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Implementation fidelity of intermittent preventive treatment with sulphadoxine pyrimethamine for malaria control in pregnant women in the ningo-prampram district of Ghana in 2018

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UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

FACULTY OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH

IMPLEMENTATION FIDELITY OF INTERMITTENT PREVENTIVE TREATMENT WITH SULPHADOXINE PYRIMETHAMINE FOR MALARIA CONTROL IN PREGNANT WOMEN IN THE NINGO-PRAMPRAM DISTRICT OF GHANA IN 2018.

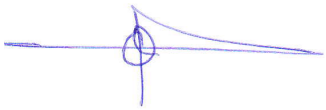
Kwabena Asare

A RESEARCH REPORT SUBMITTED TO THE FACULTY OF HEALTH SCIENCES, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN EPIDEMIOLOGY IN THE FIELD OF IMPLEMENTATION SCIENCE.

JOHANNESBURG, SEPTEMBER 2019

Declaration

I **Kwabena Asare** declare that this research report is my own, unaided work. I am submitting this work for the degree of MSc. Epidemiology (Implementation Science) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



_____

(Signature of candidate)

I declare this on 12th day of September 2019 in Johannesburg, South Africa.

Dedication

I dedicate this work to Jehovah God Almighty who has seen me through life against all the odds.

Abstract

Introduction

Ghana is a high malaria transmission area and malaria in pregnancy is a common form of morbidity. In line with World Health Organisation (WHO) recommendations, Ghana adopted the intermittent preventive treatment with Sulphadoxine-Pyrimethamine in pregnancy (IPTp-Sp) intervention in 2004 to control malaria in pregnancy. Due to several bottlenecks in implementation, full coverage of IPTp-Sp delivery to pregnant women has not been achieved yet. The aim of this study is to access the level of implementation fidelity of IPTp-Sp by ANC providers and investigate the associated factors. This will help inform strategies to improve the delivery of IPTp-Sp to pregnant women and improve the control of malaria in pregnancy.

Methods

The study used an analytical cross-sectional design which involved a retrospective review of maternal health records. The document review was done to obtain information on ANC attendance, intermittent preventive treatment (IPT) receipt and other information on mothers who had delivered in the past 18 months before the survey. Implementation fidelity outcome was defined as ANC providers' delivery of IPTp-Sp under directly observed therapy (DOT) to pregnant women when they qualified to receive IPTp-Sp as well as non-delivery of IPTp-Sp when pregnant women did not qualify to receive. Implementation fidelity was calculated. A sensitivity analysis of IPTp-Sp delivery was also performed. Logistic regression analysis was used to investigate the relationship between participant factors and implementation fidelity of IPTp-Sp delivered by ANC providers. A generalised structural equation modelling (GSEM) was used to investigate the indirect effects of participant factors on implementation fidelity of IPTp-Sp as delivered by ANC providers.

Results

The overall implementation fidelity of IPTp-Sp was 87.11%. The drawbacks of implementation fidelity were the non-adherence components of IPTp-Sp delivery by ANC providers. The non-adherence in IPTp-Sp delivery involved failure by ANC providers to deliver IPTp-Sp in some instances to pregnant women who were eligible to receive, the delivery of IPTp-Sp to pregnant women during the first trimester of pregnancy and the delivery of IPT to pregnant women who had received a previous dose of IPT in less than a month ago. In the logistic regression analysis, the significant determinants of implementation fidelity of IPTp-Sp included making four or more ANC visits during pregnancy (OR = 4.73, p=0.000)

compared to making less than 4 ANC visits, attending ANC according to WHO recommended schedules OR = 2.64, p=0.082) compared to an irregular ANC attendance pattern, employment status and parity.

Conclusion

Education and sensitisation of ANC providers are needed to increase their familiarity and knowledge of IPTp-Sp guidelines as a strategy towards achieving a higher level of implementation fidelity. Concerning ANC attendance, there should be adequate scheduling of subsequent ANC visits at first contact with pregnant women to ensure they attend ANC within the correct fidelity compliant timelines. The scheduling of ANC visits will help position pregnant women in order for them to be delivered with IPT by ANC providers with a high level of implementation fidelity. With regards to further research, this study offers an opportunity for studies that focus on the delivery of IPTp-Sp to obtain enough data to determine the eligibility status of pregnant women to receive IPTp-Sp during ANC visits. This will help reveal the actual gaps in implementation of IPTp-Sp.

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List of abbreviations

AIC	Akaike's Information Criterion
ANC	Antenatal care
AOR	Adjusted odds ratio
AUROC	The area under the receiver operating characteristic curve
BIC	Bayesian information criterion
CHPS	Community-based health planning and services
COR	Crude odds ratio
DHIMS	District health information and management system
DHS	Demographic and health survey
FANC	Focused antenatal care
GSEM	Generalized structural equation modelling
G6PD	Glucose-6-phosphate dehydrogenase deficiency
HDSS	Health and demographic surveillance system
IPT	Intermittent preventive treatment
IPT1	The 1st dose of intermittent preventive treatment
IPT2	The 2nd dose of intermittent preventive treatment
IPT3	The 3rd dose of intermittent preventive treatment
IPT4	The Fourth dose of intermittent preventive treatment
IPT5	The 5th dose of intermittent preventive treatment
IPTp-Sp	Intermittent preventive treatment with Sulphadoxine-Pyrimethamine in pregnancy

MHRB	Maternal health record book
NPV	Negative predictive value
OPD	Outpatient department
OR	Odds ratio
PI	Principal investigator
PPV	Positive predictive value
REDCap	Research Electronic Data Capture
ROC	Receiver operating characteristic
SEM	Structural equation modelling
SP	Sulphadoxine-Pyrimethamine
TDR	Special Programme for Training and Research in Tropical Diseases
WHO	World Health Organization

Definition of terms

Terminology	Definition
Implementation fidelity	The extent to which an intervention is implemented by providers as prescribed by the intervention guidelines (1).
Content	The 'active ingredients'; the drug, treatment, skills, or knowledge that an intervention seeks to deliver to its recipients (1).
Coverage	The proportion of recipients of a healthcare intervention out of the total population eligible to receive the intervention (1).
Missed opportunity to deliver IPT	This is the discrepancies or gaps between ANC attendance coverage rates and IPT coverage rates. Thus, the proportion of pregnant women who attend ANC but do not receive intermittent preventive treatment for malaria (2).
Sensitivity	The ability of a diagnostic test to detect diseased individuals correctly (3). This is the probability that the diagnostic test result is positive given that disease is present (4).
Specificity	The ability of a diagnostic test to detect non-diseased individuals correctly(3). This is the

	probability that the diagnostic test result is negative given that disease is absent (4).
Positive predictive value	It is the percentage of patients with positive test results who have the disease (4). This is the probability that a patient has the disease given that the test result is positive (3).
Negative predictive value	It is the percentage of patients with negative test results who do not have the disease(4). This is the probability that a patient does not have the disease given that the test result is negative (3).
The sensitivity of IPTp-Sp delivery	The probability that a pregnant woman receives IPTp-Sp given that she qualifies to receive IPTp-Sp.
Specificity of IPTp-Sp delivery	The probability that a pregnant woman does not receive IPTp-Sp given that she does not qualify to receive IPTp-Sp.
Positive predictive value of IPTp-Sp delivery	The percentage of pregnant women who receive IPTp-Sp and are eligible to receive IPTp-Sp.
Negative predictive value of IPTp-Sp delivery	The percentage of pregnant women who do not receive IPTp-Sp and are not eligible to receive IPTp-Sp.
Fidelity coverage of IPTp-Sp delivery	The proportion of pregnant women who received IPTp-Sp service according to the guideline. Delivery according to the guideline involves delivery of IPTp-Sp under observation to pregnant women who were eligible to receive IPTp-Sp as well as non-

	delivery of IPTp-Sp to pregnant women who were not eligible to receive IPTp-Sp.
Fidelity score of IPTp-Sp delivery	The number of instances or times a pregnant woman was delivered with IPTp-Sp with fidelity by ANC providers throughout pregnancy. This could be zero, one, two or more times. Fidelity score of IPTp-Sp is high if a pregnant woman received IPTp-Sp with fidelity many times during pregnancy.
High fidelity score of IPTp-Sp delivery	A high-fidelity score is a fidelity score of 3 or more. This means that a pregnant woman received IPTp-Sp with fidelity at least 3 times during pregnancy at ANC clinics.
Low fidelity score of IPTp-Sp delivery	A low fidelity score is a fidelity score of less than 3. This means that a pregnant woman received IPTp-Sp with fidelity less than 3 times during pregnancy at ANC clinics.

1.0 CHAPTER ONE: INTRODUCTION

1.1 Introduction

Chapter one provides a general overview of the conceptualisation of the study. It consists of background to the study, literature review, conceptual framework, problem statement, study justification, the research question, aim and objectives of the study. An overview of the study is also provided as a subsection at the end of this chapter.

1.2 Background

1.2.1 Global malaria burden

The 2016 world malaria report estimated a global malarial incidence of 212 million in 2015 with 429 000 malaria deaths (5). Out of these cases, the World Health Organization (WHO) Africa region recorded over 90% of the malaria incidence, as well as 93% of the malaria-related deaths (5). Also, of the global malaria burden, under five years children and pregnant women are the most vulnerable to the negative consequences in the form of infection, illness and death (5, 6).

1.2.2 Malaria in Ghana

Malaria is endemic in Ghana and is the leading cause of morbidity accounting for about 40-60% of the outpatient department (OPD) cases (7). Ghana is also a high malaria transmission area and recorded 8.4 million malaria cases in 2014 (8). In that same year, 27.3% of all hospital admissions, as well as 7.2% of all hospital deaths on admission were attributable to malaria (8). In 2015, malaria in pregnant women accounted for about 17.6% of OPD cases, 13.7% of admissions and 3.4% of maternal deaths (9).

1.2.3 Malaria in pregnancy

Over 50 million women in malaria transmission areas become pregnant each year and are at risk of malaria infection (10). Pregnant women attract female Anopheles (malaria-causing mosquitoes) twice more than their non-pregnant counterparts (11). They are also up to three times more likely to get sick from malaria and two times more likely to be prone to malaria-related deaths (12, 13). Malaria infection during pregnancy comes with substantial risks for the pregnant woman often leading to low birth-weight, placental malarial infection, foetal anaemia,

spontaneous abortion/preterm-birth and maternal anaemia (10, 14-17). Malaria in pregnancy also accounts for about 20% of low birth-weight deliveries, 11.4% of neonatal deaths, 5.7% of infant deaths and 20% of stillbirth deliveries in Sub-Saharan Africa (18, 19). In the areas of moderate to high malaria transmission such as Ghana, the infection of malaria during pregnancy is extensively asymptomatic and therefore requires a preventive approach (20).

1.2.4 IPTp-Sp for malaria control in pregnancy

In order to control malaria in pregnancy as well as its associated adverse outcomes, the World Health Organisation (WHO) recommends a multi-level three-pronged approach. The approach involves three tenets namely: use of Intermittent Preventive Treatment with Sulphadoxine-Pyrimethamine (IPTp-Sp), Insecticide-treated nets (ITNs) and case management through prompt and effective treatment of malaria (14, 15, 20). IPTp-Sp involves the administration of full, curative treatment doses of Sulphadoxine-Pyrimethamine (Sp) at minimum monthly intervals during pregnancy at ante-natal care (ANC) clinics (21). IPTp-Sp is effective in preventing the adverse effects of malaria on maternal and foetal outcomes (21). These adverse effects include maternal anaemia, peripheral, placental parasitemia and clinical malaria during pregnancy (10, 16, 17).

1.2.5 IPTp-Sp for malaria control in pregnancy in Ghana

In response to WHO's recommendations for malaria control in pregnancy, the Ghana health service adopted IPTp-Sp in 2004 as an approach to prevent malaria and its associated complications among pregnant women (15). All asymptomatic pregnant women are to receive a minimum of 3 doses of Sulphadoxine-Pyrimethamine (SP) at minimum intervals of at least one month during the second and third trimesters. Administration of IPTp-Sp should begin in the second trimester after confirmed signs of foetal movements or from 16 weeks of pregnancy till delivery regardless of whether the recipient has a malaria infection or not (21). The delivery of IPTp-Sp is supposed to be done under direct observation therapy (DOT) by a health care provider at ANC clinics as part of a comprehensive ante-natal care package (15). Pregnant women who attend ANC with the following conditions are exempted from IPTp-Sp (15):

- The first trimester of pregnancy (<13 weeks' gestation).
- G6PD enzyme full or partial defect or status controversy.
- Severe anaemia.
- Blood dyscrasias, e.g. neutrophilia, thrombocytopenia.

- Any history of epileptic or seizure disorders.
- Severe liver disease or unexplained recurrent jaundice.
- Any known allergy to any Sulphur containing drugs or allergy to Pyrimethamine.
- Any history of previous severe adverse reaction to Sp.
- Recent treatment with a Sulphur-containing drug such as Co-trimoxazole (within four weeks)
- Breastfeeding.
- An acute case of malaria.

