Descriptions and Measures

Variable name	Variable description	Variable measure
ANC compliance	The pregnant woman's attendance of at least four ANC visits. Coded as 1 if attended four or more ANC visits and 0 if attended fewer than four ANC visits.	Nominal, dichotomous
Type of ANC facility	The category of the health facility where the woman attended ANC during her last pregnancy. Coded 1 if attended a public health facility and 0 if attended a private health facility.	Nominal, dichotomous
Type of ANC provider	The professional category of the person attending to the woman at ANC. Coded 1 if nurses or midwives, 2 if doctors, and 3 if others (TBA, CHW or assistant nurse).	Nominal, categorical
Gender of ANC provider	The gender of the person attending to the woman during ANC. Coded 1 if a male and 0 if a female.	Nominal, dichotomous
Time to the ANC facility	The number of minutes it takes the mother to get to the health facility. Coded 1 if more than 60 minutes and 0 if less than 60 minutes.	Nominal, dichotomous
ANC costs	The amount of money (in Congolese Francs) the woman paid to receive ANC services. Coded 1 if she paid more than 500 CDFs and 0 if she paid 500 CDFs or less.	Nominal, dichotomous
Number of ANC services	Number of procedures and interventions received during ANC (it includes weight and blood pressure measurements, blood test, urine test, HIV counseling and testing, iron supplementation, deworming, malaria prevention, and tetanus toxoid vaccination). Coded 1 if fewer than four services, 2 if four to six services, and 3 if seven to nine services.	Ranked, categorical
Maternal age	The woman's age in complete years. Coded 1 if 18-29 years, 2 if 30-39 years, and 3 if 40-49 years.	Ranked, categorical
Maternal education	The woman's level of education reached. Coded 1 if no formal education, 2 if primary education, and 3 if secondary or higher education.	Ranked, categorical
Marital status	The woman's status, whether married or not. Coded 1 if not in union and 0 if in union.	Nominal, dichotomous
Live births	The number of times the woman has given birth to a live baby. Coded according to the number of reported live births.	Numeric discrete
Gestational age at first ANC visit	The age of the pregnancy in months at the time of the first ANC visit. Coded 1 if 4 or more months and 0 if less than 4 months.	Nominal, dichotomous

Research Design Connection to the Questions and Scientific Knowledge

This study questions investigated whether the compliance of rural Congolese pregnant women with the recommended four ANC visits can be predicted based on health-system characteristics. Past research has examined these questions through observational studies without manipulation and secondary data analysis of cross-sectional surveys. In that regard, the cross-sectional survey design used in this study has remained a popular research design in studies of the determinants of ANC utilization and quality (Joshi et al., 2014; Manithip et al., 2011; Mugo et al., 2015; Trinh et al., 2007; Tsegay et al., 2013). A cross-sectional household survey was more relevant in the DRC because of the poor quality of the data collected through the health management information system (HMIS). This study was a secondary analysis of data from a quantitative cross-sectional household survey conducted by the DRC Ministry of Public Health between June and July 2015. As Frankfort-Nachmias and Nachmias (2008) observed, a secondary data analysis is less expensive than studies requiring primary data collection. In advancing knowledge, this study was an initial step in establishing the relationship between health system characteristics and ANC compliance in rural DRC and has laid the ground for further studies.

Methodology

Target Population

The target population consisted of mothers aged 18-49 years with a live infant 0-5 months old who attended at least one ANC visit during their last pregnancy. WHO (2015a) estimated that almost 3 million Congolese women give birth every year. The

most recent DHS, conducted in 2014, revealed that 88% of women with a birth in the 5 years preceding the survey attended at least one ANC visit during pregnancy, and less than half completed four visits (DHS Program, n.d.b).

Setting

The study took place in 10 of the 515 health zones in the DRC where the Ministry of Public Health implemented a community-based MCH intervention to reduce access disparities among deprived populations. This project included the reactivation of village health committees and the establishment of community-based sites for the integrated management of childhood illnesses. It also involved the promotion of MCH services, including the home distribution of oral rehydration salts (ORS) and zinc tablets. The primary study was part of the end-of-project evaluation of this initiative. The 10 health zones were Dibaya, Bilomba, Lubondaie, and Ndekesha in the province of Kasai Occidental; Lodja, Kanda, and Vangakete in Kasai Oriental; and Dilala, Fungurume, and Kinkondja in Katanga.

Table 4

Description of Health Zones Included in the Study

Provinces	Health zones	Health centers	Population	Annual births
Kasai	Dibaya	17	133,231	5,329
Occidental	Bilomba	14	84,339	3,374
	Ndekesha	18	149,337	5,973
	Lubondaie	20	96,691	3,661
Kasai Oriental	Lodja	22	179,436	7,177
	Vangakete	17	120,439	4,818
	Kanda	18	224,337	8,973
Katanga	Kinkondja	25	238,412	9,536
	Fungurume	18	104,758	4,190
	Dilala	9	112,456	4,498
Total		178	1,443,436	57,529

Note. Table constructed using data from the DRC Ministry of Public Health, 2015.

Sampling and Sampling Procedures

A *sample* is a subset of sampling units that has the attributes of the target population. It has to be representative to allow generalization of the findings to the entire population (Frankfort-Nachmias & Nachmias, 2008). In this study, the sampling unit was the woman with a live infant aged 0-5 months who attended at least one ANC visit during pregnancy in the 10 health zones. There are two main sampling designs: probability

sampling and nonprobability sampling. This study used the probability sampling design to give each eligible woman an equal chance to be included in the sample (Frankfort-Nachmias & Nachmias, 2008). The study drew a representative subset of women with a live infant aged 0-5 months to examine their compliance with four ANC visits in the 10 health zones. The sampling frame included 1,280 women with a live infant 0-5 months of age who had attended at least one ANC visit and enrolled in the study conducted by the Ministry of Public Health.

G*Power 3.1.9.2 software was used to calculate the sample size for a statistical power of .80, alpha error (α) of .05, and effect size of OR = 1.5. Researchers in the social sciences commonly use a statistical power of .80 and α of .05. A statistical power of .80 assumes that an effect was detected in 80% of cases when it is present (Frankfort-Nachmias & Nachmias, 2008). An α of .05 assumes that there was only a 5% probability of erroneously rejecting a true hypothesis (Frankfort-Nachmias & Nachmias, 2008). The effect sizes reported in the literature ranged from OR = 1.57, 95% CI [1.09, 2.28] for type of ANC facility (Tran et al., 2012) to OR = 4.9, 95% CI [3.0, 8.1] for the number of ANC procedures performed (Trinh et al., 2007). I opted for a conservative OR of 1.5 and estimated a sample size of 1,074 mothers aged 18-49 years with an infant 0-5 months old for a two-tailed test using the G*Power 3.1.9.2 software. The inclusion criteria comprised women with a living infant aged 0-5 months residing in the health center catchment area who attended at least one ANC visit. The exclusion criteria included women who gave birth 6 months or longer ago, women who gave birth in the last 5 months but never attended ANC, women who gave birth in the last 5 months who lost their infants, and

women not residing in the health center catchment area. A sample of 1,280 eligible women was adequate for this study.

Procedures for Archival Data

Main study data collection. The Ministry of Public Health requested the School of Public Health of the University of Kinshasa to undertake the final evaluation of the community-based MCH intervention implemented between 2013 and 2015. The data collected for the end-of-project evaluation was to help the health zone management teams develop their operational plans for 2016. For that reason, the health zone management teams took the lead as investigators and data collectors. The data collection for the primary study took place in 10 health zones between June and July 2015. This secondary analysis study only used a subset of data on women aged 18-49 years with a live infant 0-5 months old who attended ANC and responded to questions on the use of ANC during pregnancy.

Access to the dataset and permissions. A request for a meeting was made to the Permanent Secretary in the Ministry of Public Health based in Kinshasa. The meeting with the Permanent Secretary helped to clarify the right process to follow and appropriate departments and individuals to involve. The Permanent Secretary requested that an application be submitted through the Director of the Department of Research and Planning. A meeting was held with the Director of the Department of Research and Planning in June 2015 to explain the purpose, needs, and expected use of the data. During the meeting, the parties agreed to request two separate permissions: an overall authorization to use the data signed by the Permanent Secretary and a data use agreement

signed by the Director of the Department of Research and Planning. The data use agreement provided the details of the data elements needed, the responsibilities of the data provider and beneficiaries, and the boundaries of the data use. The DRC Ministry of Public Health granted permission to use the data and signed the data use agreement. The two letters are in Appendices C to F.

Instrumentation and Operationalization of Constructs

The main source of information for this study was the limited dataset provided by the Ministry of Public Health, which contained deidentified information. It included the sociodemographic characteristics of women, reproductive health history, current pregnancy, ANC utilization, and health-system characteristics. Information on the health-system characteristics encompassed the type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services. The ANC services comprised clinical measurements of weight and blood pressure; laboratory urine and blood tests, including HIV counseling and testing; and interventions to prevent or manage maternal conditions such as anemia, malaria, neonatal tetanus, and intestinal worms.

Operationalization of each variable.

Dependent variable. The dependent variable was ANC compliance, defined as the pregnant woman's attendance of at least four ANC visits during pregnancy. The study measured ANC compliance through the variable on the number of ANC visits attended during pregnancy.

Independent variables. The independent variables included the type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services. The study gathered data on these variables as follows:

Type of ANC facility. The dataset included information on the place the woman received ANC services during pregnancy whether at home, public or private health facility and the level of the facility (hospital or health center).

Type of ANC provider. The dataset included information about the person who provided ANC services whether a doctor, midwife, nurse, assistant nurse, TBA, CHW or relative.

Gender of ANC provider. The dataset included information about the person who provided ANC services whether a male or female.

Time to the ANC facility. The dataset included information on the time (in minutes) it takes to get to the ANC facility.

Cost of ANC services. The dataset included information about the amount of money in CDF the woman paid to receive ANC services

Number of services provided during ANC. The dataset included information whether the woman received each of the nine recommended ANC services in DRC: measurement of maternal weight and blood pressure, laboratory testing of urine and blood, including HIV counseling and testing; iron supplementation, deworming, malaria prevention, and tetanus toxoid vaccination.

Control variables. The study included five control variables to minimize the risk of erroneously affirming the relationships between independent and dependent variables. The five control variables were the mother's age, mother's education level, marital status, number of live births, and gestational age at the first ANC visit.

Mother's age. The dataset included information about the mother's date of birth and age in completed years.

Mother's education level. The dataset included information on the highest level of education attained by the woman e.g., none, primary, secondary or higher education.

Marital status. The dataset included information on whether the woman was living as a single, married, cohabiting, separated, or widow.

Live births. The dataset included information on the number of babies born alive to the woman during her lifetime.

Gestational age at the first ANC visit. The dataset included information on whether the woman was less or more than 4 months pregnant when she reported for her first ANC visit.

Data Analysis Plan

Statistical software. The statistical analysis used the IBM SPSS Statistics 21 software as the statistical package of choice to run both the descriptive and inferential analyses.

Data cleaning and screening procedures. The Department of Research and Planning shared a limited dataset containing about 27 variables that were needed for the analysis. As a first step, I produced frequency tables by variable to assess for irregular

entries. This step helped me to check for coding errors, missing data, and outliers. I identified few variables that had either outliers or more than 5% missing data as explained in chapter 4.

Research questions.

Question 1. Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the type of ANC facility?

Ho1: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the type of ANC facility.

Ha1: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC facility.

Question 2. Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the type of ANC provider?

Ho2: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the type of ANC provider.

Ha2: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC provider.

***Question 3*.** Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the ANC provider's gender?

Ho3: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the ANC provider's gender.

Ha3: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the ANC provider's gender.