1.3 Literature review

1.3.1 Introduction

The closest to implementation fidelity of IPTp-Sp in the literature are publications and reports on IPT coverage versus ANC attendance coverage. IPT coverage is a reflection of IPT delivery by ANC providers since ANC clinics are the delivery points for IPTp-Sp. Most studies in the literature have analysed ANC providers delivery of IPTp-Sp by comparing IPT coverage to ANC coverage to identify possible gaps in delivery. The gaps between ANC coverage and IPT receipt is referred to in the literature, as "the missed opportunities for IPT delivery". These gaps partly reflect adherence or fidelity of implementation of IPTp-Sp by ANC providers. This literature review, therefore, focuses more on studies and reports on missed opportunities for IPT delivery as a reflection of the implementation fidelity of IPTp-Sp.

1.3.2 The missed opportunities for IPTp-Sp at ANC clinics in sub-Saharan Africa.

A systematic review of data from 58 Demographic and Health Surveys report information on IPT delivery. This review was conducted between 2003 and 2013 and involved 31 sub-Saharan African countries including Ghana (2). This review revealed information on IPTp-Sp delivery by ANC providers (2). The results showed that a median of 72.9% (IQR 58.4–79.5%) of second and third trimester ANC visits represented missed opportunities to deliver IPTp (2). Thus, ANC providers did not deliver IPTp-Sp services between 58.4% to 79.5% (median 72.9%) of ANC visits that were made by pregnant women in their second and third trimesters. These were instances where pregnant women could have been given IPTp during an ANC visit but received none.

Another review and meta-analysis of data from 39 studies of Malaria Indicator Surveys (MIS) and Demographic and Health Surveys (DHS) also provide information on IPTp-Sp delivery (22). Data used for this review were from studies conducted between 2007 and 2011 in malaria-endemic sub-Saharan African countries including Ghana. Coverage of second Intermittent Preventive Treatment (IPT2) which is the recommended minimum dose by WHO before 2012, ranged between 0.3% in Burundi in 2010 to 66% in Zambia in 2007. The overall pooled weighted average of IPT2 was 20%. For pregnant women who attended ANC once during pregnancy, only 42% of them received one dose of Sp. For those who made two ANC visits, only 57% received two doses of Sp during pregnancy (22). Thus 43% of pregnant women who received only one dose of IPTp during pregnancy made more than one ANC visits and yet ended up receiving only one dose of IPTp during pregnancy (23).

The 2017 world malaria report reveals a more recent situation. In this report, out of twenty-three African countries that reported IPTp-Sp data in 2016, an estimated 19% of pregnant women received the recommended three or more doses (the recommended minimum dose by WHO since 2012) of IPTp-Sp (6). This estimate was 18% in 2015 and 13% in 2014 (6). Still, in 2016, only two countries which were Ghana (59.6%) and Zambia (49.6%) reported coverage of about 50% of pregnant women receiving the recommended three or more doses of Sp. The lowest coverage in 2016 was recorded by the Democratic Republic of the Congo (5.4%) This report, however, does not also provide the ANC coverage rates for comparison.

1.3.3 The missed opportunities for IPTp-Sp delivery in Ghana.

The Ghana Health Service 2016 annual report provides estimates of IPTp-Sp coverage between 2011 to 2016 among pregnant women at ANC clinics (23). The first dose of intermittent preventive treatment (IPT1) coverage ranged from 69.7% in 2011 to 69% in 2016. IPT2 coverage ranged from 56.2% in 2011 to 51.6% in 2016. IPT3 coverage ranged from 39.8% in 2011 to 36.7% in 2016. IPT4 coverage ranged from 4.0% in 2011 to 16.7% in 2016. IPT5 coverage ranged from 1.1% in 2011 to 6.7% in 2016. Within this same period, however, coverage of four or more ANC visits during pregnancy was between 76% in 2011 to 75.9% in 2016 (24). ANC coverage is shown to be far more than IPT coverage reflecting some missed opportunities to deliver IPTp-Sp in Ghana. The missed opportunity is reflected by the gap between ANC coverage and IPT coverage.

In the 2014 Ghana Demographic and Health Survey, women who had delivered two years before the survey reported their IPTp-Sp use during pregnancy. Of these women, 83% reported receiving one dose, 68% reported taking 2 or more doses, and 39% reported taking 3 or more doses of Sp during pregnancy at ANC clinics. However, 87% of these women reported having made four or more ANC visits at a health facility during pregnancy (25). This difference reflects a gap between ANC attendance coverage and the coverage of the three or more dose of IPT during pregnancy.

1.3.4 Factors that influence IPTp-Sp delivery

1.3.4.1 ANC provider and health care system related factors

Health care system related factors that have been shown in the literature to influence IPTp-Sp delivery include stock-outs of IPTp drugs, user fees for ANC services, unavailability of program guidelines at the health facilities and availability of drinking water at ANC clinics (26-28). Other health system related factors include conflicting information from different programmes within the ministry of health, lack of adequate training and supervision of healthcare providers, inconsistent guidelines, lack of quality assurance and supervision of IPTp-Sp delivery in health facilities (26-28). ANC provider-related factors that negatively affect IPTp-Sp delivery include healthcare provider confusion over IPTp-Sp safety and efficacy, the timing of each IPTp-Sp dose with gestational age, low knowledge level of ANC providers on IPTp guidelines and administration, imprecise estimation of gestational age and poor health worker attitude (26-28).

1.3.4.2 Client/Pregnant women related factors

Client level factors that have been shown to promote access to IPTp-Sp services include early ANC booking, increased number of ANC visits (3 to 4), right timing of ANC visits and being pregnant for the first time (22, 26, 27, 29). On the contrary, late presentation at ANC clinics by the women, user fees for ANC services, fear of side effects of Sp, irregular and poor ANC attendance on the part of pregnant women have been shown to reduce uptake of IPTp services (29, 30).

1.4 Conceptual framework for implementation fidelity of IPTp-Sp

Implementation fidelity is the extent to which the delivery of an intervention adheres to the protocol or the program model as intended by the program developers (1, 31). Adherence is the main bottom-line measurement of fidelity (1). If an intervention adheres to the program manual in terms of content, frequency, duration and coverage, then fidelity is said to be high (1). Content and coverage components of adherence fit more in this context than the other two components. The content of an intervention refers to its active ingredients such as the drug, treatment that an intervention seeks to deliver to its recipients (1). Coverage refers to whether all the participants who qualify to receive the benefits of a intervention do receive it (1).

The logic model of IPTp-Sp is in figure 1.1 below. A part of this logic model is the component of implementation fidelity which is the role of the ANC provider in the logic model. The section under activities is the fidelity component of IPTp-Sp. This is the role that ANC providers have to play to ensure adequate implementation of IPTp-Sp. Thus, the "activities" component of the logic model is the implementation fidelity component of IPTp-Sp. The whole logic model has been presented to reflect how the adherence or fidelity component feeds into the whole theory of change of the IPTp-Sp intervention.

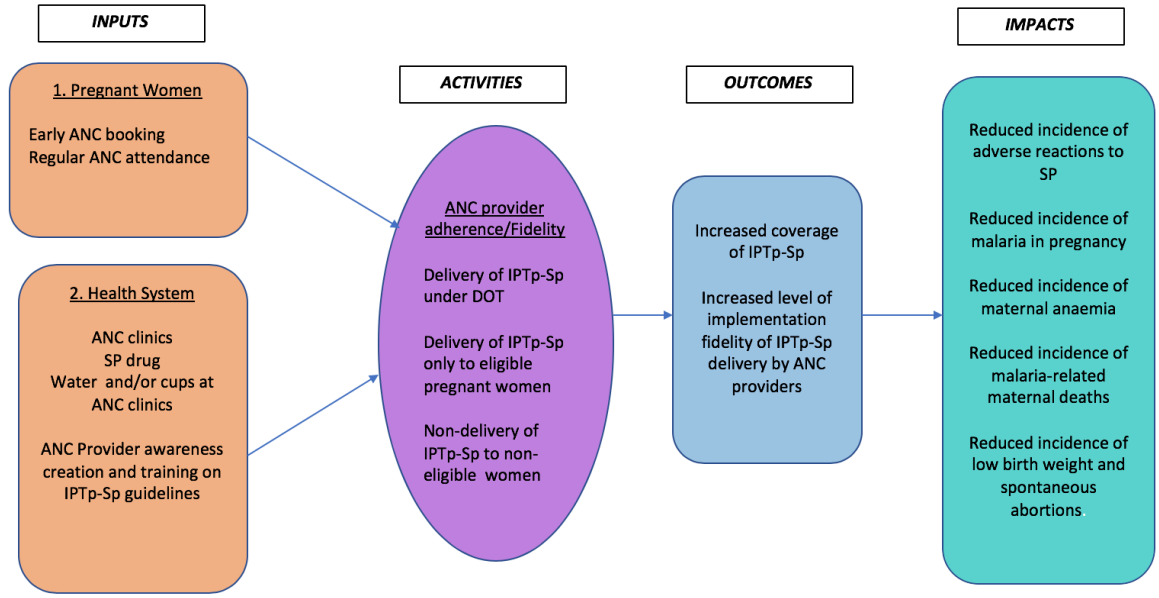


Figure 1.1: Logic model for IPTp-Sp intervention with the implementation fidelity component

1.5 Problem statement

There is a generally low uptake of IPTp-Sp services in most African countries including Ghana (21, 25). This low uptake in most cases reflects missed opportunities to deliver IPTp-Sp services to pregnant women at ANC clinics. Thus, in most cases of ANC visits by pregnant women, even though there was an opportunity for IPT service to be received, they never received it (2, 21). These missed opportunities reflect low delivery of IPTp-Sp by ANC providers despite continued high rates of ANC attendance in Sub-Saharan African countries. The missed opportunities to deliver IPTp-Sp also highlight the fact that the low uptake of IPTp-Sp is not mainly due to low levels of antenatal clinic attendance but reflects health system inefficiencies in the delivery of IPTp-Sp (2, 21, 30). Uncertainty and confusion among health care providers about the administration of IPTp-Sp have been reported to be among the possible reasons for the low uptake of IPTp-Sp in Sub-Saharan Africa (32).

1.6 Justification of the study

Assessing the implementation fidelity of IPTp-SP will help to estimate how close we are to achieving the intended outcomes of the intervention (1). The implementation fidelity influences the extent to which an intervention leads to its outcomes (1). It also helps to identify gaps in the delivery of the intervention and highlight areas of the intervention to target for improvement. More importantly, assessing the implementation fidelity of IPTp-Sp will reveal whether the missed opportunities to deliver IPTp-Sp in the literature are real missed opportunities or not. The reason is that there are conditions and guidelines for the delivery of IPTp-Sp.

Certain factors at the level of the pregnant women, particularly their ANC attendance patterns can also influence whether they receive IPTp-Sp with fidelity during pregnancy. These factors help to determine the part pregnant women have to play concerning receiving IPTp-Sp services with fidelity from ANC providers. All these will offer a basis for providing recommendations to improve provider adherence to the intervention. This will by extension lead to better clinical outcomes for mothers and their babies in the form of reduced placental infection with malaria, reduced incidence of maternal anaemia, reduced incidence of foetal anaemia and reduced incidence of low birth weight.

1.7 Research questions

1. What is the level of implementation fidelity of IPTp-Sp delivery by ANC providers in ANC clinics in the Ningo-Prampram District of Ghana?

2. What are the client factors that influence the fidelity of IPTp-Sp delivery by ANC providers in the Ningo-Prampram District of Ghana?

1.8 Aim

The study aims to assess whether the delivery of IPTp-Sp by ANC providers to pregnant women in the Ningo-Prampram District of Ghana is done as prescribed by the Ghana IPTp-Sp intervention manual. Recommendations will be made based on the gaps in delivery in terms of provider adherence to improve the fidelity of implementation of IPTp-Sp.

1.9 Objectives

1. To assess the implementation fidelity coverage of IPTp-Sp delivery by ANC providers in the Ningo-Prampram District of Ghana in 2018.

2. To investigate the direct association between participant characteristics and implementation fidelity of IPTp-Sp delivery by ANC providers in the Ningo-Prampram District of Ghana in 2018.

3. To investigate the indirect association between participant characteristics and implementation fidelity of IPTp-Sp delivery by ANC providers in the Ningo-Prampram District of Ghana in 2018.

1.10 Overview of the study

Low coverage of IPTp-Sp is reported in the literature in sub-Saharan Africa despite high levels of ANC attendance. Some published literature including some by WHO even stresses the fact that ANC attendance is not the reason for the low IPTp-Sp coverage (21). The low IPTp-Sp coverage vis a vis higher ANC attendance rates partly reflect low implementation fidelity of the delivery of Sp by ANC providers.

Although ANC attendance is a necessary condition for IPTp-Sp delivery, it is not a sufficient condition as per IPT policy and guidelines. Thus, IPTp-Sp cannot be delivered to any pregnant woman at every ANC visit. IPTp-Sp delivery is recommended at certain gestational ages during pregnancy and at recommended time intervals between doses. Thus, even though ANC coverage can be high, but if the ANC visits do not occur in the right timings that qualify pregnant women to receive IPTp-Sp, they are more likely not to receive the service. There are also other conditions that exempt pregnant women from receiving IPT at ANC clinics. Thus, in order to objectively analyse the adherence of healthcare providers in delivering IPTp-Sp, there should be more information on whether pregnant women qualified or were eligible or not to receive IPTp-Sp.

This study focuses on incorporating these components of IPTp-Sp guidelines to have a relatively holistic view of how the intervention is being delivered with fidelity by ANC providers.

2.0 CHAPTER TWO: METHODOLOGY

2.1 Introduction

Chapter two provides information on the whole conduct of the study. The information is on all activities from after the conceptualisation of the study through to data collection and data analysis. The chapter consists of the study design, study site, study population and sampling, data collection, data management, data analysis and ethical considerations.

2.2 Study design

The study used an analytical cross-sectional design. It involved quantitative data collection methods to obtain documented information on IPTp-Sp delivery by ANC providers. The data used was retrospective data recorded at ANC clinics during ANC visits by pregnant women. Data were obtained by reviewing the maternal health record books (MHRB) of pregnant women who had attended ANC in selected ANC clinics within the Ningo-Prampram District in Ghana.

2.3 Study site and setting

The study was conducted in the Ningo-Prampram District in the Greater Accra region of Ghana in 2018. The Ningo-Prampram District which is along the south-eastern coast of Ghana offers a mix of rural, peri-urban and urban settlements with a good mix of health facility types. The mix of health facility types offered the opportunity to assess the study outcome among healthcare providers and pregnant women in different settings. The study site forms part of the surveillance area of the Dodowa Health and Demographic surveillance site (HDSS). All houses in the area are identifiable with the house numbering system by the HDSS (33). The house identification system made the conduct of the study survey relatively easier.

2.4 Study population and data source for IPTp-Sp delivery

The study population involved all mothers or women who had delivered in the past 18 months before the start of the survey. Thus, the study participants involved women who had delivered between December 2016 and May 2018. Among this population, only those who had their maternal health record book (MHRB) were included in the study. The MHRB is the pregnant woman's version of a patient folder which is a health facility record but given to be kept by the pregnant women. Keeping the MHRB with pregnant women make it easy for maternal health

services to be recorded by ANC providers during ANC visits by pregnant women. Thus, the MHRB contains comprehensive information on all maternal health services a pregnant woman receives including IPTp-Sp from any health facility she attends. Mothers were contacted mainly to have access to their MHRBs. The purpose was to obtain documented information on IPTp-Sp services received as well as ANC attendances and other information in the MHRB. Mothers who had delivered were selected because they had already passed through all the stages of pregnancy and have had the opportunity to receive IPTp-Sp services at ANC clinics. Eighteen months was chosen to allow for the relatively easy recall of some of the IPTp-Sp services received during pregnancy and also to allow for the possibility of obtaining enough sample of women.

2.5 Study Sampling

2.5.1 Sampling of sub-districts and ANC clinics

The Ningo-Prampram District is made up of 6 sub-districts namely; Prampram, Old-Ningo, Nyigbenya-Dawa, Lekpongunor, Dawhenya and Afienya-Mataheko sub-districts. Three of these sub-districts which are Prampram, Old-Ningo and Lekpongunor sub-districts were purposively selected for the study. Health facilities in these three sub-districts record the highest number of deliveries in the district. They recorded 79% of the total health facility deliveries and 65% of ANC registrations in the district in 2016 according to data from the district health information and management system (DHIMS2) (34). Thus, the sampling frame was large enough to recruit the required number of women for the study due to the high number of deliveries as well as ANC attendances. There are five health facilities with ANC clinics that deliver IPTp-Sp services in these three sub-districts. We included all of these five health facilities in the study. These health facilities were the source of the sampling frame that was used to select the study participants.

2.5.2 Sample size calculation and the total sample of women selected from each health facility

The 2014 Ghana Demographic and Health Survey estimated that 39% of pregnant women received the optimal three doses of IPT during pregnancy. The study based the sample size calculation on detecting this proportion as delivered by ANC providers. The decision was necessary because, in order to assess the fidelity of IPTp-Sp delivery, we needed a

representative proportion of women who previously receive IPTp-Sp. A sample minimum of 296 women was required in a particular setting to detect this proportion within 8% of the estimated value of 39%, with 80% power, at a 5% level of significance. Using a response rate of 80%, the required sample needed then became 370. The estimation was done using STATA statistical software release 14. See Appendix E for STATA output of sample size calculation.

An allocated quota was then taken from each health facility out of the total sample of 370. The quotas or proportions were based on health facility client volumes at each health facility. The client volumes were the proportion of ANC registrants in each health facility out of the total ANC registrations within the three sub-districts in the year 2016. Table 2.1 shows detailed information on the total number selected from each health facility.

Table 2:1: Allocated sample of women from each health facility

Name of Health Facility	**Sub-District**	**Number of ANC registrants in 2016**	**The proportion of ANC registrants in 2016 (%)**	**Number proposed for selection (Sample)**
Prampram Polyclinic	Prampram	768	41	152
Old-Ningo Health Centre	Old-Ningo	607	32	118
New Ningo CHPS	Prampram	29	2	7
Dangme Community Hospital	Prampram	268	14	52
Lekpongunor CHPS	Lekpongunor	207	11	41
TOTAL		**1879**	**100**	**370**

2.6 Data collection

2.6.1 Selection of study participants

As already indicated in section 2.4, the sampling frame was all ANC registrants at the selected health facilities. These were ANC registrants who according to their gestational age at ANC registration had delivered in the past 18 months (December 2016 to May 2018) before the survey. ANC registers at each health facility were used to compile the list of ANC registrants. Variables compiled included the name and house numbers of pregnant women. The compilation was done to obtain the total sample frame for each health facility. The sample frame for each health facility was put in separate Microsoft Excel sheets. Random numbers were generated for each observation. Sorting by the random numbers was done, and the selection was then made. The selection was made by selecting the first entries downwards after sorting by the random numbers until the allocated quota was obtained. This procedure was repeated for each health facility in the different Microsoft Excel sheets, and the allocated sample for each health facility was obtained.

2.6.2 Survey of mothers

The survey involved the use of a structured questionnaire (see Appendix A) to obtain information on IPTp-Sp services delivered to women by ANC care providers. Data collection involved the extraction of information from the MHRB as well as asking the women/participants a few questions. Information on IPT delivery as well as ANC attendances was extracted from the MHRB. The main variables obtained from the MHRB were ANC attendance dates and gestational ages at those times, dates and gestational ages of IPTp-Sp receipt. The questions asked were whether pregnant women took IPT drugs under observation and which health facility they usually attended for ANC during their previous pregnancy.

Trained data collectors did data collection. Names of women selected during the participant selection stage as well as their contact information (house numbers) were given to data collectors to locate and interview them. When any participant was unavailable, was not eligible or did not have the MHRB, she was replaced randomly from the surplus compiled list after the first sampling stage. The replacement was done from the corresponding surplus data for each health facility. Thus, a woman from health facility A, who was not available, was replaced with a woman from the surplus compiled list for health facility A.

A paper-based questionnaire was used to collect data. After each interview, the questionnaire was thoroughly checked for errors and inconsistencies particularly among ANC and IPT receipt dates. Data was approved if all information were consistent before data capture was done. All checked and approved questionnaires after data collection were captured online on research electronic data capture (REDCap) platform. Data capture was done systematically with one record captured at a time until all approved records were captured.

2.6.3 Permission to collect data

The Ghana Health Service Ethics Review Committee approved the study with an approval number **GHS-ERC:019/12/17**. (see Appendix C for a copy of the approval letter). The University of the Witwatersrand's Ethics Review Committee also approved the study with approval number M180145. (see Appendix B for a copy of the approval letter). All study procedures began by seeking informed consent from participants.

2.7 Data management

2.7.1 Computer programs and platform for data management

Study data were captured and managed using the electronic data capture tool (REDCap) hosted at the University of the Witwatersrand. REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing; 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources (35).

The questionnaire was designed as a data collection instrument in REDCap using the online designer tool. The study strictly ensured data quality. The data quality tool with the default data quality checks was used in REDCap to further check for errors and consistency in the data after data capture. Additional customised data quality rules were added to check for errors in the data to further ensure data quality. These additional checks included consistency among ANC dates as well as IPT receipt dates. For example, ANC1 date cannot be ahead in time than ANC2. Consistency among gestational ages in weeks was also checked. Example, gestational age at

ANC1 cannot be more than that at ANC2. Other checks included consistency between parity and gravidity and age.

Errors were corrected by rechecking information on the paper-based completed questionnaires. This was effective in ensuring data quality because, as already stated in section 2.6.2, all paper-based questionnaires were thoroughly checked for inconsistencies among related variables and approved before data capture was done. Thus, most of the errors at this stage were data entry errors. However, observations with incomplete and inconsistent data as well as errors after this stage and which could not be rectified by checking the paper-based questionnaires were dropped during analysis. This is further explained in section 2.7.2. The data was then exported from REDCap to STATA using the data export feature in REDCap. The data was further cleaned using STATA software package release 14 (36). Also, additional variables were created using the STATA software package (36). Data cleaning using STATA software package involved checking the number of responses for each variable and whether they were consistent with other related variables. Related variables were then checked for correctness and accuracy.

2.7.2 Obtaining final datasets used for analysis

The diagram in figure 2.1 presents information about the flow of the data from the sampling stage to the final dataset used for analysis. A total of 370 women were sampled from the ANC registers as already mentioned in sections 2.5.2 and 2.6.1. Out of the total 370 women, 349 were available at home when contacts were made and were also in possession of their MHRBs. These were interviewed. The remaining 21 were either not available or did not have their MHRB. Thus, 21 women needed to be replaced. Only 19 of the 21 were successfully replaced and interviewed, and two were not. The total number interviewed now became 368 women (349 plus 19).

Out of the number interviewed, 4 of them had inconsistent pieces of information, 9 had some missing data, and 355 had complete information. The final 355 observations with a complete set of information made up the final dataset used for the analysis.

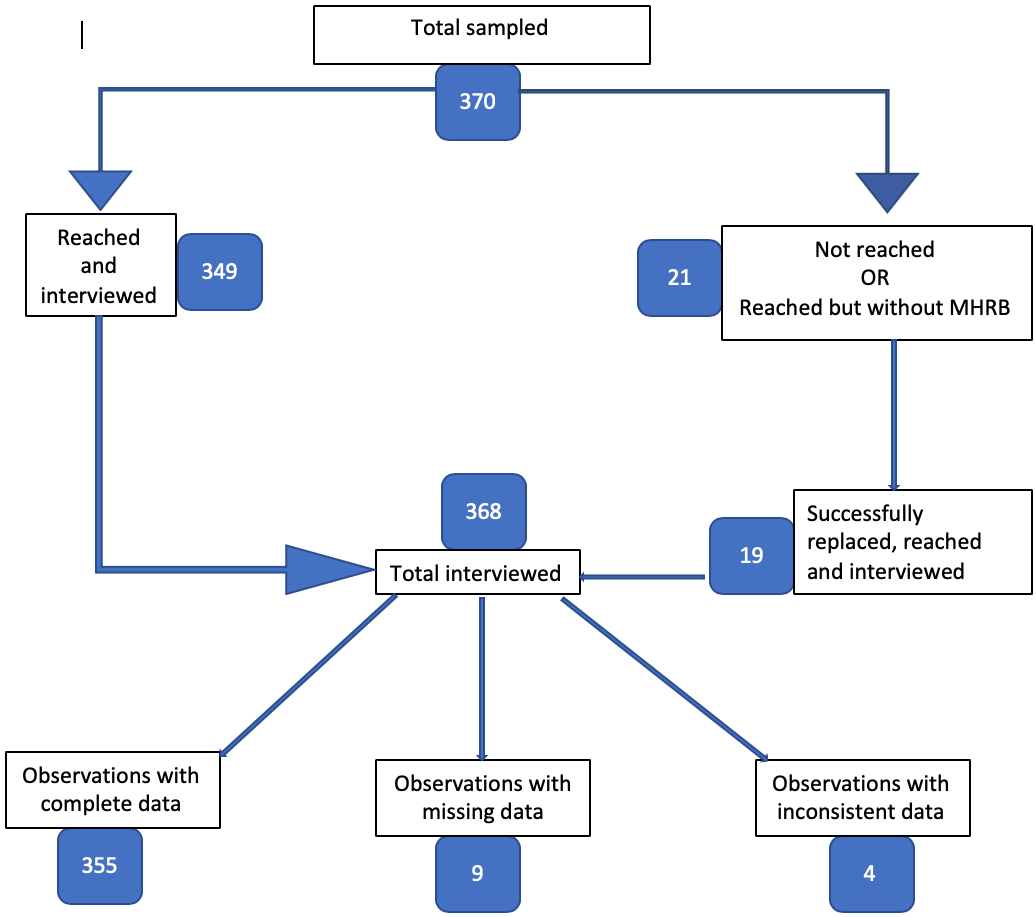


Figure 2.1: Flow of study data from the sampling stage to the final dataset used for analysis

2.7.3 Creation of new variables

New variables were created to make the analysis of the outcomes of interest easier. The creation of new variables was also necessary because the analysis for the outcomes involved a combination of other variables in the dataset. The variables created are the qualification to receive IPTp-Sp variable, the fidelity of IPTp-Sp variable and fidelity score variable. Appendix G shows the details of the creation of variables (Stata do file commands).

2.7.3.1 Creation of qualification/eligibility to receive IPTp-Sp variable

This variable was created as a binary (yes/no) variable to ascertain whether participants qualified or were eligible to receive IPT or not at ANC visits. The qualification or eligibility status to receive each IPT dose (1st, 2nd, 3rd, 4th and 5th) was first checked at all ANC visits pregnant women made. This is because a particular dose of IPT could be received at any ANC visit. Thus, for example, the first dose of IPT can be received at the first or second ANC visit.