Question 4. Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the time to the ANC facility?

Ho4: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the time to the ANC facility.

Ha4: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the time to the ANC facility.

Question 5. Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the costs of ANC services?

Ho5: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the costs of ANC services.

Ha5: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the costs of ANC services.

Question 6. Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the number of ANC services?

Ho6: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the number of ANC services.

Ha6: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the number of ANC services.

Statistical analysis.

Data weighting. The primary study selected a disproportional sample of 19 mothers aged 18-49 years with a live infant 0-5 months old in each health center

catchment area, regardless of its population size. Therefore, the preparation for data analysis included the data weighting to account for population size differentials between the health center catchment areas.

Testing for multicollinearity. Before running the full analysis, I tested for multicollinearity to ascertain the independence of independent variables from each other. Forthofer, Lee, and Hernandez (2007) defined multicollinearity as a significant correlation between independent variables that can negatively affect the regression estimates by inflating the variance and standard errors. Multicollinearity occurs when an independent variable is a duplicate of another variable or is a redundant variable that measures the same thing. The analysis included a pairwise correlation analysis that correlated independent variables with each other variable in a bivariate correlation matrix. Any bivariate correlation equal or above .80 was considered an indication of a potential collinearity between two variables (Field, 2013). I calculated the tolerance and variance inflation factor (VIF). Field (2013) defined Tolerance as the proportion of variance in the independent variable not attributable to the other independent variable: $1-R^2$. The higher the tolerance, the lower the risk of multicollinearity. A tolerance of .10 or less is considered problematic. Likewise, the VIF reflects an inflation of the standard error due to multicollinearity: $1/ (1-R^2)$. A VIF of 10 or more is considered problematic (Field, 2013; Forthofer et al., 2007).

Checking for outliers. I checked for the presence of outliers on originally numerical variables such as the number of ANC visits, mother's age, gestational age at first ANC visit, cost, and distance to the health facility. Field (2013) defined outliers as

values that are either extremely high or extremely low in the data (Field, 2013). They have the potential to skew the data in one direction or the other and bias the statistics. I used the descriptive analysis function of SPSS to compare the mean and trimmed mean – mean without the 5% lowest and highest values – to see if there was a considerable difference. Besides, *Z*scores were created to identify outliers as all values with *Z*scores above 3.29. Furthermore, a graphic representation using histograms and boxplots was used to spot the outliers.

Descriptive analysis. The first phase of the descriptive analysis included a chi-square test to compare women who complied with four ANC visits with those who did not comply. The comparison focused on sociodemographic characteristics (mother's age, education level, and marital status), number of live births, and gestational age at the first ANC visit. A p-value < .05 was considered statistically significant. The variables achieving a p-value < .05 indicated the characteristics of difference between the two groups of women. The descriptive analysis also analyzed the proportion of women with ANC compliance by variable category and estimated the standardized deviations. These two analyses helped to identify the variable categories with high ANC compliance.

Inferential analysis. The inferential analysis applied the logistic regression in two steps to assess the association between health system variables and ANC compliance.

First step or Model 1. It included a bivariate analysis of the crude association between each of the six health system variables (type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services) and five control variables (mother's age, mother's education

level, marital status, number of live births, and gestational age at the first ANC visit.) and ANC compliance with four visits (dependent variable). The results are presented as crude OR, 95% CI, and *p*-value.

Second step or Model 2. It included a multivariate analysis of the adjusted association between health system variables with $p < .05$ identified during the bivariate analysis and ANC compliance with four visits. A hierarchical order of factors included in the first iteration the variables of ANC availability (type of ANC facility, type of ANC provider, and gender of ANC provider). The second iteration included the variables of ANC accessibility (cost of ANC services). The third iteration included variables of ANC quality (number of ANC services). The multivariate adjusted logistic regression analysis controlled for confounders that had a $p < .05$ in the bivariate analysis of their association with ANC compliance with four visits. The results are presented as the Adjusted OR, 95% CI, and *p*-value.

Third step. It included chi-square tests of association to compare between private and public health facilities, looking at the number of ANC services provided and women's access to doctors.

Threats to Validity

External Validity

There is a threat to external validity when the findings are erroneously generalized to individuals who do not have the study participants' characteristics, places that do not have the study setting characteristics, and different past or future situations (Creswell, 2013). The primary study minimized the threats to external validity by randomizing the

study participants in their natural environment. The randomization helped to ensure the representativeness of the study participants to the target population. Besides, this study has restricted the generalization of its findings and claims to similar population groups and settings to enhance its external validity (Creswell, 2013).

Internal Validity

Creswell (2013) observed that threats to internal validity include the procedures, treatments, and participants' characteristics that may restrict the researcher's ability to draw meaningful conclusions. In this study, the threats to internal validity were limited because of the use of secondary data. Besides, the random selection of participants in the primary study minimized the selection bias. Furthermore, the cross-sectional survey design with no experiment did not allow for the effect of history, maturation, regression, mortality, diffusion of treatment, testing, instrumentation, and selection-maturation interaction.

Construct Validity

Creswell (2013) reported that threats to construct validity occur when variable definitions and measures are inadequate. This study maintained the same definitions and measures of variables used in previous studies of ANC utilization and compliance (Joshi et al., 2014; Mugo et al., 2015; Trinh et al., 2007; Tsegay et al., 2013).

Statistical Conclusion Validity

The threat to statistical conclusion validity occur when the study findings are not accurate because of insufficient statistical power or the violation of key assumptions (Creswell, 2013). This study used a sufficient sample of 1,280 women aged 18-49 years

with a live infant 0-5 months old that achieved a computed power of .80 or more on all independent variables. Besides, I ensured that the study met the assumptions required for a logistic regression analysis. First, the dependent variable – ANC compliance collected as the number of ANC visits – was transformed into a dichotomous variable with two categories: less than four ANC visits and four or more ANC visits. Second, I assigned the code 1 to the category of four or more ANC visits as the desired outcome. Third, only the variables with $p < .05$ on bivariate analysis were included in multivariate analysis through a hierarchical stepwise method. Fourth, I tested for multicollinearity to ensure the independent variables were independent of each other. Fifth, I assessed for outliers and missing data and used multiple imputations to replace the missing data. Last, the study included an adequate sample size and the minimum number of cases per variable category was 18.

Ethical Procedures

To ensure the protection of the study participants' rights, I took the web-based ethics training of the National Institutes of Health (NIH) Office of Extramural Research. The course intended to raise the awareness of researchers working with human subjects regarding their obligations towards the rights and welfare of human subjects in the conduct of research. The NIH certificate of completion is in Appendix B.

Protection of Participants' Rights

This study used secondary data that have the advantage of enhancing the participants' privacy as I did not interact directly with the study participants. In addition, the limited dataset did not include personal identifiers such as the mother and child's

names to prevent linking the data to the study participants. Furthermore, the Walden University IRB approved this study to ensure that it meets fully the required ethical standards.

Data Protection

The limited dataset is stored on a password-protected computer with a backup on a password-protected hard drive. I will keep the data for 5 years after the end of the study and destroy it using appropriate methods in close collaboration with the DRC Ministry of Public Health. The results of this study are aggregated to protect the privacy of the study participants. I will disseminate the results to the DRC Ministry of Public Health, in national and international conferences, and through peer-reviewed journals.

Summary

This study was a quantitative cross-sectional survey using secondary data collected by the DRC Ministry of Public Health between June and July 2015. The Walden University IRB approved the study after verifying that it met the required ethical standards. The sample included 1,280 women aged 18-49 years with a live infant 0-5 months old selected randomly in the 10 health zones that implemented a community-based MCH intervention. The dependent variable was ANC compliance defined as pregnant women's attendance of four or more ANC visits. The independent variables included the type of ANC facility, type of ANC provider, gender of ANC provider, time to the ANC facility, cost of ANC services, and number of ANC services. The control variables comprised the mother's age, mother's education level, marital status, number of live births, and gestational age at the first ANC visit. I performed the data analysis using

the IBM SPSS Statistical software version 21. It included a descriptive analysis of the study participants' characteristics as well as bivariate and multivariate logistic regressions of the health system characteristics that best predicted ANC compliance with the recommended four visits.

Chapter 4 that follows describes the secondary data analysis and presents its results.

Chapter 4: Results

Introduction

The purpose of this quantitative cross-sectional household survey using secondary data analysis was to investigate the association between health-system characteristics and ANC compliance among rural Congolese women. The study participants included 1,280 women aged 18-49 years with a living infant 0-5 months old recruited from 10 health zones in the DRC during the months of June and July 2015. I used the IBM SPSS Statistics 21 software to answer the questions and test the hypotheses listed below:

Question 1: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the type of ANC facility?

Ho1: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the type of ANC facility.

Ha1: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC facility.

Question 2: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the type of ANC provider?

Ho2: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the type of ANC provider.

Ha2: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC provider.

Question 3: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the ANC provider's gender?

Ho3: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the ANC provider's gender.

Ha3: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the ANC provider's gender.

Question 4: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the time to the ANC facility?

Ho4: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the time to the ANC facility.

Ha4: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the time to the ANC facility.

Question 5: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the costs of ANC services?

Ho5: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the costs of ANC services.

Ha5: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the costs of ANC services.

Question 6: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the number of ANC services?

Ho6: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the number of ANC services.

Ha6: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the number of ANC services.

This chapter describes the time frame and steps taken in collecting, cleaning, and preparing the data for analysis. It includes a discussion on any divergence from initial data collection plans, the study participants' characteristics, and the sample's representativeness of the population of interest. It includes also the statistical assumptions and findings of statistical analyses organized by research questions.

Data Collection

The data were collected by requesting for permission from the Ministry of Public Health to use the secondary data from its 2015 MCH survey. The data were obtained within 3 weeks of signing the data use agreement with the Department of Research and Planning in the DRC Ministry of Public Health. The Kinshasa School of Public Health implemented the survey on behalf of the Ministry of Public Health. The field data collection took place during the months of June and July 2015 in the 10 health zones that implemented the project. There was no discrepancy between the plan presented in Chapter 3 and the actual data collection.

Inclusion and Exclusion Criteria

The original dataset included records of 1,767 women with an infant 0-5 months old recruited from 10 rural health zones in the DRC. The records were assessed for eligibility based on the inclusion and exclusion criteria. Mothers were included if they were at least 18 years old, had given birth to a live baby in the 5 months preceding the survey, resided in the survey area, and had attended at least one ANC visit during

pregnancy. They were excluded if they were less than 18 years old, had given birth more than 5 months before the survey, did not reside in the survey area, or did not attend any ANC visit. The study sample comprised 1,280 women aged 18-49 years who had a living infant 0-5 months old and met the inclusion criteria.

Variable Categorization and Coding

The analysis included one outcome, six independent, and five control variables. The outcome variable, ANC compliance, had two categories: fewer than four ANC visits (code: 0) and four or more ANC visits (desired outcome, coded 1). The six independent variables included two or more categories. Type of ANC facility used for ANC comprised two categories: public health facility (reference category, coded 0) and private facility (coded 1). The type of ANC provider seen during ANC included three categories: nurses and midwives (coded 1), doctors (coded 2), and others (auxiliary nurses, TBA, CHWs; reference category coded 3). The gender of the ANC provider seen during ANC had two categories: male (reference category, coded 0) and female (coded 1). The time to the ANC facility comprised two categories: more than 1 hour (reference category, coded 0) and within 1 hour (coded 1). The costs of ANC services included two categories: more than 500 CDFs (reference category, coded 0) and up to 500 CDFs (coded 1). The number of services received during ANC had three categories: Three or fewer services (reference category, coded 1), four to six services (coded 2), and seven to nine services (coded 3). The five control variables also had each two or more categories. The mother's age had three categories: age 18-29 years (coded 1), age 30-39 years (coded 2), and age 40-49 years (reference category, coded 3). The mother's education had three categories: not

educated (reference category, coded 1), primary education (coded 2), and secondary or higher education (coded 3). Marital status had two categories: not in a union (reference category, coded 0) and in a union (coded 1). The gestational age at the first ANC visit had two categories: more than 3 months (reference category, coded 0) and within 3 months (coded 1). The number of live births is a numeric variable that captures the reported number of babies born alive.