Therefore, the qualification to receive each dose was first checked and created for all ANC visits made by pregnant women. The details of the description of how these variables were created are shown in Tables 6.1 to 6.5 of Appendix F, for each stage of IPT at different ANC visits. Appendix G provides the STATA do file commands on how these variables were created.

After creating the qualification to receive the various IPT doses at the various ANC visits, these were combined to create the qualification to receive IPT variable at a particular stage (IPT1, IPT2, IPT3, IPT4, IPT5). The reason is that a participant could qualify to receive a particular dose of IPT say the first or second dose at different ANC visits depending on the number of ANC visits made. Hence qualification to receive say 1st IPT was "yes" if the participant ever qualified at least once to receive the first IPT at any of the ANC visits she made. The same was done to create the qualification variable to receive all IPT doses (first, second, third, fourth and fifth).

2.7.3.2 Creation of fidelity of IPTp-Sp variable

After creation of the qualification to receive IPT variable, it was easy to now create the fidelity of IPTp-Sp variable. Fidelity involved the receipt or otherwise of IPT in the face of being eligible or not. Fidelity of IPTp-Sp variable was also created as a binary variable with two outcomes "yes" or "no". The creation of the fidelity variable was done for all stages of IPT using the IPT receipt variable obtained at data collection and the qualification to receive IPT variable already created and explained in section 2.7.3. The details are shown in Table 2.2. Appendix G provides information on the Stata do file commands used.

Table 2:2: Creation of fidelity of IPTp-Sp variable at each IPT stage

	Fidelity of IPTp-Sp	
IPT Stage	**Fidelity (Yes) if**	**No if**
1st IPT	Participant qualified to receive the 1st IPT dose and received it under DOT. **OR** Participant did not qualify to receive the 1st IPT dose and did not receive.	Participant qualified to receive the 1st IPT dose but did not receive it. **OR** Participant did not qualify to receive the 1st IPT dose but received.
2nd IPT	Participant qualified to receive the 2nd IPT dose and received it under DOT. **OR** Participant did not qualify to receive the 2nd IPT dose and did not receive.	Participant qualified to receive the 2nd IPT dose but did not receive it. **OR** Participant did not qualify to receive the 2nd IPT dose but received.
3rd IPT	Participant qualified to receive the 3rd IPT dose and received it under DOT. **OR** Participant did not qualify to receive the 3rd IPT dose and did not receive.	Participant qualified to receive the 3rd IPT dose but did not receive it. **OR** Participant did not qualify to receive the 3rd IPT dose but received.
4th IPT	Participant qualified to receive the 4th IPT dose and received it under DOT. **OR** Participant did not qualify to receive the 4th IPT dose and did not receive.	Participant qualified to receive the 4th IPT dose but did not receive it. **OR** Participant did not qualify to receive the 4th IPT dose but received.
5th IPT	Participant qualified to receive the 5th IPT dose and received it under DOT. **OR** Participant did not qualify to receive the 5th IPT dose and did not receive.	Participant qualified to receive the 5th IPT dose but did not receive it. **OR** Participant did not qualify to receive the 5th IPT dose but received.

2.7.3.3 Creation of fidelity of IPTp-Sp score variable

A score of fidelity variable was created in order to obtain a categorical variable to be used as the outcome variable for the logistic regression and the generalised structural equation modelling (GSEM) analysis. After the creation of the fidelity of IPTp-Sp variable, each participant now had a number of fidelity instances at the various stages of IPT. Thus, each participant observation in the data had either 0,1,2,3,4 or 5 instances where IPTp-Sp was delivered with fidelity by ANC providers. The total number of the fidelity instances for each participant at the various stages of IPT was summed to create a score of fidelity for each participant. The score ranged between 0 and 5 inclusive. The scores were further categorised into high and low. High was a score of 3 or more fidelity instances, and low was a score of 2 or less. The categorised fidelity score was the outcome variable for the logistic regression and GSEM analysis. Appendix G provides information on the Stata do file commands used.

2.8 Data analysis

2.8.1 Computer software package for data analysis

STATA software package release 14, was used for all the analysis after using it for the data cleaning and the creation of new variables (36).

2.8.2: Analysis of background characteristics

Analysis of the background characteristics was performed with a cross-tabulation of the socio-demographic variables by sub-district. The analysis was also done for the clinical variables. The outcome of the cross tabulation was in the form of proportions. The Pearson's Chi2 test of the cross-tabulation associations between variables was also performed, and estimates reported. The socio-demographic variables were age group, educational status, marital status, religion and employment status. The clinical variables were parity, gravidity, number of ANC visits made, number of ANC visits made with a minimum of 1-month intervals, trimester of 1st ANC visit, whether pregnant women attended ANC according to the World Health Organisation focused antenatal care (WHO-FANC) model and the number of IPTp-Sp doses received during pregnancy.

2.8.3 Analysis of objective 1: Implementation fidelity coverage of IPTp-Sp

The first objective of the study was to estimate the implementation fidelity coverage of IPTp-Sp delivery by ANC providers in the Ningo-Prampram District of Ghana. In other words, this

objective was to find out the proportion of times ANC providers adhered to the IPTp-Sp delivery guidelines. The analysis of this objective first involved, analysing and presenting the IPT eligibility characteristics of pregnant women at ANC visits as well as at the time of IPT receipt. This was followed by an analysis of the coverage of the eligibility or qualification status to receive IPT. The qualification to receive IPT status was then combined with IPT receipt status in a sensitivity and specificity analysis to reveal true positives and true negatives in terms of IPT delivery. The fidelity of IPT coverage was then analysed and reported. Details of the analysis of objective one are provided in order in the ensuing sub-sections (section 2.8.2.1 to 2.8.2.5).

2.8.3.1 IPTp-Sp eligibility characteristics of pregnant women at ANC visits

The eligibility characteristics analysed were the gestational age (in weeks) at ANC visits, the clinical history and conditions of pregnant women and the time intervals (in days) between subsequent ANC visits. The mean gestational age and standard deviations at all ANC visits were estimated. The mean number of days and standard deviations between ANC visits were also estimated. The proportion of women who had any clinical history or condition that exempted them from receiving IPT at every ANC visit was also calculated. The results are presented in a table.

2.8.3.2 IPT eligibility characteristics of pregnant women at the time of IPTp-Sp receipt

The eligibility characteristics analysed at the time of IPTp-Sp receipt, involved the gestational age (in weeks) at the time of IPT receipt, the clinical history and conditions of pregnant women and the time intervals (in days) between subsequent IPT doses. The mean gestational age and standard deviations at all IPT stages were estimated. The mean number of days and standard deviations between IPT receipt dates were also estimated. The proportion of women who had any clinical history or condition that exempted them from receiving IPT were also calculated at the various IPT stages. The results are presented in a table.

2.8.3.3 Coverage of eligibility or qualification to receive IPTp-Sp

After analysing the eligibility characteristics, they were combined to determine the eligibility status at the various stages of IPTp-Sp. The outcome was in the form of proportions of women who qualified to receive IPT or not at the different IPT stages or doses. The eligibility coverage

was presented using pie charts. This was done by sub-districts. The variable used was the qualification to receive IPT variable already created for the various IPT stages in section 2.7.3.1.

2.8.3.4 Sensitivity and specificity analysis of IPTp-Sp delivery

A sensitivity and specificity analysis were conducted to reveal the true positives and true negatives. The sensitivity, specificity, the positive predictive value (PPV) and the negative predictive value (NPV) were estimated at each IPT stage.

In clinical tests and diagnosis, the sensitivity of a test refers to the ability of the test to identify those patients with the disease (3). This is the probability that, the test result is positive given that disease is present (true positives) (4). Specificity, on the other hand, refers to the ability of the test to identify those patients without the disease (3). This is the probability that, the test result is negative given that disease is absent (true negatives) (4). Sensitivity and specificity, however, do not answer the question of how likely someone has the disease or not given the test results (positive or negative)(3). The positive predictive value (PPV) and negative predictive value (NPV) answer this question. The PPV is the percentage of patients with a positive test who have the disease (4). The NPV is the percentage of patients with a negative test who do not have the disease (4). These are however based on the prevalence of the disease in the population since the disease status is not certainly known after diagnostic testing (3, 4). Thus, in clinical diagnostic testing, the classifier variable is the test results, or the test and the reference variable is the disease status. Table 2.3 presents the mathematical definitions of sensitivity, specificity, PPV and NPV (3, 4).

Table 2:3: Sensitivity and specificity analysis

	Disease Status		
Results of the diagnostic test	Disease present	Disease absent	**Total**
Positive	a	b	a+b
Negative	c	d	c+d
Total	a+c	b+d	

Sensitivity = $\frac{a}{a+c}$ **Positive Predictive Value**= $\frac{a}{a+b}$

Specificity = $\frac{b}{b+d}$ **Negative Predictive Value**= $\frac{d}{c+d}$

Prevalence = $\frac{a+c}{a+b+c+d}$

Applying this analysis to IPTp-Sp delivery, the classifier variable becomes the delivery of IPTp-Sp by ANC providers (or receipt of IPTp-Sp by pregnant women), and the reference variable is the qualification to receive IPT status. Thus, how is IPTp-Sp delivery by ANC providers able to detect or classify pregnant women based on their qualification or eligibility status to receive IPTp-Sp. Sensitivity here then reflects the probability that a pregnant woman received IPT given that she qualified to receive (true positives). Specificity also reflects the probability that a pregnant woman did not receive IPT given that she did not qualify to receive (true negatives). The PPV reflects the probability that a pregnant woman who qualified to receive IPT successfully received IPT. The PPV also means the likelihood of a pregnant woman to receive IPTp-Sp if she were eligible. The NPV value also reflects the probability that a pregnant woman who did not qualify to receive IPT was successfully refused IPT. The NPV also means the likelihood of a pregnant woman to be refused IPTp-Sp if she did not qualify to receive. The correctly classified IPT delivery involves the true positives and the true negatives as a proportion of the corresponding totals. All estimates of sensitivity, specificity, PPV and NPV were calculated and reported for each stage of IPT.

2.8.3.5 Implementation fidelity coverage of IPTp-Sp

The implementation fidelity coverage in the form of proportions was calculated and reported. The calculation was done using the fidelity variables already created. Pie charts were used to present the proportions of fidelity by sub-district and at each stage of IPT. The pie chart was done with the fidelity variable created and explained in section 2.7.3.2.

2.8.4 Analysis of objective 2: Direct association between implementation fidelity score of IPTp-Sp and participant characteristics

The second objective of this study was to investigate the direct association between participant characteristics and implementation fidelity of IPTp-Sp as delivered by ANC providers. This objective was analysed using a univariable and multivariable logistic regression.

2.8.4.1 Outcome variable for logistic regression analysis

The outcome variable was the categorised fidelity score variable already created and explained in section 2.7.3.3. The fidelity score was categorised into high (>=3 fidelity instances) and low (<3 fidelity instances). Thus, the outcome variable was binary.

2.8.4.2 Univariable logistic regression

A univariable logistic regression was performed to estimate the association between the level of fidelity of IPTp-Sp score and participant characteristics. The explanatory variables were all socio-demographic variables as well as all clinical variables obtained during data collection. The logistic regression analysis was adjusted for the random effect of health facility by using the cluster option in Stata to specify health facility as the cluster variable. For the univariable logistic regression, the outcome variable was regressed on each of the explanatory variables to estimate the unadjusted or crude odds ratios (COR), p-values and their corresponding 95% confidence intervals (CI).

2.8.4.3 Multivariable logistic regression and model selection

The automated stepwise regression was used to select models for consideration in terms of selecting a final model. The automated stepwise selection of significant covariates involved performing both forward and backward stepwise selection on all the explanatory variables setting a liberal p-value of <0.10. However, the manual addition and dropping of explanatory variables was also performed to obtain different sets of models. Selection of the final model was based on the goodness of fit test, the area under the receiver operating characteristic curve (AUROC) and the Akaike's Information Criterion (AIC) of the models. The adjusted odds ratios (AOR), p-values and 95% confidence intervals were estimated and reported.

2.8.5 The analysis of objective 3: Indirect association between participant characteristics and implementation fidelity score of IPTp-Sp.

The third objective of the study was to estimate the indirect association or effects of participant characteristics on implementation fidelity. The purpose was to overcome the weakness in the direct logistic effects model which does not explore mediation between variables and their indirect effect on the outcome. The indirect association was analysed with a generalised structural equation model (GSEM). The GSEM was necessary considering the nature of the outcome variable which was binary with also some categorical explanatory variables. The variables used were the same as those used in the final multivariable logistic regression model, for both the outcome and explanatory variables. The direct GSEM model was explored first. The direct effects model was then followed by the indirect effect's mediation model. The main aim of the GSEM was to model the conceptual framework with the direct and indirect pathways.

2.8.5.1 Generalised structural equation model used to explore direct and indirect effects

A binary-outcome path analysis mediation model was fitted using the GSEM feature in Stata. The SEM builder was used to fit the model (37). The first step was to fit the direct effects of logistic regression pathways using the GSEM feature in Stata. The outcome variable was specified as a Bernoulli logit variable and paths were drawn from the explanatory variables to it (37). The explanatory variables were specified by default as gaussian identity variables (37). Afterwards, the indirect effects model was fitted. This involved drawing the paths among the explanatory variables in the path analysis model diagram. All estimations were performed by specifying health facility as the cluster variable to adjust for the random effect of health facility type. The final estimates generated were the un-exponentiated raw coefficients with their p values and 95% CI for both the direct and indirect relationships. The indirect effects were computed as the product of the coefficients along related pathways towards the main outcome (37). The total effects were calculated as a sum of the indirect and direct effects coefficients (37). The path analysis diagrams for both direct and indirect paths were saved and reported. This presented only significant pathways either direct or indirect.

3.0 CHAPTER THREE: RESULTS

3.1 Introduction

Chapter three presents the results of the study. Results are in order of the study objectives preceded by the background information. Thus, the first section presents information on the background characteristics of participants followed by results of the study objectives in chronological order. Results are mainly in the form of tables that show the value of estimates, frequencies and percentages. Some results are presented in the form of graphs and diagrams.

3.2 Background Characteristics

3.2.1 Socio-demographic characteristics of participants by Sub-District

A total of 355 women aged between 15 and 41 years participated in the study. These women had attended ANC between July 2016 and September 2017. Table 3.1 shows a summary of the socio-demographic characteristics of the study participants by sub-district. The socio-demographic variables presented are age-group, parity, gravidity, employment status, educational status, religion and marital status. Concerning age-group, the percentage of women in the various categories was evenly distributed by sub-district with minimal differences. This difference was not statistically significant. Participants from Lekpongunor sub-district had a significantly higher percentage (26%) of women without any form of education compared to the other two sub-districts. Also, women from Prampram subdistrict had a significantly higher percentage (93.7%) of employment status followed by Old-Ningo (69.9%). The percentage of Christians was similar among all three sub-districts and the association was not statistically significant. Concerning marital status, Prampram sub-district had a significantly higher percentage (57%) of unmarried women compared to the other two sub-districts, 35% for Old-Ningo and 30% for Lekpongunor.

Table 3:1: Socio-demographic characteristics of participants by Sub-District

Variable	Sub-District			P-values (Chi2)
	Prampram N (%)	Old-Ningo N (%)	Lekpongunor N (%)	
Age group				
15-19	53 (37.3)	65 (39.9)	21 (42)	0.970
20-34	46 (32.4)	51 (31.3)	14 (28)	
35+	43 (30.3)	47 (28.8)	15 (30)	
Education level				
Not educated	22 (15.5)	12 (7.4)	13 (26)	0.000
Basic education	58 (40.8)	112 (68.7)	28 (56)	
Post basic education	62 (43.7)	39 (23.9)	9 (18)	
Employment status				
Unemployed	9 (6.3)	49 (30.1)	20 (40)	0.000
Employed	133 (93.7)	114 (69.9)	30 (60)	
Religion				
Other religion	8 (5.6)	12 (7.4)	1 (2)	0.366
Christianity	134 (94.4)	151 (92.6)	49 (98)	
Marital status				
Not married	81 (57)	57 (35)	15 (30)	0.000
Married	49 (34.5)	55 (33.7)	13 (26)	
Cohabitating	12 (8.5)	51 (31.3)	22 (44)	

3.2.2 Clinical characteristics of participants by Sub-District

Table 3.2 presents the results of participants clinical characteristics by sub-district. In terms of early ANC attendance (first ANC in the first trimester), women from Prampram sub-district recorded a significantly higher percentage followed by Old-Ningo sub-district. Women from Prampram sub-district also recorded the lowest coverage in terms of late ANC attendance (first ANC in the third trimester) followed by Lekpongunor sub-district with Old-Ningo sub-district recording the highest percentage. Concerning the number of ANC visits made, however, women from Old-Ningo sub-district recorded a significantly higher percentage of 4 or more ANC visits during pregnancy followed by women in Prampram sub-district. For ANC

attendance made according to the WHO focused antenatal care (WHO-FANC) schedule, women from Prampram sub-district recorded the highest and statistically significant percentage compared to the other two sub-districts. Receipt of the optimal dose of IPT (3 or more) was statistically significantly higher for Prampram sub-district followed by Old-Ningo sub-district in terms of coverage and were all higher than that for Lekpongunor sub-district. Old-Ningo sub-district recorded the highest percentage of women with 2 or more children (multiparous) followed by Prampram and this association was not statistically significant. The percentages of gravidity types were similar among the sub-districts but the association was not statistically significant.

Table 3:2: Clinical characteristics of participants by Sub-District

Variable	Sub-District			P-values (Chi2)
	Prampram N (%)	Old-Ningo N (%)	Lekpongunor N (%)	
Parity				
Nullipara	43 (30.3)	44 (27)	15 (30)	0.888
Primipara	39 (27.5)	45 (27.6)	11 (22)	
Multipara	60 (42.3)	74 (45.4)	24 (48)	
Gravidity				
Primigravida	29 (20.4)	33 (20.2)	13 (26)	0.710
Secundigravida	39 (27.5)	37 (22.7)	10 (20)	
Multigravida	74 (52.1)	93 (57.1)	27 (54)	
Number of ANC visits				
<4	45 (31.7)	43 (26.4)	27 (54)	0.001
>=4	97 (68.3)	120 (73.6)	23 (46)	
Trimester of 1st ANC visit				
1st trimester	51 (35.9)	34 (20.9)	22 (44)	0.000
2nd trimester	87 (61.3)	98 (60.1)	21 (42)	
3rd trimester	4 (2.8)	31 (19)	7 (14)	
Number of ANC visits made one month apart				
<3	84 (59.2)	88 (54)	32 (64)	0.397
≥3	58 (40.8)	75 (46)	18 (36)	
ANC visits made according to WHO focused ANC schedule				
Only 1 in any trimester	8 (5.6)	37 (22.7)	16 (32)	0.000

At least 1 in any 2 trimesters	99 (69.7)	98 (60.1)	23 (46)	
At least 1 in all 3 trimesters	10 (7)	8 (4.9)	5 (10)	
WHO-FANC	25 (17.6)	20 (12.3)	6 (12)	
Number of IPT doses received during pregnancy				
Less than 3 doses	32 (22.5)	54 (33.1)	30 (60)	0.000
3 or more doses	110 (77.5)	109 (66.9)	20 (40)	

3.2.3 ANC attendance pattern

The bar graph in figure 3.1 shows information on the overall ANC attendance pattern throughout pregnancy by sub-district. The coverage at first ANC was 100%. The reason is that only women who had made at least one ANC visit were recruited for the study. After the first ANC visit, the subsequent ANC attendance declined consistently until the 9th visit. Thus, the highest number of ANC visits recorded by a participant was nine visits. Attendance frequencies for Old-Ningo sub-district were the highest at all ANC visits followed by Prampram.

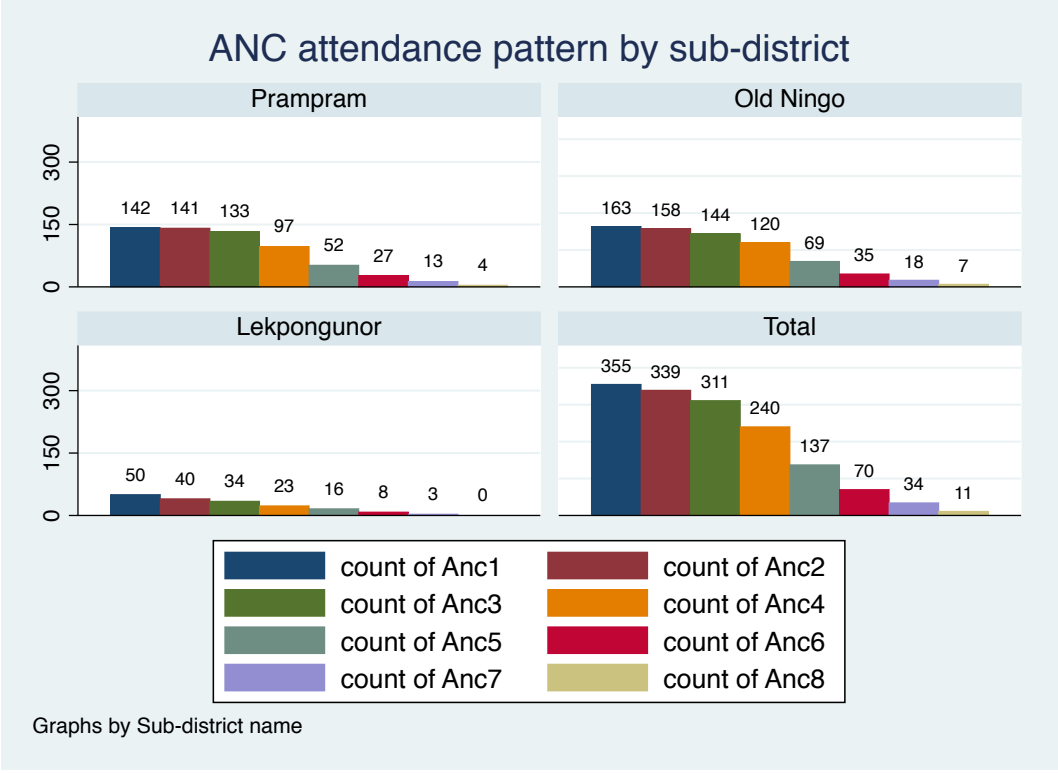


Figure 3.1: ANC attendance pattern of pregnant women by sub-District

3.2.4 IPTp-Sp receipt pattern

Figure 3.2 shows the IPTp-Sp receipt pattern. The results are provided by sub-district. IPTp-Sp receipt also declined consistently after the receipt of the first dose up to the 5th dose. Also,

the highest number of doses received by a participant was 5. Consistent with ANC attendance pattern in section 3.2.2, Old-Ningo sub-district generally recorded the highest frequencies in terms of pregnant women IPTp-Sp receipt.

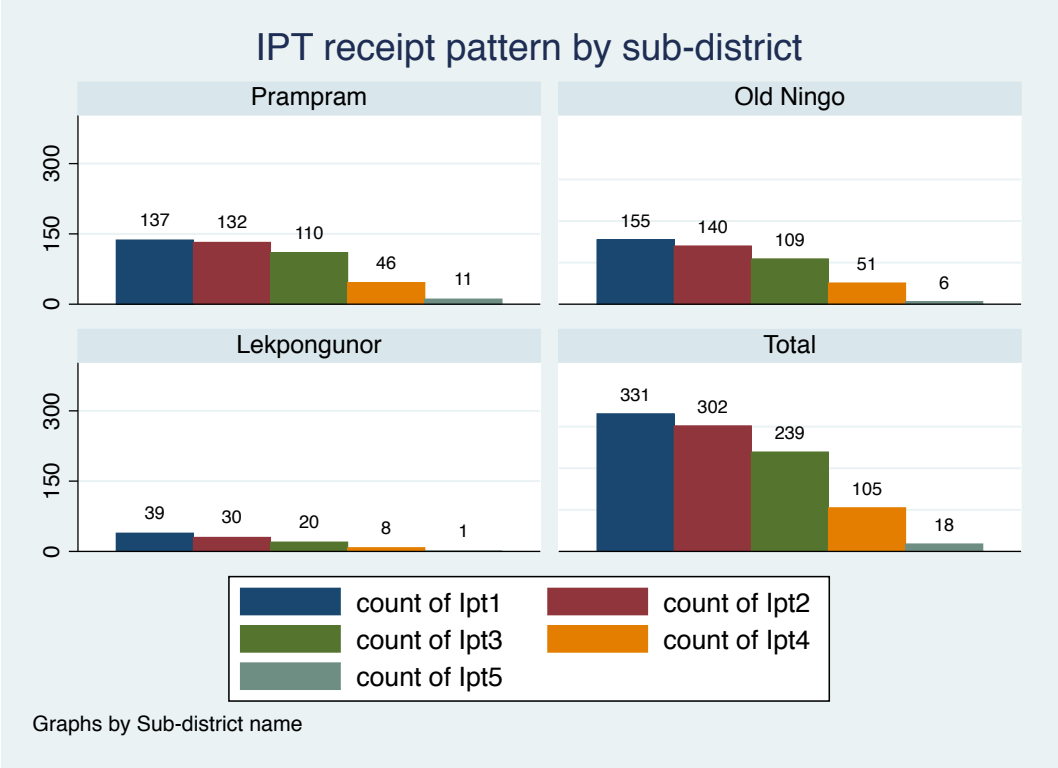


Figure 3.2: IPTp-Sp receipt pattern of pregnant women by sub-District

3.3 Implementation fidelity of IPTp-Sp by ANC providers

3.3.1 IPTp-Sp eligibility or qualification characteristics of pregnant women at ANC visits

The characteristics or conditions of pregnant women presented at ANC visits made them eligible or not to receive IPT as specified by the IPTp-Sp guidelines. Table 3.3 shows the results of these characteristics by ANC visit. IPTp-Sp exemption by clinical history includes pregnant women who attended ANC whiles with any of the following conditions: G6PD enzyme full or partial defect or status controversy, history of epileptic or seizure disorders, severe liver disease or unexplained recurrent jaundice, known allergy to any Sulphur containing drugs or allergy to Pyrimethamine and breastfeeding. As shown, at the first ANC visit, 3.1% of women presented with at least one of the exemption conditions by clinical history. This percentage declined to 0.73% at the 5th ANC visit. The mean number of days from a previous ANC visit (time interval

between ANC visits) was highest at ANC2 (42.93 (SD:±19.65)) and declined consistently up to 7.29 (SD: ± 3.50) days at the 9th ANC visit. Concerning the gestational age at ANC visit, the results show that most pregnant women attended ANC visit at a gestational age greater or equal to 13 weeks. However, between ANC1 and ANC4, some pregnant women attended ANC at a gestational age less than 13 weeks with the highest proportion being at ANC1. This attendance timing is not wrong, however, but IPT cannot be delivered at a gestational age less than 13 weeks according to the IPTp-Sp guideline for implementation.