Baseline Descriptive and Demographic Characteristics of the Sample

The study enrolled Congolese women aged 18-49 years, living in rural areas, who had a living infant 0-5 months old at the time of the study. The participants were selected from 93 health center catchment areas in the 10 health zones that implemented the Ministry of Public Health MCH project. The total population of the 93 health center catchment areas comprised 955,944 people, of which an estimated 35,382 (3.7%) pregnant women were expected to attend ANC every year. This study included 1,280 women aged 18-49 years with an infant 0-5 months old who were selected randomly from 93 health center catchment areas through a stratified random selection technique.

Sample Representativeness of the General Population

The study participants were rural Congolese women aged 18-49 years in a country where 65% of the population live in rural areas (United Nations Statistics Division, 2015). The use of randomization in the selection of study participants helped to ensure that they were representative of the general population of rural women attending ANC. The primary study recruited 19 eligible rural women from each of the 93 health center catchment areas regardless of its population size. The study analysis included data

weighting to account for population differentials between health center catchment areas and correct any population representation imbalances in the study sample.

The data showed that 23% of the women had no education while 77% had at least a primary education. This finding agrees with the DHS 2014, which showed that in a nationally representative sample of rural women, 25% had no education while 75% had a primary, secondary, or higher education (DHS Program, n.d.). However, more rural women had reached a secondary or higher education level in this study than in the DHS 2014: 30% and 1.4% versus 17.5% and 0.1%, respectively.

Results

Descriptive Analysis

About 82% of women enrolled in the study attended at least one ANC visit. However, only 39% of them completed the recommended four ANC visits. Overall, the women in the sample were young (mean age = 29.21 years, *SD* = 6.631), living in a union (93%), residing within 60 minutes of a health facility (88%), and less educated (65% had a primary or no education). A comparison across groups showed that younger women 18-29 years, women with a secondary or higher education, and those starting ANC within 3 months of gestation had a higher frequency of four or more ANC visits (Table 5).

Table 5

Background Characteristics of the Study Participants

Characteristics	All women *n* (%)	< 4 visits *n* (%)	≥ 4 visits *n* (%)	Chi-square	Degrees of freedom	*P*-value
Mother's age						
18 to 29 years	683 (54)	390 (50)	293 (60)			
30 to 39 years	490 (39)	323 (42)	167 (34)	9.009	2	.011
40 to 49 years	93 (7)	62 (8)	31 (6)			
Mother's education						
Not educated	296 (23)	202 (26)	94 (19)			
Primary	531 (42)	330 (42)	201 (40)	14.193	2	.001
Secondary/higher	453 (35)	252 (32)	202 (41)			
Marital status						
In a union	1185 (93)	732 (93)	453 (91)	1.808	1	.109
Not in a union	95 (7)	52 (7)	43 (9)			
Time to facility						
≤ 60 mins	1122 (88)	679 (87)	443 (89)	1.376	1	.139
> 60 mins	157 (12)	105 (13)	52 (11)			
Timing of ANC 1						
≤ 3 months	434 (35)	226 (30)	208 (44)	25.957	1	.000
> 3 months	803 (65)	536 (70)	267 (56)			

Review of Statistical Assumptions

The study analysis included binary logistic regressions on one outcome variable (ANC compliance) and six independent variables (type of ANC facility used for ANC, type of ANC provider seen during ANC, gender of ANC provider seen during ANC, time to the ANC facility, costs of ANC services, and number of services received during ANC). I reviewed the key assumptions of logistic regression analysis, in particular the presence of multi-collinearity and outliers, the magnitude of missing data, and the compliance with a minimum of 10 cases per variable category.

Multicollinearity. The first test was a bivariate correlation analysis of the six independent and five control variables in SPSS using the Pearson correlation coefficient. The results showed no value of the Pearson correlation coefficient equal or above .80, confirming that there was no multicollinearity between the variables of interest. All the correlation coefficients were below .50. The second test was the collinearity diagnostics in linear regression that examined the tolerance rate and variance inflation factor (VIF) (Field, 2013). The results found no tolerance rate below .10 or VIF above 10. All the tolerance values were above .70 and VIF below two, indicating that there was no multicollinearity.

Outliers. The descriptive analysis of ANC compliance with four ANC visits as the main outcome variable revealed a mean number of ANC visits of 3.5 visits with standard deviation (SD) of 2.2. Using the *Z*-score method to identify outliers, the number of ANC visits above the threshold *Z*-score or *SD* value of 3.29 corresponded to 13 ANC visits. All values of 13 ANC visits and above were considered as outliers. There were 13

outliers with values ranging between 13 and 36 ANC visits, which represented about 1% of the 1,280 cases included in the analysis. In the practice of ANC, the threshold of 12 visits was considered of programmatic relevance. The standard ANC model recommended one visit per month during the first 6 months, one visit every 2 weeks during the seventh and eighth months, and one visit every week during the last month, for a total of 12 visits during pregnancy (Villar & Bergsjo, 2002). The 13 outliers identified with *Z*-scores above 3.29 were treated as missing data and replaced through multiple imputations.

Missing data. The first part of the missing data analysis showed that six of the 12 variables included in the study had some missing data. These variables were mother's age (9.7%), ANC compliance with four visits (7.6%), gestational age at first ANC (3.4%), ANC cost (2.3%), type of ANC facility (1.6%), and type of ANC provider (.3%).

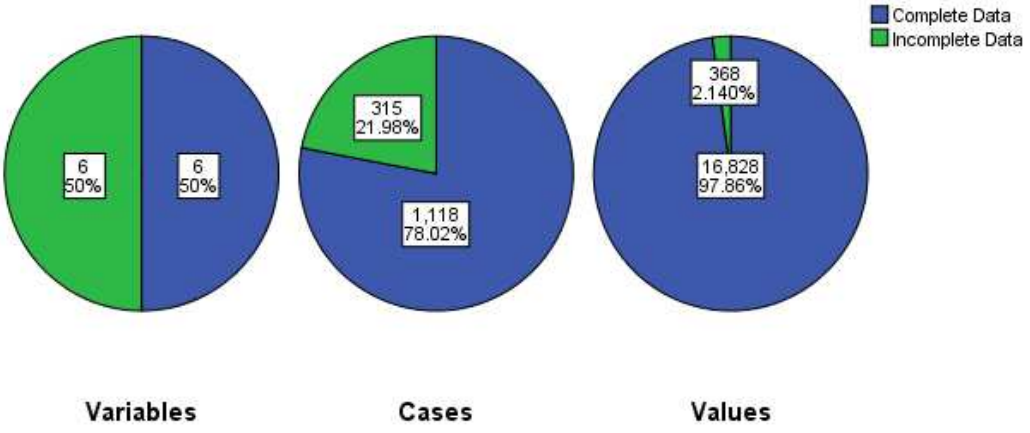

Figure 3. Summary of missing data in the study database. Generated from SPSS multiple imputation analysis of missing data patterns.

The second part of the missing data analysis included Little's missing completely at random (MCAR) test using the expectation maximization (EM) technique to assess the

pattern of missing values on three numeric variables before transformation into categorical variables: number of ANC visits, mother's age, and costs of ANC services. The MCAR test was not statistically significant, χ^2 (8, N = 1,233) = 4.248, p = .834, indicating that the values were missing completely at random. High rates of missing data can introduce biases and compromise the validity of the study findings. The multiple imputations, one of the most recommended missing data handling techniques, were used to replace the missing values with five imputations based on the predictive values derived from the observed data (Sterne et al., 2009).

Sample size and minimum number of cases in each variable category. Logistic regression requires larger samples than linear regression. As a rule of thumb, each category of the independent variables included in logistic regression analysis must have a minimum of 10 cases (Vittinghoff & McCulloch, 2007). In that regard, the total sample of 1,280 was large enough to achieve sufficient statistical power. Some categories of the independent variables were combined to satisfy the rule of 10. The lowest cell count was 18 cases. All the other categories had more than 20 cases.

Statistical Analysis Findings by Research Questions and Hypotheses

The analysis report below includes the outcomes of bivariate and multivariate logistic regression analyses, based on a sample of 1,280 women aged 18-49 years who met the inclusion criteria. The first step was a bivariate analysis of the association between six independent variables (type of ANC facility used for ANC, type of ANC provider seen during ANC, gender of ANC provider seen during ANC, cost of ANC services, and number of services received during ANC) and ANC compliance. The

findings showed that all the independent variables, with the exception of time to the ANC facility, had a statistically significant association with women's compliance with four ANC visits and achieved a *p*-value < .05. The second step included a bivariate analysis of the association between five control variables (mother's age, mother's education level, marital status, gestational age at first ANC visit, the number of live births, and time to the ANC facility) and ANC compliance. The findings showed that only the mother's education level and gestational age at the first ANC visit had a statistically significant association with ANC compliance, *p*-value < .05. The last step was a multivariate logistic regression analysis of the five independent and two control variables that had a statistically significant association with the outcome variable and a *p*-value < .05. The unadjusted odds ratios (OR) of the bivariate analysis and the adjusted odds ratios (AOR) of the multivariate analysis are reported above (Figure 3).

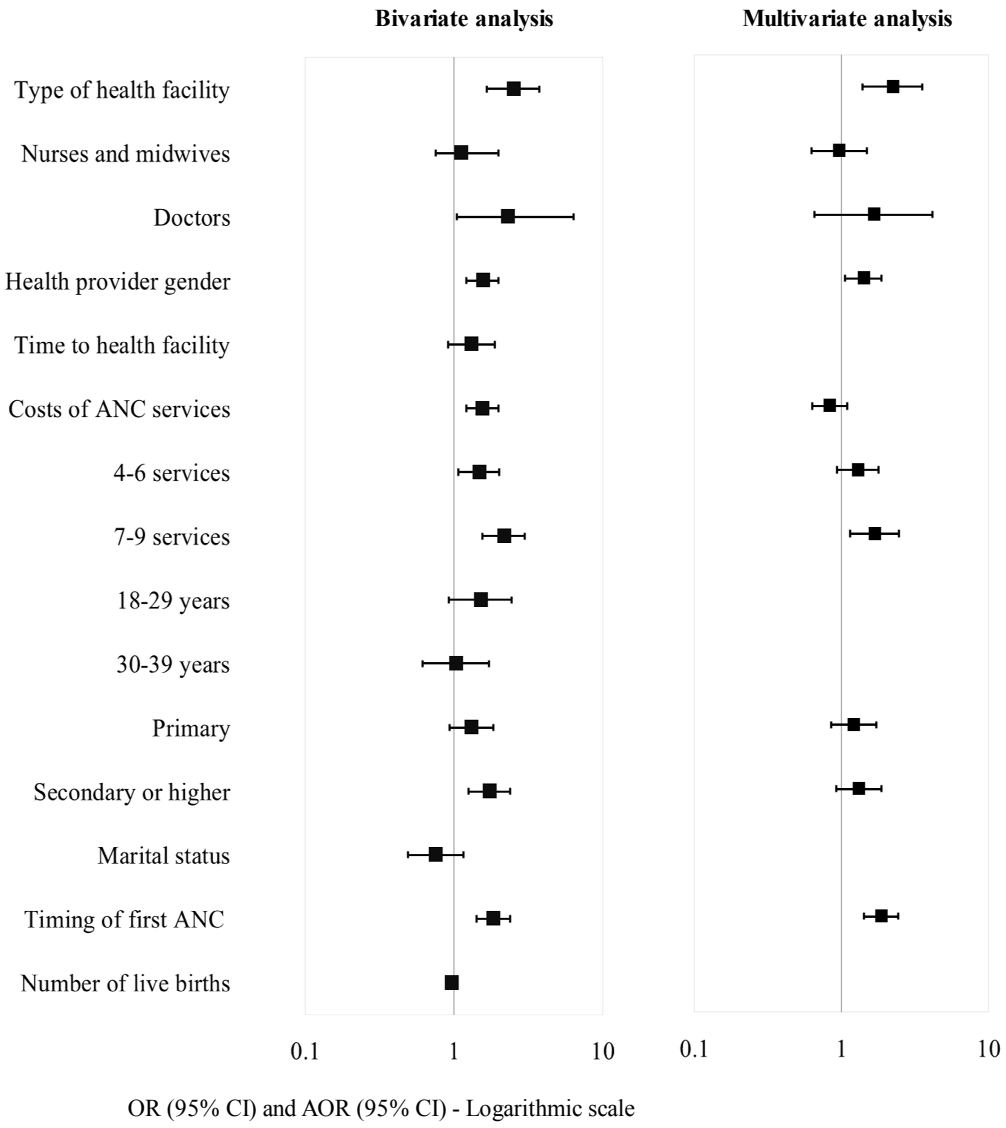

Figure 4. Health system predictors of women's compliance with four ANC visits in rural DRC. A postestimation plot designed with data from the bivariate and multivariate regression analyses and presenting odds ratios with 95% confidence intervals.