Table 3:3: IPTp-Sp eligibility characteristics of pregnant women at ANC visits

Variable	N	Gestational age in weeks at ANC			Days elapsed from previous ANC visit	IPT exempt by clinical history
		Mean (SD)	Categories (N %)		Mean (SD)	(N %)
			<=12 weeks	>=13 weeks		
ANC1	355	16.79 (±7.40)	107 (30.14)	248 (69.68)	-	11 (3.1)
ANC2	339	22.75 (±6.88)	28 (8.26)	311 (91.74)	42.93 (±19.7)	11 (3.24)
ANC3	311	27.42 (±6.71)	9 (2.89)	302 (97.11)	34.98 (±14.9)	9 (2.89)
ANC4	240	30.68 (±6.35)	1 (0.42)	239 (99.58)	29.72 (±13.7)	6 (2.50)
ANC5	137	32.70 (±5.93)	0	137 (100)	23.36 (±11.8)	1 (0.73)
ANC6	70	33.44 (±5.35)	0	70 (100)	19.44 (±12.5)	0
ANC7	34	34.94 (±5.01)	0	34 (100)	14.12 (±10.0)	0
ANC8	11	36.27 (±3.64)	0	11 (100)	10.55 (± 5.28)	0
ANC9	7	38.29 (±3.73)	0	7 (100)	7.29 (±3.50)	0

3.3.2 IPTp-Sp eligibility characteristics of pregnant women at the time of IPT receipt

Table 3.4 presents information about pregnant women eligibility characteristics but at the time of IPT receipt. As shown, no pregnant woman received IPT having exhibited any of the exemption conditions by clinical status. In terms of gestational age, 12.39% of women who received IPT1 were delivered with IPT at a gestational age less than 13 weeks (in the first trimester). The highest percentage in terms of receipt of IPT in the first trimester was at the

first IPT stage. This percentage was 1.99% at IPT2 and 0.42% at IPT3. The mean number of days between a current IPT receipt and the previous was highest at IPT1 and declined for the subsequent stages of IPT. The standard deviations, however, show a possibility that some pregnant women received IPT doses at less than the recommended minimum monthly interval between doses.

Table 3:4: IPTp-Sp eligibility characteristics of pregnant women at the time of IPT receipt

Variable	N	Gestational age in weeks at IPT stages			Days elapsed from previous IPT receipt	IPT exempt by clinical history
		Mean (± SD)	Categories (N %)		Mean (± SD)	(N %)
			<=12 weeks	>=13 weeks		
IPT1	331	19.61 (±5.9)	41 (12.39)	290 (87.61)	-	0
IPT2	302	25.18 (±5.8)	6 (1.99)	296 (98.01)	41.18 (±17.3)	0
IPT3	239	29.52 (±5.5)	1 (0.42)	238 (99.58)	37.26 (±14.9)	0
IPT4	105	32.97 (±5.1)	0	105 (100)	34.69 (±11.7)	0
IPT5	18	34.56 (±5.5)	0	18 (100)	37.39 (±11.6)	0

3.3.3 Coverage of IPTp-Sp eligibility status of pregnant women

All the eligibility characteristics put together resulted in the determination of whether a pregnant woman qualified or was eligible to receive IPT or not. Figures 3.3, 3.4 and 3.5 show qualification to receive IPT coverage at the various stages of IPT and by sub-district. Most pregnant women were eligible to receive the first three doses of IPT. Thus, the eligibility coverage of IPT1, IPT2, IPT3 were high for all sub-districts. The highest coverage between IPT1 and IPT3 was recorded by Old-Ningo sub-district which recorded over 90% eligibility to receive IPT coverage at IPT1 and IPT2 and about 80% at IPT3. Eligibility to receive the 4th IPT and 5th IPT were relatively lower for all sub-districts. The highest coverage at IPT4 was recorded by Lekpongunor sub-district at 62.5%. At the 5th IPT, the highest coverage dropped to 39.02% for Old-Ningo sub-district and went as low as 14.29% for Lekpongunor sub-district. In terms of the overall qualification to receive IPT status, Old-Ningo subdistrict recorded the highest coverage at 81.44% followed by Prampram at 77.82% and Lekpongunor at 68.38%. The qualification status for all districts and all IPT stages combined was at 78.49%. Thus, in general, pregnant women qualified to receive IPT 78.49% of the time at all ANC visits.

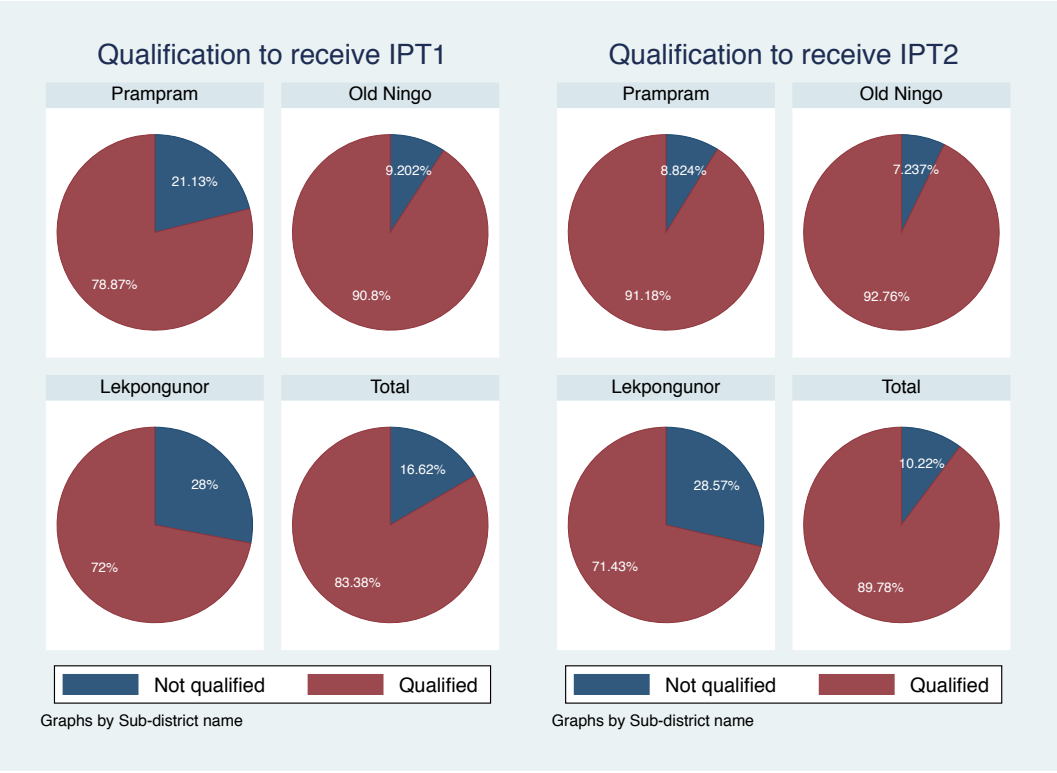


Figure 3.3: Coverage of qualification to receive IPT coverage at IPT1 and IPT2

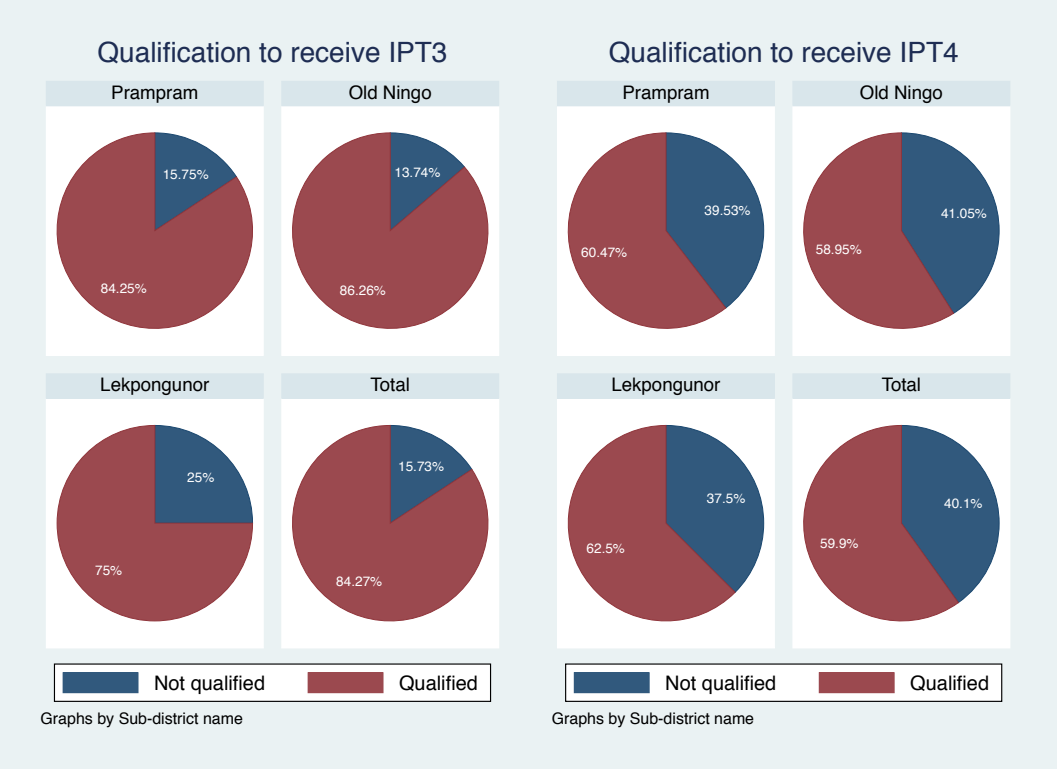


Figure 3.4: Coverage of qualification to receive IPT coverage at IPT3 and IPT4

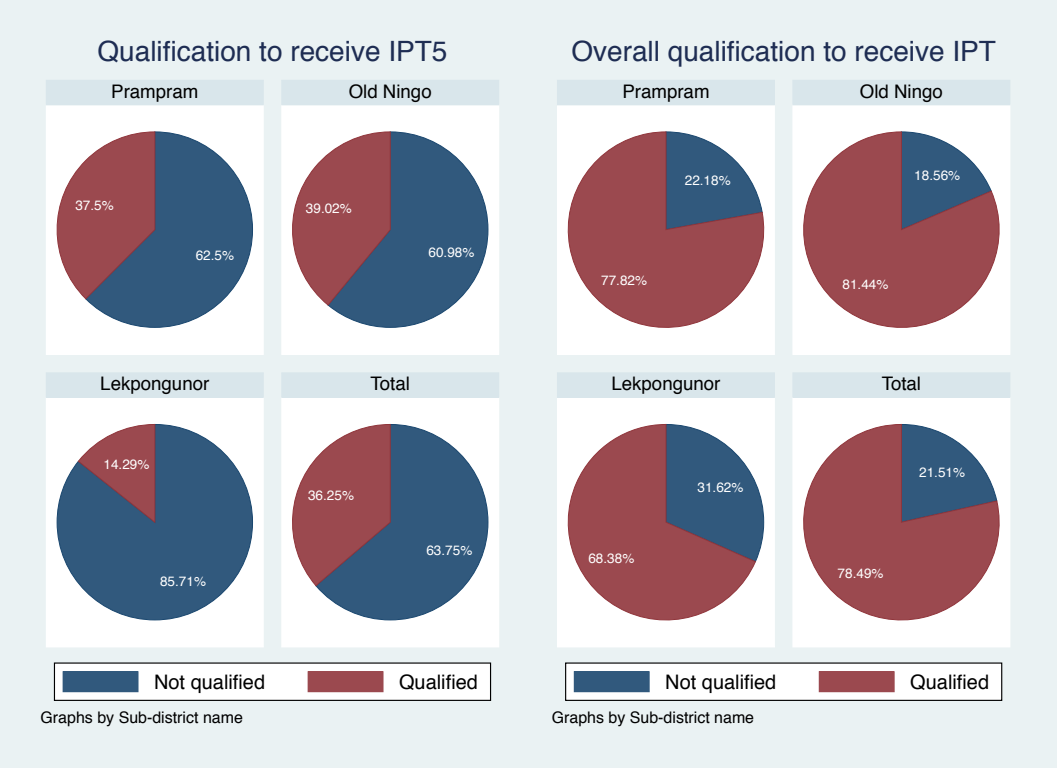


Figure 3.5: Coverage of qualification to receive IPT coverage at IPT5 and overall

3.3.4 Sensitivity and Specificity of IPTp-Sp delivery

Qualification or eligibility to receive IPT or not is one factor necessary for the ascertainment of fidelity. The other factor is whether the pregnant woman received IPT or not. Combining these two sets of information revealed essential detail about the IPTp-Sp delivery practices of ANC providers.

Table 3.5 to 3.10 presents information on the sensitivity and specificity of IPTp-Sp delivery. The PPV, NPV and the correctively classified delivery are also presented. Tables 3.5 to 3.9 present this information at IPT1, IPT2, IPT3, IPT4 and IPT5 respectively. Table 3.10 presents information on the overall IPT receipt.