Research Question 1. The first question was stated as follows: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the type of ANC facility?

Ho1: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the type of ANC facility.

Ha1: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC facility.

The study investigated the relationship between the type of ANC facility used for ANC and women's compliance with four ANC visits. The type of ANC facility variable included two categories: public and private health facilities. The vast majority (87%) of rural Congolese pregnant women enrolled in the study used public health facilities for ANC.

I estimated the standardized deviations to measure the magnitude of the difference between observed and expected values on women's attendance of four or more ANC visits by type of ANC facility. I used the formula suggested by Spiegel, Schiller, and Srinivasan (2009) below:

*Standardized deviation (%) = ((Observed-Expected)/Expected)) * 100*

A negative standardized deviation indicates that the observed values are lower than expected and a positive standardized deviation that the observed values are higher than expected. The findings showed that women using private health facilities had a negative deviation towards less than four ANC visits and positive deviation towards four or more ANC visits. The inverse directions were observed for women attending ANC in the public health facilities (Table 6). These findings show that more women attending ANC in the private health facilities had four or more ANC visits than did women attending ANC in the public health facilities (58.7% vs. 36%).

Table 6

Standardized Deviations of ANC Compliance by Type of ANC Facility

Type of ANC facility	Had fewer than four ANC visits	Had four or more ANC visits
Public health facilities	+4.8%	-7.4%
Private health facilities	-33.5%	+51.5%

A bivariate analysis showed a statistically significant association between the type of ANC facility used during ANC and women's compliance with four visits. Women using private health facilities were more than twice as likely to complete four ANC visits as those attending ANC in the public health facilities, OR = 2.499, 95% CI [1.663, 3.757], $p < .001$. A multivariate analysis that followed retained the statistically significant association between the type of ANC facility and women's compliance with four visits. Women using private health facilities were more than twice as likely to complete four ANC visits as those attending ANC in public health facilities, AOR = 2.220, 95% CI [1.384, 3.561], $p < .01$; after adjusting for confounders (mother's education, gestational age at the first ANC visit, type of ANC provider, gender of ANC provider, costs of ANC services, and number of ANC services). Therefore, I reject the null hypothesis and conclude that the compliance of rural Congolese pregnant women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC facility.

Research Question 2. The second question was stated as follows: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the type of ANC provider?

Ho2: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the type of ANC provider.

Ha2: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the type of ANC provider.

The study examined the association between the type of ANC provider and women's compliance with four ANC visits. The type of ANC provider variable included three categories: nurses and midwives, doctors, and other less skilled providers (assistant nurses, CHWs, and TBAs). The vast majority of rural Congolese pregnant women (86.6%) were seen by a nurse or midwife during ANC, 3.4% by a doctor, and 10% by a less skilled provider (assistant nurses, CHWs, or TBAs).

The estimation of standardized deviations showed that women seen by a doctor during ANC had a negative deviation on less than four ANC visits and positive deviation on four or more ANC visits. Women seen by nurses and midwives or other less skilled providers had a positive deviation on less than four ANC visits and negative deviation on four or more ANC visits. These findings indicate that more women seen by a doctor during ANC attended four or more visits than those seen by nurses and midwives and other less skilled providers. About 56.3% of women seen by doctors during ANC completed four ANC visits compared with 38.4% and 36% of women seen by nurses/midwives and other less skilled providers respectively.

Table 7

Standardized Deviations of ANC Compliance by Type of ANC Provider

Type of ANC provider	Had fewer than four ANC visits	Had four or more ANC visits
Nurses and midwives	+1.6%	-1.75%
Doctors	-32.21%	+49.85%
Others (TBA, CHWs, AN)	+1.5%	-2.34%

A bivariate analysis was performed. It showed a statistically significant association between the type of ANC provider seen during ANC and women's compliance with four ANC visits. Women seen by a doctor during ANC were more than twice as likely to complete four ANC visits as those seen by a less skilled health provider, OR = 2.302, 95% CI [1.042, 5.084], $p < .05$. However, women seen by nurses and midwives were no more likely to complete four ANC visits than those seen by a less skilled health provider, OR = 2.316, 95% CI [.938, 5.720], $p > .05$. The statistical significance of the association between the type of ANC provider and women's compliance with four ANC visits was lost during multivariate analysis. The findings showed no statistically significant association between women seen by a doctor during ANC and women's compliance with four ANC visits, AOR = 1.655, 95% CI [.658, 4.164], $p > .05$; after adjusting for confounders (mother's education, gestational age at the first ANC visit, type of ANC facility, gender of ANC provider, costs of ANC services, and number of ANC services). Therefore, I accept the null hypothesis and conclude that the compliance of rural Congolese pregnant women aged 18-49 years with

the recommended four ANC visits cannot be predicted based on the type of ANC provider.

Research Question 3. The third question was stated as follows: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the ANC provider's gender?

Ho3: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the ANC provider's gender.

Ha3: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the ANC provider's gender.

The study examined the relationship between the gender of the ANC provider seen during ANC and women's compliance with four visits. The gender variable included two categories: male and female providers. Three out of every five women attending ANC were seen by a female ANC provider while the rest was attended to by a male provider.

The estimation of standardized deviations showed that women seen by a female ANC provider during ANC had a negative deviation on less than four ANC visits and positive deviation on four or more ANC visits. Women seen by a male ANC provider showed inverse directions: a positive deviation on less than four ANC visits and negative deviation on four or more ANC visits. These findings indicate that more women seen by a female ANC provider during ANC attended four or more visits than women seen by a male ANC provider. About 42.8% of women seen by a female provider completed four ANC visits compared with 32.5% of women seen by a male provider.

Table 8

Standardized Deviations of ANC Compliance by Gender of ANC Provider

Gender of ANC provider	Had fewer than four ANC visits	Had four or more ANC visits
Male	+10.2%	-15.91%
Female	-6.77%	+10.49%

A bivariate analysis revealed a statistically significant association between the gender of the ANC provider seen during ANC and women's compliance with four visits. Women seen by a female ANC provider were more likely to complete four ANC visits than women seen by a male ANC provider, OR = 1.553, 95% CI [1.209, 1.993], $p < .01$. A multivariate analysis that followed retained the statistically significant association between the gender of the ANC provider seen during ANC and women's compliance with four visits. Women seen by a female ANC provider had a higher likelihood of completing four ANC visits than women seen by a male provider, AOR = 1.407, 95% CI [1.055, 1.877], $p < .05$; after adjusting for confounders (mother's education, gestational age at the first ANC visit, type of ANC facility, type of ANC provider, costs of ANC services, and services received during ANC). Therefore, I reject the null hypothesis and conclude that the compliance of rural Congolese pregnant women aged 18-49 years with the recommended four ANC visits can be predicted based on the gender of the provider seen during ANC.

Research Question 4. The fourth question was stated as follows: Can the compliance of rural Congolese women aged 18-49 years with the recommended four

ANC visits be predicted based on the time to the ANC facility?

Ho4: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the time to the ANC facility.

Ha4: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the time to the ANC facility.

The study examined the relationship between the time spent to get to the health facility and women's compliance with four ANC visits. The time to the ANC facility was transformed into a categorical variable with two categories: women residing within 60 minutes of the health facility and those residing beyond 60 minutes of the health facility. An estimated 88% of women in this study resided within 60 minutes of the health facility. Twelve percent resided beyond 60 minutes with a range from 61 minutes to 12 hours.

The estimation of standardized deviations showed that women residing within 60 minutes of a health facility had a negative deviation on less than four ANC visits and positive deviation on four or more ANC visits. Women residing beyond 60 minutes of a health facility had a positive deviation on less than four ANC visits and negative deviation on four or more ANC visits. These findings show that more women residing within 60 minutes of a health facility attended four or more visits than those residing beyond 60 minutes. About 39.5% of women residing within 60 minutes of a health facility completed four ANC visits compared with 33,2% of women residing more than 60 minutes away.

Table 9

Standardized Deviations of ANC Compliance by Time to the ANC Facility

Time to the ANC facility	Had fewer than four ANC visits	Had four or more ANC visits
Beyond 60 minutes	+9%	-14%
Within 60 minutes	-1.2%	+2.14%

A bivariate analysis showed no statistically significant association between the time to the ANC facility and women's compliance with four visits, OR = 1.309, 95% CI [.912, 1.880], $p > .05$. For this reason, the time to the ANC facility was not included in the multivariate analysis. Therefore, I accept the null hypothesis and conclude that the compliance of rural Congolese pregnant women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the time to the ANC facility.

Research Question 5. The fifth question was stated as follows: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the costs of ANC services?

Ho5: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the costs of ANC services.

Ha5: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the costs of ANC services.

The study investigated the relationship between the costs of ANC services paid by women and their compliance with four ANC visits. The cost of ANC services variable was transformed into a categorical variable with two categories: up to 500 CDFs - the

subsidized cost established in the implementing health zones - and more than 500 CDFs. Close to two thirds of women attending ANC in this study paid 500 CDFs or less. The remaining women paid more than the subsidized cost, ranging from 501 to 8,500 CDFs. Women in the private health facilities paid twice as much as women in the public health facilities, median cost of ANC services of 1,000 CDFs vs. 500CDFs.

The estimation of standardized deviations showed that women who paid more than the subsidized cost of 500 CDFs for ANC services had a negative deviation on less than four ANC visits and positive deviation on four or more ANC visits. Women who paid the subsidized cost of 500 CDFs or less showed a positive deviation on less than four ANC visits and negative deviation on four or more ANC visits. These findings indicated that more women who paid more than the subsidized cost of 500 CDFs for ANC services completed four or more visits than those who paid 500 CDFs or less. About 45.5% of women who paid more than 500 CDFs completed four ANC visits compared with 35% of women who paid 500 CDFs or less.