The results show that, for the first three stages of IPT, the sensitivity of IPT delivery was high (all above 90%). Specificity was relatively low. Specificity was about 30% at IPT1, about 33% at IPT2 and about 64% at IPT3. In terms of sensitivity, this means that there was a higher chance that IPT was delivered to pregnant women who were eligible to receive at the first three stages of IPT. With specificity, however, this means that relatively, there was a lower

probability for ANC providers to refuse the delivery of IPT to pregnant women who were not eligible to receive. This practice was one of the bottlenecks in IPT delivery.

In terms of the overall levels (Table 3.10), sensitivity was generally high (92.61%) with low specificity (65.17%). The PPV (90.7%) was also very high and again with a relatively low NPV (70.7%). Thus generally, the high level of sensitivity means that there was a generally high level of IPT delivery to eligible women. There was however relatively low level of refusal to deliver IPT to non-eligible pregnant women by ANC providers.

Table 3:5: Sensitivity analysis at IPT1

	Did participant qualify to receive IPT 1?			
IPT 1 Received?	**No**	**Yes**	**Total**	
	N (%)	**N (%)**		**P-values (Chi2)**
No	18 (75)	6 (25)	24	0.000
Yes	41 (12.4)	290 (87.6)	331	
Total	59 (16.6)	296 (83.4)	355	

Sensitivity: 97.8%
Specificity: 30.5%
Positive predictive value: 87.6%
Negative predictive value: 75%
Correctly classified (Fidelity): 86.8%

Table 3:6: Sensitivity analysis at IPT2

	Did participant qualify to receive IPT 2?			
IPT 2 Received?	**No**	**Yes**		
	N (%)	**N (%)**		**P-values (Chi2)**
No	11 (52.4)	10 (47.6)	21	0.000
Yes	22 (7.3)	280 (92.7)	302	
Total	33 (10.2)	290 (89.8)	323	

Sensitivity: 96.6%
Specificity: 33.3%
Positive predictive value: 92.7%
Negative predictive value: 52.4%
Correctly classified (Fidelity): 90.1%

Table 3:7: Sensitivity analysis at IPT3

	Did participant qualify to receive IPT 3?			
IPT 3 Received?	**No**	**Yes**		
	N (%)	**N (%)**		**P-values (Chi2)**
No	29 (61.7)	18 (38.3)	47	0.000
Yes	16 (6.7)	223 (93.3)	239	
Total	45 (15.7)	241 (84.3)	286	

Sensitivity: 92.5%
Specificity:64.4%
Positive predictive value: 93.3%
Negative predictive value: 61.7%
Correctly classified (Fidelity): 88.1%

Table 3:8: Sensitivity analysis at IPT4

	Did participant qualify to receive IPT 4?			
IPT 4 Received?	**No**	**Yes**		
	N (%)	**N (%)**		**P-values (Chi2)**
No	67 (72.8)	25 (27.2)	92	0.000
Yes	12 (11.4)	93 (88.6)	105	
Total	79 (40.1)	118 (59.9)	197	

Sensitivity: 78.8%
Specificity: 84.8%
Positive predictive value: 88.6%
Negative predictive value: 72.8%
Correctly classified (Fidelity): 81.2%

Table 3:9: Sensitivity analysis at IPT5

	Did participant qualify to receive IPT 5?			
IPT 5 Received?	**No**	**Yes**	**Total**	
	N (%)	**N (%)**		**P-values (Chi2)**
No	49 (79)	13 (21)	62	0.000
Yes	2 (11.1)	16 (88.9)	18	
Total	51 (63.7)	29 (36.2)	80	

Sensitivity: 55.17%
Specificity: 96.08%
Positive predictive value: 88.9%
Negative predictive value: 79%
Correctly classified (Fidelity): 81.25%

Table 3:10: Overall Sensitivity analysis of IPT receipt

Overall	**Did participant qualify to receive IPT?**			
IPT Received?	**No**	**Yes**	**Total**	
	N (%)	**N (%)**		**P-values (Chi2)**
No	174 (70.7)	72 (29.3)	246	0.000
Yes	93 (9.3)	902 (90.7)	995	
Total	267 (21.5)	974 (78.5)	1241	

Sensitivity: 92.61%
Specificity: 65.17%
Positive predictive value: 90.7%
Negative predictive value: 70.7%
Correctly classified (Fidelity): 86.70%

3.3.5 Implementation fidelity coverage of IPTp-Sp delivery

The delivery of IPTp-Sp with fidelity involves delivery to those who qualified or were eligible to receive as well as refusal to deliver IPT to those who did not qualify to receive.

Figures 3.6, 3.7 and 3.8, present the implementation fidelity coverage at the various stages of IPT delivery. The overall implementation fidelity of IPTp-Sp was above 80% at all stages of IPT. It, however, increased with increasing IPT stage up to IPT3 and then decreased slightly to 81.2% at IPT5. Thus, the lowest level of fidelity was at the 4th, and 5th IPT (81.2%) and the highest was at the 2nd IPT stage (90.1%). The overall level of implementation fidelity of IPTp-Sp was 86.7%. Thus, in terms of adherence to the components of the IPT guidelines, ANC providers adhered or followed the guidelines or delivered IPTp-Sp with fidelity in 86.7% of all instances when they had the opportunity to deliver IPT.

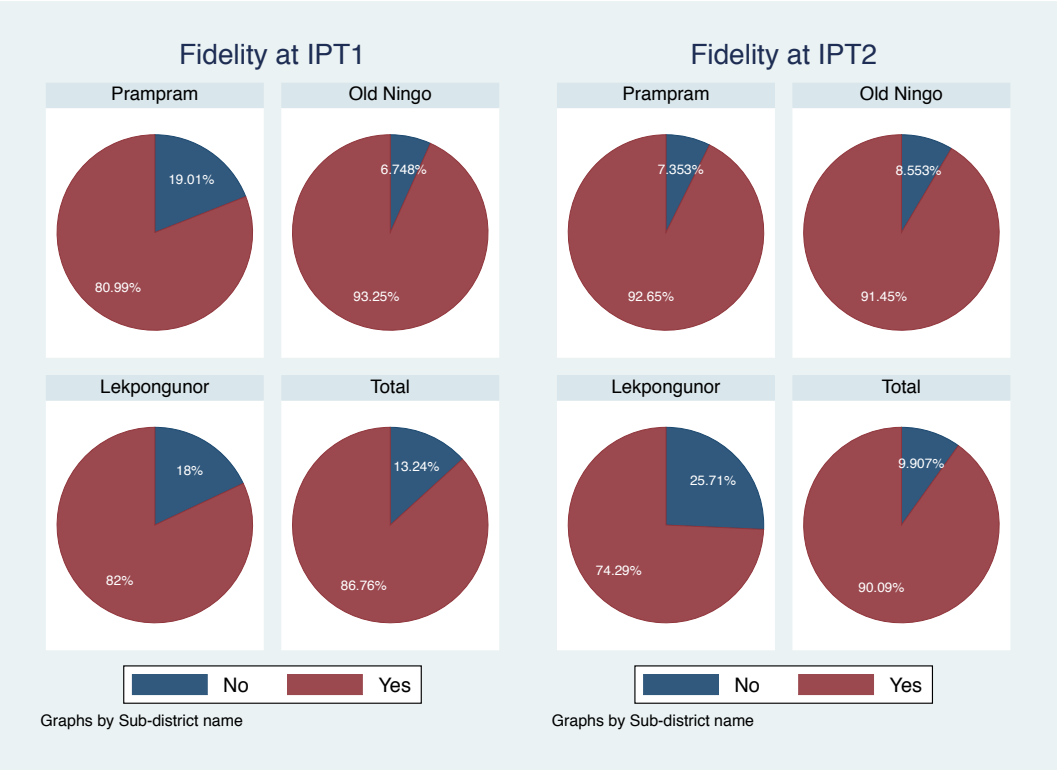


Figure 3.6: Implementation fidelity coverage at IPT1 and IPT2 by subdistrict

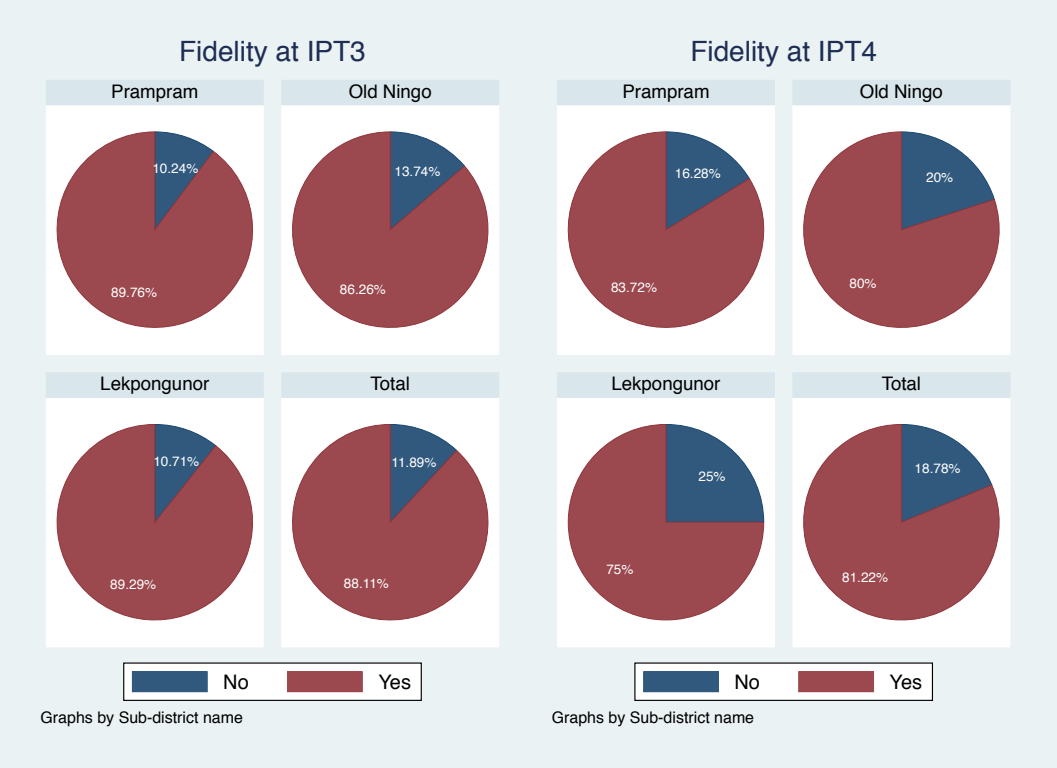


Figure 3.7: Implementation fidelity coverage at IPT3 and IPT4 by subdistrict

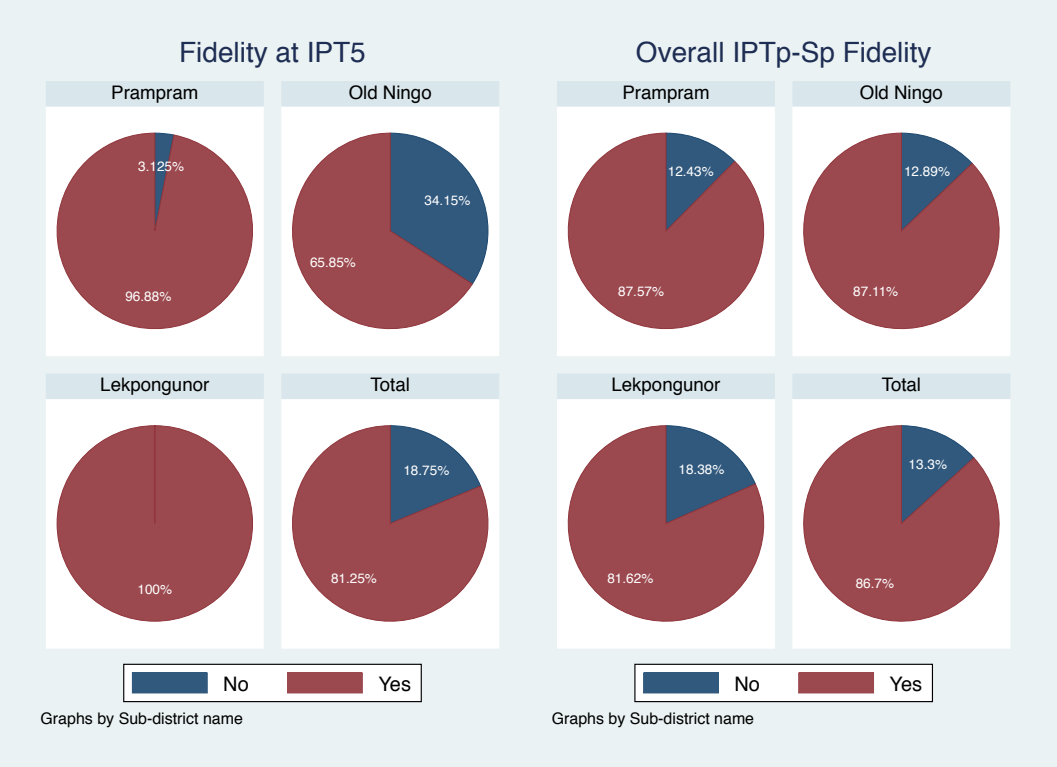


Figure 3.8: Implementation fidelity coverage at IPT5 and overall IPT by sub-district

3.3.6 The bottlenecks in implementation fidelity

Implementation fidelity was at 86.7%. The coverage is below 100% or full implementation fidelity coverage. The difference of 13.3% (N=165) between full fidelity coverage and the actual coverage is a representation of the gaps in the delivery of IPTp-Sp by ANC providers. This 13.3% also represents the discordant pairs in the sensitivity, specificity and the fidelity analysis. The discordant pairs include pregnant women who qualified to receive IPT but did not receive as well as those who received IPT being ineligible to receive. Figure 3.9 presents the proportions in terms of the breakdown of the non-adherence component.