Table 10

Standardized Deviations of ANC Compliance by Cost of ANC Services

Cost of services	Had fewer than four ANC visits	Had four or more ANC visits
More than 500 CDF	-11.50%	+17.87%
500 CDF or less	+6.40%	-9.89%

The bivariate analysis showed a statistically significant relationship between the costs of ANC services paid and women's compliance with four visits. Women who paid

more than the subsidized cost of 500 CDF were more likely to complete four ANC visits than women who paid 500 CDF or less, OR = 1.549, 95% CI [1.211, 1.981], $p < .01$. The statistical significance of the association between the costs of ANC services and women's compliance with four visits was lost during multivariate analysis. The findings showed no statistically significant association between the costs of ANC services and women's compliance with four ANC visits, AOR = 1.159, 95% CI [.869, 1.545], $p > .05$; after adjusting for confounders (mother's education, gestational age at the first ANC visit, type of ANC facility, type of ANC provider, gender of ANC provider, and services received during ANC). Therefore, I accept the null hypothesis and conclude that the compliance of rural Congolese pregnant women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the costs of ANC services.

Research Question 6. The sixth question was stated as follows: Can the compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits be predicted based on the number of ANC services?

Ho6: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits cannot be predicted based on the number of ANC services.

Ha6: The compliance of rural Congolese women aged 18-49 years with the recommended four ANC visits can be predicted based on the number of ANC services.

The study investigated the association between the number of services received during ANC and women's compliance with four ANC visits. It assessed access to nine key services recommended during ANC: two measurements (weight and blood pressure),

three laboratory services (urine test, blood test, and HIV counseling and testing), and four preventive interventions (iron supplementation, tetanus toxoid vaccination, malaria prevention, and deworming). The number of services received during ANC was transformed into a categorical variable with three categories: three or fewer services, four to six services, and seven to nine services. An estimated 30% of women in this study received seven to nine services, 45% received four to six services and 25% received three or fewer services during ANC.

The estimation of standardized deviations showed that women who received seven to nine services during ANC had a negative deviation on less than four ANC visits and positive deviation on four or more ANC visits. Women who received four to six services and three or fewer services showed a positive deviation on less than four ANC visits and negative deviation on four or more ANC visits. These findings indicate that more women who received seven to nine services during ANC completed four or more visits than those who received fewer services. About 47.6% of women who received seven to nine services during ANC completed four ANC visits compared with 37% and 29.8% of women who received four to six and three or fewer services respectively.

Table 11

Standardized Deviations of ANC Compliance by Number of ANC Services

ANC services received	Had fewer than four ANC visits	Had four or more ANC visits
Three or fewer services	+16.2%	-25.14%
Four to six services	+2.03%	-3.07%
Seven to nine services	-14.01%	+21.78%

A bivariate analysis showed a statistically significant association between the number of services received during ANC and women's compliance with four ANC visits. Women who received four to six services, OR = 1.469, 95% CI [1.073, 2.010], $p < .05$; and those who received seven to nine services, OR = 2.165, 95% CI [1.559, 3.006], $p < .001$; were more likely to complete four ANC visits than women who received three or fewer services. This statistically significant association was only maintained for women who received the highest number of services during the multivariate analysis. Women who received seven to nine services during ANC were more likely to complete four ANC visits than those who received fewer services, AOR = 1.680, 95% CI [1.142, 2.472], $p < .05$; after adjusting for confounders (mother's education, gestational age at the first ANC visit, type of ANC facility, type of ANC provider, gender of ANC provider, and costs of ANC services). Therefore, I reject the null hypothesis and conclude that the compliance of rural Congolese pregnant women aged 18-49 years with the recommended four ANC visits can be predicted based on the number of services received during ANC.

Relationships Between Health System Characteristics

The observation of statistically significant correlations between health system characteristics during multi-collinearity testing in pairwise correlation analysis motivated further analysis of the relationships between them. I compared the private and public health facilities on the number of services they provided, and type and gender of ANC provider seen by women during ANC.

Type of ANC facility and services provided during ANC. The bivariate and multivariate analyses revealed a statistically significant association between each of the two independent variables (type of ANC facility and number of ANC services) and women's compliance with four ANC visits. A chi-square test of association was computed to compare the services provided during ANC in the public and private health facilities. The findings summarized in Table 12 showed a statistically significant difference in five services, all provided during the first ANC visit: maternal weight, blood test, urine test, HIV counseling and testing, and tetanus toxoid vaccination.

Table 12

Distribution of ANC Services by Type of ANC Facility

ANC services received during ANC	All women reached (%)	Private facility	Public facility	Chi-square	Degree of freedom	*P*-value
Maternal weight	77.9	84.3	76.9	4.341	1	.021
Blood Pressure	73.5	75.5	73.2	.356	1	.311
Urine test	28.2	60	23.5	92.753	1	.000
Blood test	55.4	74.2	52.7	25.945	1	.000
HIV counseling and testing	71.4	81.3	68.8	4.587	1	.021
Tetanus Toxoid vaccination	84	71.7	86.2	22.062	1	.000
Iron supplementation	75.6	72.3	76	1.052	1	.177
Malaria prophylaxis	51.3	56.7	50.6	1.416	1	.135
Deworming tablets	62.2	66.5	61.5	1.397	1	.137

Private health facilities provided more services to women during ANC than public health facilities (median of 6 vs. 5, $p = .000$). They outperformed the public health facilities in four services: maternal weight, blood test, urine test, and HIV counseling and testing. Public health facilities outperformed private health facilities only on one service:

tetanus toxoid vaccination. There was no statistically significant difference between public and private facilities on three services: iron supplementation, deworming, and malaria intermittent preventive therapy during pregnancy (IPTp). Deworming and IPTp are provided late in pregnancy, starting from the second visit.

Type of ANC facility and type of ANC provider. A chi-square test was computed to assess the relationship between the type of ANC facility and type of ANC provider. The results showed a statistically significant association between the two variables, $\chi 2$ (2, N = 1,251) = 41.799, p = .000. Five times more women were seen by a doctor in the private ANC facilities than in the public ANC facilities (11% vs 2%). This result may point to the lack of referrals of women with pregnancy-related complications and risk factors and may indicate the poor quality of services in the public facilities.

Type of ANC facility and gender of the ANC provider. The analysis also included a chi-square test of the association between the type of ANC facility and gender of the ANC provider. The results showed a statistically significant association between the two variables, $\chi 2$ (1, N = 1,259) = 12.202, $p < .001$. More women were seen by a female ANC provider in the private ANC facilities than in the public ANC facilities (72.9% vs 58.4%). As seen above, women seen by a female ANC provider were more likely to complete four ANC visits than those seen by a male provider.

Summary

This study included six questions and 12 hypotheses investigating the association between health system characteristics and women's compliance with four ANC visits. The analysis involved bivariate and multivariate analyses. Bivariate analyses showed that

five of the six health system characteristics examined (type of ANC facility, type of ANC provider, gender of ANC provider, costs of ANC services, and number of ANC services) had a statistically significant association with women's compliance with four ANC visits with a *p*-value < .05. The time to the ANC facility had no statistically significant association with women's compliance with four ANC visits, $p > .05$.

Multivariate analyses included the five independent variables and two confounders (mother's education and gestational age at the first ANC visit), which had a *p*-value <.05. The findings showed that women attending ANC in a private health facility, $p < .01$; women seen by a female ANC provider, $p < .05$; and women receiving seven to nine services during ANC, $p < .01$; are more likely to complete four ANC visits.

A Chi-square test of association compared the private and public health facilities on ANC services, and type and gender of ANC provider. The findings revealed that private health facilities provided more ANC services (median of 6 vs. 5, $p = .000$) and had five times more women seen by doctors (11% vs. 2%, $p = .000$), and 25% more women seen by female providers (72.9% vs 58.4%, $p < .001$) than public health facilities.

I conclude that the type of ANC facility, gender of the ANC provider, and number of ANC services are good predictors of ANC compliance in rural DRC.

Chapter 5 includes a discussion of health system characteristics that have shown a statistically significant association with ANC compliance in rural DRC and a comparison of these findings with previous studies. It presents the study limitations, its implications for positive social change, and recommendations for research, policy and practice.

Chapter 5: Discussions, Conclusions, and Recommendations

Introduction

This study was a quantitative cross-sectional survey using secondary data from the Ministry of Public Health MCH survey of 2015. It examined the association between health system characteristics and women's compliance with four ANC visits in the DRC. DRC is one of the five countries with the highest burden of maternal and under-5 child mortality in the world (UNICEF, 2014a, 2014b). The use of ANC, a proven intervention to improve maternal and perinatal health outcomes (Villar et al., 2001), has remained suboptimal, in particular among rural women (DHS Program, n.d.b). Repeated surveys have shown that the vast majority of rural Congolese women attend ANC during pregnancy but less than half complete the recommended four visits (DHS Program, n.d.a, n.d.b). The suboptimal use of ANC may explain in part the persisting high maternal and perinatal mortality rates as rural Congolese women have not taken full advantage of the benefits of ANC. This study was conducted to identify the health system determinants of rural Congolese women's compliance with four ANC visits.

The data analysis included bivariate and multivariate analyses that showed that the type of ANC facility, gender of ANC provider, and number of ANC services had a statically significant association with women's compliance with four ANC visits. The findings revealed that rural Congolese women attending ANC in private facilities, AOR = 2.220, 95% CI [1.384, 3.561], $p < .01$; women seen by female providers during ANC, AOR = 1.407, 95% CI [1.055, 1.877], $p < .05$; and women who received seven to nine ANC services, AOR = 1.680, 95% CI [1.142, 2.472], $p < .05$, were more likely to

complete four ANC visits after adjusting for confounders. The type of ANC provider, cost of ANC services, and time to get to the ANC facility had no statistically significant association with women's compliance with four ANC visits after adjusting for confounders. Further analysis showed that the private health facilities provided more ANC services (median of 6 vs. 5, $p = .000$), had 5 times more women seen by a doctor during ANC (11% vs. 2%, $p = .000$), and 25% more women seen by female providers (72.9% vs. 58.4%, $p < .001$) than public health facilities.

Interpretation of the Findings

Study Findings and Past Research

Type of ANC facility and ANC compliance. The study analysis showed that women attending ANC in private health facilities had a higher likelihood of completing four ANC visits than those in public health facilities. Additionally, private health facilities provided more ANC services and had more women seen by a female provider during ANC than public health facilities. These two determinants—number of ANC services and a female provider—were associated with ANC compliance. Private health facilities charged more for ANC services than public health facilities (median cost of 1,000 CDFs vs. 500 CDFs, $p < .001$). However, private health facilities achieved higher compliance with four ANC visits despite the high cost of ANC services. Furthermore, private health facilities had more women seen by doctors than public health facilities. Previous research showed that 13% to over 40% of women attending ANC presented with pregnancy-related complications that required a referral to a higher level of care (Law et al., 2015; Villar & Bergsjo, 2002).

In the DRC, ANC is primarily provided by nurses and midwives at the PHC health centers. The combination of fewer services provided during ANC and women seen by a doctor (only 2%) in the public health facilities may be an indication of a suboptimal quality of ANC in these facilities. Conversely, the 11% of pregnant women seen by a doctor during ANC in the private health facilities are close to the minimum level of referrals expected from pregnant women. These two elements (high number of ANC services and more women seen by a doctor during ANC) may indicate a level of quality of ANC that is better in the private health facilities than in the public health facilities. This difference in the quality of ANC could partly explain the high ANC compliance in the private sector.

There is a paucity of studies in the literature that have examined the relationship between the type of ANC facility and women's compliance with four ANC visits. This study supports the findings of a study conducted by Victora et al. (2010) that examined the quality of maternal health care in the public and private health facilities in Pelotas, Brazil. Victora et al. showed that, in comparison with public health facilities, private health facilities provided more ANC services (9.3 vs. 8.1, $p < .001$), and that women attended more ANC visits in private facilities (10.7 vs. 7.7, $p < .001$). The differences between private and public health facilities occurred in the context of a government's universal health coverage scheme, the Unified Health System, targeting both public and private health facilities to provide health services to all (Victora et al., 2010). Despite its many successes, the Brazilian Unified Health System suffered from chronic underfunding that affected the development of infrastructure and human resources in the public health

sector (Paim, Travassos, Almeida, Bahia, & Macinko, 2011). These shortcomings may explain the low quality and number of ANC visits in the public health facilities reported by Victora et al.

This study diverged from the findings of another study conducted by Trinh et al. (2007) in rural Vietnam that showed that more women in public health facilities attended three or more ANC visits than those in private health facilities, 66% vs. 57%, $p < .001$. Nevertheless, Trinh et al. found a statistically significant association between the number of ANC services and ANC visits, OR = 4.4, 95% CI [2.8, 7.0], $p < .001$. Unlike the situation in the DRC and Brazil, the Vietnamese private health system was only 10 years old at the time of the study. It was unregulated with many unregistered private practices, a poor infrastructure, and many unqualified health providers (Tuan, Dung, Neu, & Dibley, 2005). These factors could explain the low number of ANC services and poor ANC compliance in the public health facilities in Vietnam.

In the DRC, the public health infrastructure has deteriorated following decades of dictatorship, government mismanagement, and civil wars (Clark, 2011; Deibert, 2008; Sadiki, 2015, Van Herp, Parqué, Rackley, & Ford, 2003). The estimated health expenditure per capita in the public health sector was one of the lowest in the world, estimated at US$8.45 in 2013 (53% of the US$16 overall health expenditure per capita for the DRC; World Bank Group, 2015c). The underfunding of the public health sector in the DRC is comparable to the public health sector supported through the Unified Health System in Brazil. It may explain the lower number of services provided and poor ANC compliance observed in the public health facilities in the DRC.

Type of ANC provider and ANC compliance. This study examined the association between the type of ANC provider seen during ANC and women's compliance with four ANC visits. The results showed, in a bivariate logistic regression analysis, that women who had seen a doctor during ANC had a higher likelihood of completing four ANC visits than those who had seen a nurse, midwife, or less skilled provider. However, this association disappeared in multivariate analysis after adjusting for confounders.

These findings are similar to the findings of a study by Trinh et al. (2007) in Vietnam that found no association between the type of ANC provider and ANC compliance. However, Trinh et al. examined only two categories of ANC providers that were different from the three categories included in this study. They combined doctors and midwives into one category and compared them with assistant doctors and nurses. Therefore, the two findings cannot be compared.

The findings diverged from a Ghana study conducted by Atunah-Jay et al. (2013) that showed a statistically significant association between the type of ANC provider and ANC compliance. However, the two studies differed on four points. First, unlike in this study, the significant association between the two variables was maintained in the bivariate and multivariate analyses in the Ghana study. Second, this study showed that doctors had higher ANC compliance than nurses and midwives, whereas the study by Atunah-Jay et al. found no difference between doctors and midwives. Third, this study combined nurses and midwives in one variable category, whereas the Ghana study used midwives alone as a separate category. Therefore, low ANC compliance of women seen

by nurses could have diluted high ANC compliance of women seen by midwives in this study. Fourth, this study found that the ANC compliance of women seen by nurses and midwives was similar to that of other categories, whereas Atunah-Jay et al. showed that midwives had higher ANC compliance than other categories. The DRC DHS 2014 reported that nonskilled health providers attended to only 0.5% of ANC clients (DHS Program, n.d.). Many rural health centers in the DRC use nurses for ANC and delivery services in the absence of midwives. The 10% of women seen by less skilled workers reported in this study may reflect a bias in the rural women's classification of nurses who are not qualified midwives as less skilled providers. This could explain the lack of association between the two categories.

Gender of ANC provider and ANC compliance. The study examined the association between the gender of the ANC provider and women's compliance with four ANC visits. The findings of bivariate and multivariate analyses showed that women seen by a female ANC provider had a higher likelihood of completing four ANC visits than those seen by a male ANC provider. There is no published study on the relationship between the gender of the ANC provider and ANC compliance. However, a study conducted by Ndiaye et al. (2005) examined the sociocultural factors associated with delayed initiation of ANC in the Richard-Toll district in northern Senegal. Its findings showed that Senegalese women preferred to be attended to by a female provider for reasons of illiteracy and culture. The majority of rural Congolese women included in this study were either illiterate (23%) or of primary education level (42%), making them comparable to the Senegalese women in the study by Ndiaye et al. Another study by Faye

et al. (2011) showed that having a male provider at birth was associated with a 3.9 times greater likelihood of home delivery, OR = 3.9, 95% CI [2.30, 6.65]. This study supports the findings of the studies conducted by Ndiaye et al. and Faye et al. that showed that women preferred female ANC providers in maternal health services.

Time to the ANC facility and ANC compliance. The study examined the association between the time it takes to get to the health facility and ANC compliance. The findings showed that 39.5% of women residing within 60 minutes of a health facility completed four ANC visits, compared with 33,2% of women residing more than 60 minutes away. However, the association between the two variables was not statistically significant in bivariate analysis.

These findings agree with the findings of two studies, by Anastasi et al. (2015) in Uganda and O'Meara et al. (2013) in Kenya. Anastasi et al. conducted a mixed methods study in Uganda to investigate why women get lost between ANC and skilled delivery services. The findings showed no association between the time to the ANC facility and use of services in bivariate analysis. O'Meara et al. (2013) examined the demand-side factors of ANC use among pregnant women enrolled in a home-based HIV counseling and testing survey in western Kenya. The study found no association between geographic proximity to a health facility or transport network and use of ANC services, despite using geographic coordinates, a more objective measure of distance.

However, this study diverges from the findings of other studies conducted in Ethiopia (Wilunda et al., 2015), Kenya (Brown et al., 2008), Tanzania (Gupta et al., 2014), and Zambia (Kyei et al., 2012) that showed that women residing far from the

health facility had a higher likelihood of not completing four ANC visits. There may be some underlying cultural differences related to values associated with health, pregnancy, and pregnancy care that explain the divergence in these study findings. Further, nearness to a health facility may increase ANC attendance because of severe transportation difficulties in many developing countries (Mahapatro, 2015; Tann et al., 2007). In that regard, time to a health facility may still be an important determinant of ANC initiation in the DRC, but not a critical factor for its continuation to four visits for women who had braved the distance to attend the first visit.

Costs of ANC services and ANC compliance. The study examined the association between the cost of ANC services and ANC compliance and found that women who paid more were more likely to attend more ANC visits than those who paid less.

However, this association disappeared in multivariate analysis. This study diverged from studies conducted by Feinstein et al. (2013) in the DRC and Sambo et al. (2013) in Nigeria, as well as from a systematic review by Simkhada et al. (2008). Their findings showed that the cost of ANC services played an important role in ANC use and compliance with four visits. However, this study took place in the DRC in the context of a standardized low ANC cost of 500 CDFs (US$ 0.60) for four ANC visits, paid at the first visit. This can explain why the cost of ANC had no effect on ANC continuation to the fourth visit. The ANC cost in this study had a much lower base, 20-times cheaper than the US$12.4 reported in the Nigerian study by Sambo et al. In the DRC, women only paid more if they had pregnancy-related complications or risk factors that required

additional interventions outside the recommended basic ANC package. That may explain the positive association between the cost of ANC and the number of ANC visits observed in this study in bivariate analysis.

Number of ANC services and ANC compliance. The study investigated the association between the number of ANC services and ANC compliance and found that women who received seven to nine services were more likely to complete four ANC visits than women who received fewer services. The positive association persisted in multivariate analysis. These findings are similar to the findings of the studies conducted by Bbaale (2011) in Uganda and Gupta et al. (2014) in Tanzania, which showed that the number of ANC services was positively associated with the number of ANC visits. However, this study diverged from the Ghana study conducted by Naariyong et al. (2012), which showed no association between the number of ANC services provided during ANC and women's compliance with four ANC visits. Unlike in the DRC, Tanzania, and Uganda, where ANC compliance with four visits remained below 50% in the study districts, the background high ANC compliance in Ghana (above 70%) may explain the lack of association between ANC services and compliance.

Study Findings and Andersen's Behavioral Model of Service Utilization

This study used Andersen's behavioral model of service utilization as its theoretical framework. The model posited that individuals use health services when they have the predisposition (e.g., individual characteristics) and enabling resources (e.g., health system) and perceive the need to seek and use health care services (Andersen, 1968). The 1990s model advanced that certain primary determinants lead to the adoption

of healthy behaviors that, in turn, contribute to improving health outcomes (Andersen, 1995). The study examined ANC as an intervention to improve maternal and perinatal outcomes (health outcomes). Its findings support Andersen's behavioral model of service utilization. They showed that women attending private ANC facilities, women receiving higher numbers of ANC services, and women seen by female ANC providers (primary determinants of MCH system) had a higher likelihood of ANC compliance (healthy behavior). Further, certain individual characteristics such as maternal education and gestational age at the first ANC visit (primary determinants of women's characteristics) played an important role in women's compliance with four ANC visits (healthy behavior). In this regard, Andersen's behavioral model of service utilization was a useful model that guided the identification of the study variables, design of study questions and hypotheses, data analysis, and interpretation of findings.

Limitations of the Study

The study used a cross-sectional household survey design that collected data at one point in time (Sedgwick, 2014). There were five limitations in this study. First, the high illiteracy rate (23% of women had no education) posed a challenge to determining the age of women and gestational age at the first ANC visit. As a result, 9.7% of women did not know their date of birth. Second, there was a possibility of recall bias as mothers were asked to remember experiences that happened between 6 and 12 months preceding the survey. To that effect, 7.6% of women could not remember the number of ANC visits they attended during pregnancy. Third, the self-reporting women were at risk of social desirability bias by giving socially acceptable answers. Fourth, the observational nature

of the survey did not allow any cause-and-effect analysis in the absence of variable manipulation. Fifth, the cross-sectional nature of the survey did not allow any sequencing of events between independent and dependent variables nor any trend analysis on the study outcome.

Recommendations for Further Research

This study was the first study in the DRC to examine the health system determinants of ANC compliance. It has highlighted the important role of quality of ANC and ANC provider gender in women's compliance with the recommended four ANC visits, and pointed to some knowledge gap areas for further research. More than 80% of rural Congolese women sought pregnancy care in the public health facilities in the study districts. However, the study has revealed that suboptimal quality of ANC in the public health facilities, with fewer ANC services provided to women and fewer women seen by doctors, may have contributed to women's noncompliance with four visits. Not much is known about the quality of ANC in the public health facilities in the DRC. Therefore, further qualitative and quantitative research are needed on the quality of ANC in the public health facilities in the DRC. These studies should examine the content, organization, processes, and outcomes of ANC to guide the design of public health interventions to improve the quality of ANC services and increase ANC compliance among rural Congolese women.

The study findings also showed that women seen by female ANC providers had a higher likelihood of completing four ANC visits than those seen by male ANC providers. It highlighted the role of the provider gender in ANC compliance. There are no studies

from the DRC in the literature on this subject. Therefore, further research could help understand the cultural drivers of women's motivation to comply with ANC visits. In particular, qualitative studies will be needed to understand how the ANC provider gender may influence women's compliance with ANC.

The cross-sectional nature of this study did not allow any causal inferences. A prospective study of ANC compliance among rural Congolese women can help understand the sequencing of events and establish cause-and-effect relationships among independent variables. Furthermore, future studies should include other health system characteristics (independent variables) not measured in this study such as the attitudes of health providers, privacy at the health facility, duration of ANC consultation, waiting time, and indirect costs of care.

The achievement of better health for rural Congolese women and children will depend on the effectiveness and level of implementation of innovative strategies specific to the context and realities of the DRC. Therefore, further studies are needed to identify the most effective strategies to improve the quality of ANC and attract more female ANC providers to the rural DRC.

Implications

Implications for Positive Social Change

This study examined an important health issue affecting vulnerable women and children in rural DRC, where health disparities and social injustices are evident through the disproportional burden of maternal and child deaths (DHS Program, n.d.). ANC use has remained suboptimal in rural DRC despite government's efforts and the evidence of

its effectiveness in improving maternal and perinatal health. Limited understanding of the drivers of ANC compliance among rural Congolese populations may have contributed to the persisting inequalities in access to quality ANC services.

This study will foster positive social change by generating knowledge on the predictors of ANC compliance among rural Congolese women to help policy makers, health mangers, and service providers understand the barriers to ANC services faced by this vulnerable population. The findings, if used appropriately, could guide the design of public health interventions aimed at improving access to quality ANC services in rural DRC, and reduce the urban-rural gap in MCH outcomes.

For these reasons, the dissemination of the study findings will target the DRC Ministry of Public Health, DRC Partner Coordination Forum, and national and international experts through program, policy, and strategic meetings and conferences. Besides, the study will be published in peer-reviewed journals to share its findings with the international community, including the donors, nongovernmental organizations (iNGOs) and research institutions.

Implications for Practice

This study may play an important role in the design of interventions to improve the delivery of ANC services in rural DRC. Its findings have pointed to two important areas of work: the quality of care and the gender of ANC providers. The Ministry of Public Health should establish MCH Quality Improvement programs (MCH-QIP) to ensure that women attending ANC receive all the services they need for the well-being of the mother-baby pair.

The MCH-QIP should define the standards of care. For ANC, this may require reorienting health managers and professionals on the standards of ANC recommended through the Focused ANC strategy. The MCH-QIP should help health managers and policy makers to define quality performance indicators to support MCH quality assessments in the public health facilities. The MCH-QIP should establish mechanisms for regular assessment, auditing, and certification of the quality of care in the public health facilities.

Like many developing countries (Lehmann, Dieleman, & Martineau, 2008), DRC suffers from the maldistribution of health professionals, and conditions of work in the rural areas are not attractive to qualified midwives. Therefore, the Ministry of Public Health should put in place a human resource policy that encourages the training and redistribution of female midwives and nurses to the rural areas. The efforts of government and its implementing partners should aim at getting and retaining trained female midwives and nurses in every rural public health facility. In that regard, health authorities should establish incentive systems for female providers in rural areas.

Conclusion

The persisting high maternal and child mortality in rural DRC testifies to the prevailing social injustice in access to quality MCH services for disadvantaged populations. This study was the first to examine the relationship between health system characteristics and women's compliance with four ANC visits in rural DRC. Its findings support the hypothesis that health system characteristics, in particular, the type of ANC facility, gender of the ANC provider, and number of ANC services; can predict women's

compliance with four ANC visits in rural DRC. This new knowledge is useful to guide Congolese health authorities in the design of interventions, in particular quality improvement programs and rural area incentives, to improve access to quality ANC services among rural Congolese populations. If successfully implemented, these interventions should help close the urban-rural gap in MCH outcomes. Further research is needed to understand the drivers of the poor quality of ANC in the public health facilities and the influence of gender on ANC compliance.

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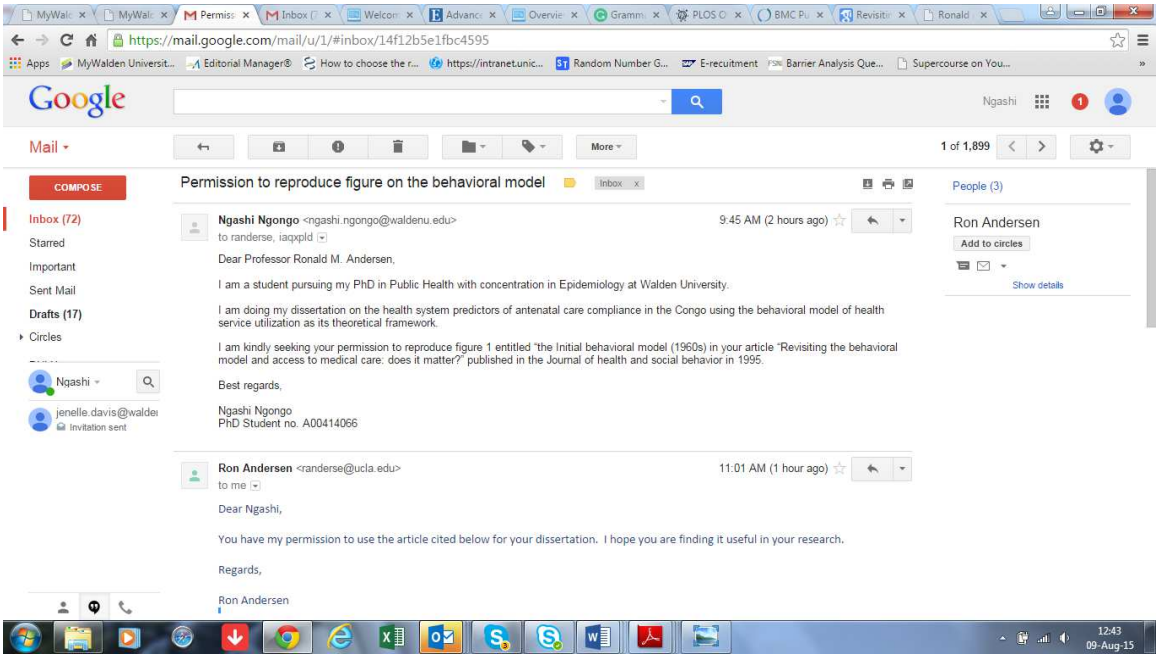
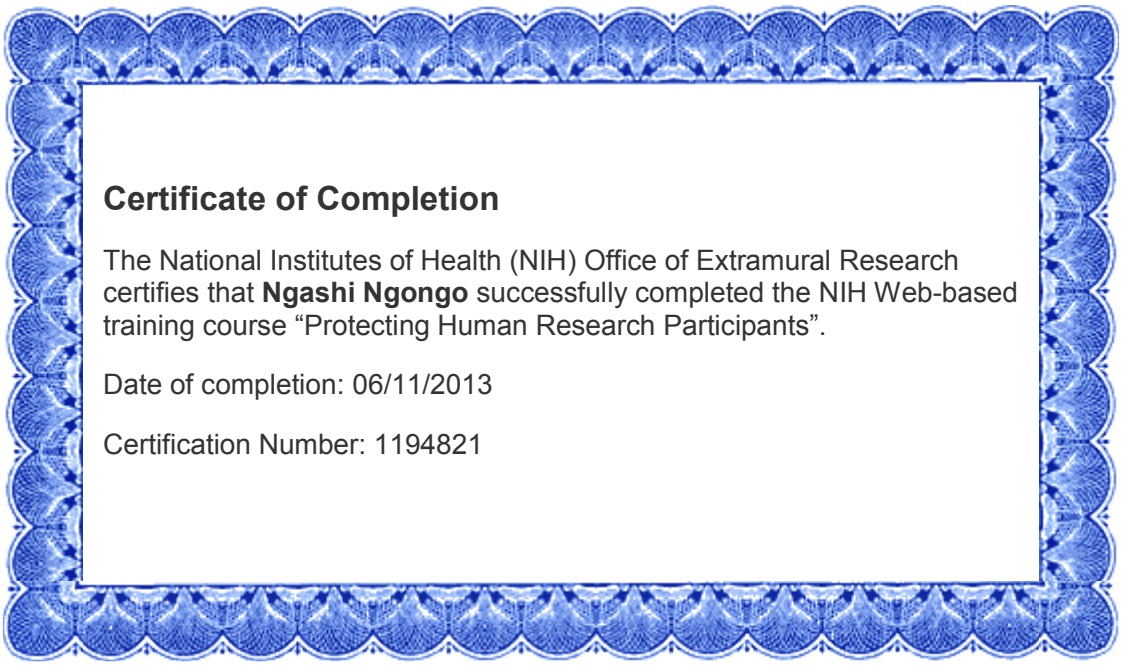
Appendix A: Permission to Reproduce Figure 2 from Dr. Ronald M. Andersen



Appendix B: NIH Ethics Course Certificate of Completion



Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Ngashi Ngongo** successfully completed the NIH Web-based training course “Protecting Human Research Participants”.

Date of completion: 06/11/2013

Certification Number: 1194821

Appendix C: Permission Letter (English Translation)

Democratic Republic of Congo
Ministry of Public Health
Office of the Permanent Secretary

Reference no. MS/1251/SG/DEP/1957/MK/2015

From: The Permanent secretary
Ministry of Public Health

To: Dr. Ngashi Ngongo
Principal investigator
Study on the determinants of antenatal care compliance in DRC
Washington / USA

Subject: **Permission to conduct research on the determinants of pregnant women's compliance with antenatal care in the Democratic Republic of Congo**

Date: Kinshasa, 15 July 2015

I am pleased to inform you that the Ministry of Public Health hereby grants you permission to conduct your research well explained in the above subject.

The issue you are addressing is one of the areas covered under the project "Health for the Poorest Populations in the Democratic Republic of Congo" whose evaluation was completed in July 2015. The Ministry of Public Health therefore allows you to use data from the survey conducted in the context of this evaluation for your doctoral thesis in Public Health. You are requested to contact the Department of Planning and Research in the Ministry of Public Health to access the requested data.

We hope the results and recommendations of this study will guide interventions for reducing the mortality of mothers and children in the Democratic Republic of Congo.

Please accept my highest consideration.

Signed

Dr. Mukengeshayi Kupa
The Permanent Secretary a.i

Translated:

August 11, 2015

Dr. Emmanuel Mulumba

Professor, School of Liberal Arts
Berkeley College
New Jersey
Tel: 240-405-9021
Email: enmulumba@yahoo.com

Sworn to and subscribed before me
this 14th day of August 2015

SHARIANN P. QUIRK
Notary Public of New Jersey
My Commission Expires on 4/13/2020

Appendix D: Permission Letter (French Original)

République Démocratique du Congo
Ministère de la Santé Publique
Secrétariat Général

Kinshasa, le 17 JUIL 2015

Le Secrétaire Général

N°MS/1251/SG/DEP/1957/MK/2015

A Monsieur le Dr NGASHI NGONGO
Investigateur Principal de la recherche sur les determinants de l'adhésion des femmes enceintes à la continuité des consultations prénatales en RDC
à Washington/USA

Objet : Autorisation de recherche sur les déterminants de l'adhésion des femmes enceintes à la continuité des Consultations Prénatales en République Démocratique du Congo

Cher Docteur,

J'ai le plaisir de vous informer que le Ministère de la Sante Publique vous accorde l'autorisation d'effectuer votre recherche sur la thématique mieux explicitée en objet.

La problématique que vous abordez constitue l'un des domaines couvert par le Projet Santé pour les Populations les plus Pauvres en République Démocratique du Congo dont l'enquête d'évaluation était réalisée en juillet 2015. Le Ministère de la Santé Publique vous autorise d'utiliser les données issues de cette enquête dans le cadre de votre thèse de doctorat d'Etat en santé publique. Je vous inviter d'entrer en contact avec la Direction de la Planification et des Etudes du Ministère de la Sante Publique pour que les données requises soient mises à votre disposition.

Nous espérons que les résultats et recommandations de votre étude permettront d'orienter les interventions visant la réduction de la mortalité de la mère et de l'enfant en République Démocratique du Congo.

Veuillez agréer, Cher Docteur, l'expression de ma considération distinguée.

Le Secrétaire General a.i.

Dr MUKENGESHAYI KUPA

Appendix E: Data Use Agreement (English Translation)

République Démocratique du Congo
Ministère de la Santé Publique
Secrétariat Général

Le Secrétaire Général

Kinshasa, le 17 JUIL 2015

N°MS/1251/SG/DEP/1957/MK/2015

A Monsieur le Dr NGASHI NGONGO
Investigateur Principal de la recherche sur les determinants de l'adhésion des femmes enceintes à la continuité des consultations prénatales en RDC
à Washington/USA

Objet : Autorisation de recherche sur les déterminants de l'adhésion des femmes enceintes à la continuité des Consultations Prénatales en République Démocratique du Congo

Cher Docteur,

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Nous espérons que les résultats et recommandations de votre étude permettront d'orienter les interventions visant la réduction de la mortalité de la mère et de l'enfant en République Démocratique du Congo.

Veuillez agréer, Cher Docteur, l'expression de ma considération distinguée.

Le Secrétaire Général a.i.

Dr MUKENGESHAYI KUPA

Democratic Republic of Congo
Ministry of Public Health
Office of the Permanent Secretary
Department of Research and Planning

Reference no. MS/1257/DEP/DIR/170/2015

AGREEMENT TO USE DATA FROM THE FINAL EVALUATION OF THE HEALTH FOR THE POOREST POPULATIONS PROJECT

Between Dr. Alain Mboko IYETI, the Director ad interim of the Department of Research and Planning in the Ministry of Public Health (Data Provider) and Dr. Ngashi NGONGO (Data Recipient), the following was agreed:

1. **Authorized use of the limited dataset**: The Data Provider agrees to give the Data Recipient access to the database of the final evaluation of the Health for the Poorest Populations project to use for a study on the determinants of pregnant women's compliance with antenatal care (ANC) in the Democratic Republic of Congo, in accordance with the Code of Ethics of the Congo and the Federal Health Insurance Portability and Accountability Act (HIPAA) of the United States of America. Unless otherwise specified in this Agreement, all words beginning with a capital letter acquire meaning as defined in the HIPAA code of United States of America in its article 45, paragraph 160-164.
2. **Variables in the Limited Data Set relevant for the study**: For reasons of confidentiality in accordance with the Code of Ethics of the Congo and the HIPAA, the Data Provider will take care to prepare and deliver to the Data Recipient a Limited Data Set (LDS) not containing direct identifiers (name, post name and address) and including the following information:
   - The mother's age
   - The mother's education level
   - Marital status
   - Parity
   - Gestational age at the first ANC visit
   - Number of ANC visits
   - Type of health facility
   - Type of health provider seen during ANC
   - Gender of health provider seen during ANC
   - Availability of a community health worker in the village
   - Availability of drugs during ANC
   - Distance to health facility offering ANC in kilometers
   - Distance to health facility offering the ANC in hours
   - Cost of ANC in Congolese Francs
   - Affordability
   - Weight measured during ANC
   - Blood pressure measured during ANC
   - Blood tested during ANC
   - Urine tested during ANC
   - Iron tablets given ANC
   - Sulfadoxine-pyrimethamine (SP) given during ANC
   - Deworming tablets given during ANC
   - Tetanus toxoid vaccination during ANC

- Satisfaction with the wait time for the EIC
- Women's satisfaction with the waiting time in ANC
- Women's satisfaction with the duration of ANC
- Overall women's satisfaction with ANC

3. **Responsibilities of the Data Recipient**: The Data Recipient agrees to use the LDS only for the needs of his study as agreed in this agreement and in accordance with standards and guidelines of the Ministry of Public Health and the law of the Congo, and not to use this information to identify or enter in contact with individuals who participated in the study.
4. **Term and termination of the agreement:** This Agreement will become effective on the date of signature and last as long as the Data Recipient will own the database. The data Recipient may terminate this Agreement at any time by notifying the Data Provider and by returning or destroying the LDS. The Data Provider may also terminate this Agreement at any time by notifying the Data Recipient thirty (30) days in advance. Such termination may take place earlier in case of non-compliance with the provisions of this Agreement. In this case, the Data Provider will notify the Data Recipient about the termination of this Agreement within ten (10) days and will give him the opportunity to provide the necessary clarification.
5. **Final Provisions:** The two parties undertake to renegotiate the terms of this Agreement to accommodate changes in the law that would modify the obligations of each of them. In case an amicable arrangement cannot be reached, both parties can terminate the Agreement as stipulated in point 4. The terms of this Agreement shall be construed to give effect to the interpretive guidance of the Code of Ethics, law of the Congo, and HIPAA.

This Agreement does not give rights or obligations or responsibilities to a person other than the Data Recipient and his designated successors.

IN WITNESS WHEREOF, each of the undersigned has agreed that this Agreement is executed in his/her name and on his/her behalf.

Done at Kinshasa on 22 July 2015

Signed,

The data Provider	The Data Recipient
Dr. Alain Mboko IYETI	Dr. Ngashi Ngongo

Translated:

August 11, 2015

Dr. Emmanuel Mulumba

Professor, School of Liberal Arts
Berkeley College
New Jersey
Tel: 240-405-9021
Email: enmulumba@yahoo.com

Sworn to and subscribed before me
this 14th day of August 2015

SHARIANN P. QUIRK
Notary Public of New Jersey
My Commission Expires on 4/13/2020

Appendix F: Data Use Agreement (French Original)

- Accessibilité financière
- Mesure de poids pendant la CPN
- Mesure de la tension artérielle pendant CPN
- Examen de sang pendant la CPN
- Examen d'urine pendant la CPN
- Administration du fer pendant la CPN
- Administration de la sulfadoxine-pyrimethamine (SP) pendant la CPN
- Déparasitage contre les vers intestinaux pendant la CPN
- Vaccination contre le tétanos pendant la CPN
- Satisfaction avec le temps d'attente pendant la CPN
- Satisfaction avec la durée de la CPN
- Satisfaction avec les heures des services de la CPN
- Satisfaction générale avec la CPN

3. Responsabilités du Récipiendaire:

Le Récipiendaire s'engage à utiliser la base des données limitées uniquement pour le besoin de son étude comme convenu dans cet accord et conformément aux normes et directives du MSP et à la loi de RD Congo et à ne pas utiliser ces informations pour identifier ou entrer en contact avec les individus qui ont participé dans l'étude.

4. Durée et résiliation de l'accord :

Cet accord deviendra effectif à la date de sa signature et durera aussi longtemps que le Récipiendaire détiendra la base de données.

Le Récipiendaire pourra mettre fin à cet accord à n'importe quel moment en notifiant le pourvoyeur des données, en retournant ou en détruisant la base de données limitées.

Le Pourvoyeur pourra aussi mettre fin à cet accord à n'importe quel moment en notifiant le Récipiendaire trente (30) jours à l'avance. Cette résiliation pourra interviendra plus tôt en cas de non-respect des dispositions du présent accord. Dans ce cas, le Pourvoyeur notifiera le Récipiendaire la résiliation de cet accord dans les dix (10) jours qui suivent et lui accordera l'opportunité de pourvoir des éclaircissements nécessaires.

5. Dispositions finales :

Les deux parties s'engagent à renégocier les termes de cet accord pour accommoder les changements survenus dans la loi qui modifieraient les obligations des uns et des autres. Au cas où un arrangement à l'amiable ne peut être obtenu, les deux parties pourraient mettre fin à cet accord comme stipulé au point 4.

Les termes de cet accord devront être interprétés pour donner effet aux directives interprétatives du code d'éthique et de la loi de la RD Congo et en conformité avec le HIPAA.

Cet accord ne donne pas de droits, obligations ou responsabilités a une personne autre que le Récipiendaire et ses successeurs ou désignés

En foi de quoi, chacun des soussignés a accepté que cet accord soit exécuté en son nom et pour son compte

Pourvoyeur des données

Dr Alain Mboko IYETI

Récipiendaire des données

Dr Ngashi Ngongo

Appendix G: Codebook of the Variables in Original and Revised Categories

Name of Variable	Original Category Label	Revised Code	Revised Label
Mother's age	Actual: Numeric	Mother_Age	1 = 18-29 years 2 = 30-39 years 3 = 40-49 years
Mother's education	1 = No formal education 2 = Preschool 3 = Primary 4 = Secondary 5 = Tertiary	Mother_Education	1 = Not educated 2 = Preschool/Primary 4 = Secondary/higher 99 = Missing
Marital status	1 = Single 2 = Married 3 = Living together 4 = Widow 5 = Divorced/Separated	Marital_Status	0 = In union 1 = Not in union 99 = Missing
Live births	Actual: Numeric 99 = Missing	Number_live_Births	Actual: Numeric 99 = Missing
Gestational age at first ANC visit	1 = 1-3 months 2 = 4 months or more 98 = Do not know	Timing	0 = Within 3 months 1 = Beyond 3 months 99 = Missing
Number of ANC visits	Actual: Numeric 98 = Do not know	ANC compliance	0 = Less than four visits 1 = Four or more visits 99 = Missing
Type of ANC facility	1 = At own home 2 = Other person's home 3 = Public Hospital 4 = Public clinic/health center 5 = Health post 6 = Other public facility 7 = Private hospital 8 = Private clinic 9 = Private maternity 10 = Other private facility 96 = Other category	Facility	0 = Private 1 = Public 99 = Missing
Type of ANC provider	1 = Doctor 2 = Nurse/Midwife 3 = Auxiliary nurse/midwife 4 = TBA 5 = CHW 96 = Other	Provider	1 = Nurses/Midwives 2 = Doctors 3 = Others 99 = Missing
Gender of ANC provider	1 = Male 2 = Female 98 = Do not know	Gender	0 = Female 1 = Male 99 = Missing
Time to the ANC facility	Actual: Numeric	ITime_to_facility60	0 = Within 60 minutes 1 = More than 60 minutes 99 = Missing
Cost of ANC services	Actual: Numeric	ANC_costs	0 = Within 500 CDFs 1 = More than 500 CDFs 99 = Missing
Number of ANC services	Actual: Numeric 99 = Missing	Q29_30_31_32_48_51_53_54_55Services	1 = Less than four services 2 = Four to six services 3 = Seven to nine services 99 = Missing

Appendix H: Bivariate and Multivariate Analysis of Factors Associated With ANC Compliance

Variables	Bivariate analysis			Multivariate analysis		
	OR	95% CI	P-value	OR	95% CI	P-value
Type of ANC facility	.499	[1.6633.757]	.000	2.220	[1.384, 3.561]	.002
Nurses and midwives	.106	[.750, 1.632]	.611	.964	[.622, 1.495]	.870
Doctors	2.302	[1.042, 5.084]	.039	1.655	[.658, 4.164]	.279
Gender ANC provider	1.553	[1.209, 1.993]	.001	1.407	[1.055, 1.877]	.020
Time to ANC facility	1.309	[.912, 1.880]	.144			
Costs of ANC services	1.549	[1.211, 1.981]	.001	1.159	[.869, 1.545]	.177
7-9 ANC services	2.165	[1.559, 3.006]	.000	1.680	[1.142, 2.472]	.009
4-6 ANC services	1.469	[1.073, 2.010]	.016	1.291	[.931, 1.791]	.126
Age 18-29 years	1.501	[.928, 2.427]	.097			
Age 30-39 years	1.028	[.614, 1.723]	.915			
Primary education	1.310	[.935, 1.835]	.116	1.206	[.847, 1.717]	.298
Secondary or higher ed	1.731	[1.259, 2.380]	.001	1.307	[.918, 1.862]	.137
Marital status	.752	[.488, 1.159]	.197			
Timing of first ANC	1.837	[1.419, 2.377]	.000	1.865	[1.422, 2.445]	.000
Number of live births	.961	[.906, 1.019]	.184			