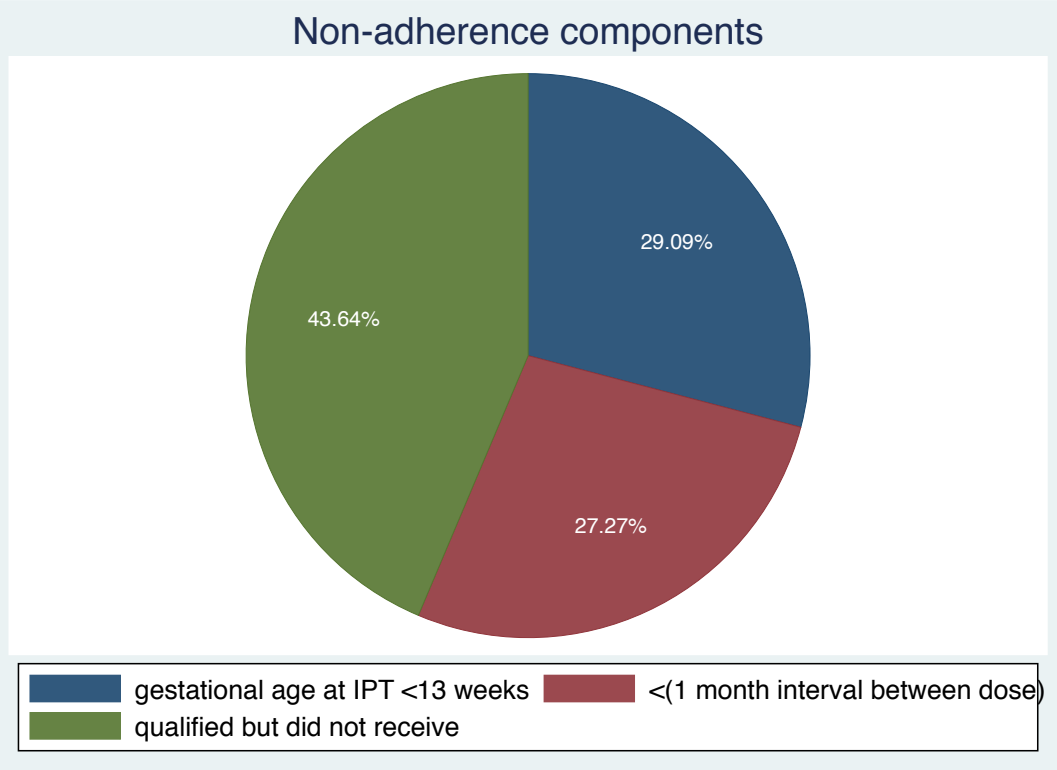


Figure 3.9: Non-adherence component of IPTp-Sp delivery

As shown in figure 3.9, a large proportion of the non-adherence components was the failure by ANC providers to deliver IPT to pregnant women who qualified to receive when they made ANC visits (43.64%). The remaining proportion was distributed evenly between delivery of IPT within the first trimester of gestation and the delivery of IPT at a time interval less than one month after a previous dose.

3.4 The direct association between participant characteristics and implementation fidelity of IPTp-Sp

3.4.1 Outcome Variable for logistic regression (Implementation fidelity score)

The outcome variable for the logistic regression analysis was the fidelity score of IPTp-Sp. Every pregnant woman throughout pregnancy had a total number of times when IPTp-Sp service was delivered with fidelity. This number of times was calculated as the fidelity score. Each woman had either zero, one, two, three, four or five instances where ANC providers delivered IPTp-Sp to them with fidelity. These were categorised into high (>=3 instances) and low (<3 instances).

Figure 3.10 shows the fidelity scores categorised into high level (3 or more instances) and low level (less than three instances). This categorised fidelity score was used as the outcome variable for the logistic regression. The overall proportion of women with high fidelity score was 68.17%.

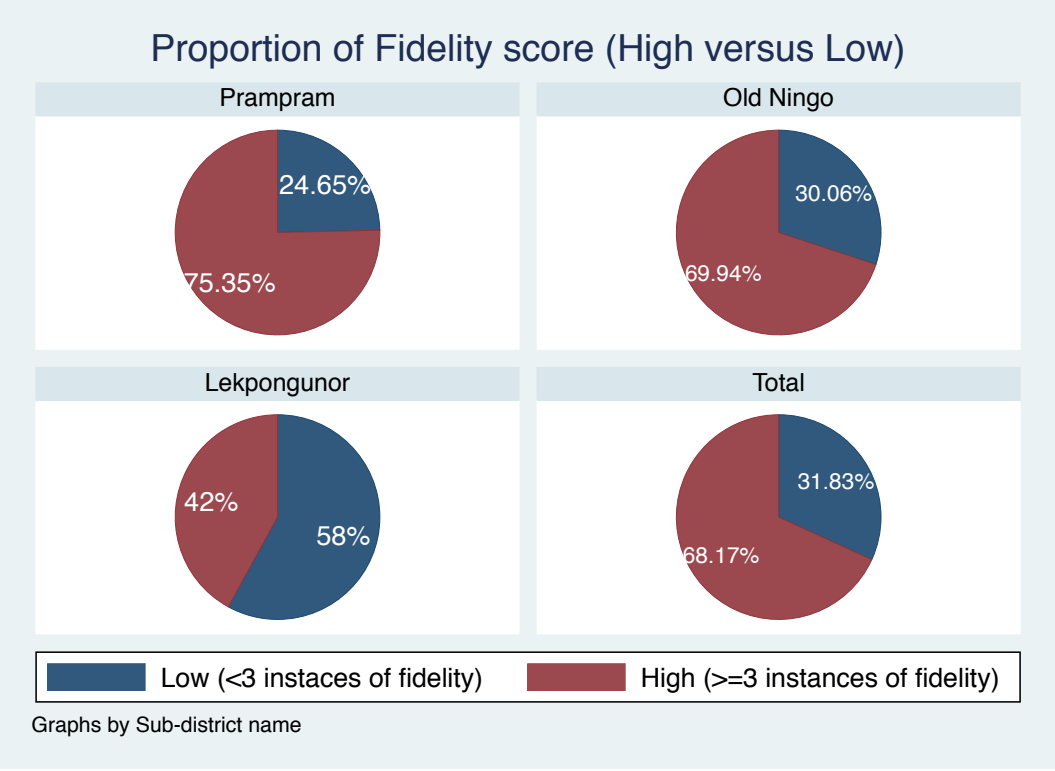


Figure 3.10: Level of fidelity of IPTp-Sp score by sub-district

3.4.2 Univariable logistic regression of implementation fidelity score on pregnant women characteristics

The univariable logistic regression results showed that 5 out of the 11 explanatory variables were significantly associated with high implementation fidelity score of IPTp-Sp. The significant determinants of high implementation fidelity score were: age group (20-34) compared to (15-19) (OR = 1.30, p-value = 0.007), being employed compared to being unemployed (OR = 1.93, 95%, p-value = 0.000), making four or more ANC visits during pregnancy compared to making less than four during pregnancy (OR = 5.20, 95%, p-value = 0.000). Other significant determinants included making three or more ANC visits at minimum monthly intervals compared to making less than 3 ANC visits at minimum monthly intervals during pregnancy (OR = 3.58, p-value = 0.000) and attending ANC visit according to WHO-FANC model compared to not attending ANC according to the WHO-FANC model (OR = 7.41, p = 0.000). Table 3.11 shows the results.

Table 3:11: Univariable logistic regression of implementation fidelity score on pregnant women characteristics

	Univariable Logistic regression			
	Low (fidelity instances<3)	**High (≥3fidelity instances)**		
Variable	**N (%)**	**N (%)**	**OR (95% CI)**	**P-value**
Age group			1 (ref)	
15-19	48 (42.5)	91 (37.6)		
20-34	32 (28.3)	79 (32.6)	1.30 (1.166,1.454)	0.007
35+	33 (29.2)	72 (29.8)	1.15 (0.580,2.283)	0.688
Education level				
Not educated	18 (15.9)	29 (12)	1 (ref)	
Basic education	64 (56.6)	134 (55.4)	1.30 (0.774,2.182)	0.322
Post basic education	31 (27.4)	79 (32.6)	1.58 (0.836,2.993)	0.159
Employment status				
Unemployed	34 (30.1)	44 (18.2)	1 (ref)	
Employed	79 (69.9)	198 (81.8)	1.93 (1.392,2.694)	0.000
Religion				

Other religion	3 (2.7)	18 (7.4)	1 (ref)	
Christianity	110 (97.3)	224 (92.6)	0.34 (0.100,1.158)	0.084
Marital status				
Not married	45 (39.8)	108 (44.6)	1 (ref)	
Married	36 (31.9)	81 (33.5)	0.94 (0.581,1.512)	0.791
Cohabitating	32 (28.3)	53 (21.9)	0.69 (0.333,1.429)	0.318
Parity				
Nullipara	36 (31.9)	66 (27.3)	1 (ref)	
Primipara	28 (24.8)	67 (27.7)	1.31 (0.997,1.708)	0.053
Multipara	49 (43.4)	109 (45)	1.21 (0.826,1.783)	0.325
Gravidity				
Primigravida	25 (22.1)	50 (20.7)	1 (ref)	
Secundigravida	28 (24.8)	58 (24)	1.036 (0.595,1.804)	0.901
Multigravida	60 (53.1)	134 (55.4)	1.117 (0.692,1.802)	0.651
Number of ANC visits				
<4	65 (57.5)	50 (20.7)	1 (ref)	
>=4	48 (42.5)	192 (79.3)	5.20 (3.747,7.216)	0.000
Trimester of 1st ANC visit				
1st trimester	44 (38.9)	63 (26)	1 (ref)	
2nd trimester	54 (47.8)	152 (62.8)	1.97 (0.860,4.496)	0.109
3rd trimester	15 (13.3)	27 (11.2)	1.26 (0.623,2.537)	0.523
Number of ANC visits made one month apart				
<3	87 (77)	117 (48.3)	1 (ref)	
≥3	26 (23)	125 (51.7)	3.58 (2.763,4.626)	0.000
ANC visits made according to WHO FANC schedule				
Only 1 in any trimester	33 (29.2)	28 (11.6)	1 (ref)	
At least 1 in any 2 trimesters	64 (56.6)	156 (64.5)	2.84 (1.638,5.038)	0.000
At least 1 in all 3 trimesters	9 (8)	14 (5.8)	1.83 (0.693,4.853)	0.222
WHO-FANC	7 (6.2)	44 (18.2)	7.41 (2.838,19.34)	0.000

3.4.2 Multivariable logistic regression of implementation fidelity score on pregnant women characteristics.

Table 3.12 presents the results of the final logistic regression model. Five explanatory variables were significantly associated with a high level of implementation fidelity of IPTp-Sp score. Concerning employment status, women who were employed were over two times more likely to have a higher level of implementation fidelity score as delivered by ANC providers compared to those who were unemployed (OR = 2.36, p-value=0.000). Women who had more than one birth (multiparous) were more likely to have a higher level of implementation fidelity score as delivered by ANC providers compared to women who had never given birth (nulliparous) (OR = 1.75, p-value=0.000). Concerning gravidity, however, multigravida women were about 50% less likely to have a higher level of implementation fidelity score compared to primigravida women (OR = 0.51, p-value=0.001).

Concerning ANC attendance, women who made 4 or more ANC visits during pregnancy were over four times more likely to have a higher level of implementation fidelity score as delivered by ANC providers compared to those who made less than 4 ANC visits during pregnancy (OR = 4.73, p=0.000). For ANC attendance pattern, women who made their ANC attendance according to WHO-FANC schedule were over two times more likely to have a higher level of implementation fidelity compared to those who did not (made only one ANC visit). This association was however only significant at 10% significance level (OR = 2.64, p=0.082).

Table 3:12: *Multivariable logistic regression of implementation fidelity score on pregnant women characteristics*

	Multivariable Logistic regression			
	Low (fidelity instances<3)	**High (≥3 fidelity instances)**		
Variable	**N (%)**	**N (%)**	**OR (95% CI)**	**p-value**
Employment status				
Unemployed	34 (30.1)	44 (18.2)	1 (ref)	
Employed	79 (69.9)	198 (81.8)	2.36 (1.795,3.093)	0.000
Parity				
Nullipara	36 (31.9)	66 (27.3)	1 (ref)	

Primipara	28 (24.8)	67 (27.7)	1.71 (0.725,4.050)	0.219
Multipara	49 (43.4)	109 (45)	1.75 (1.339,2.283)	0.000
Gravidity				
Primigravida	25 (22.1)	50 (20.7)	1 (ref)	
Secundigravida	28 (24.8)	58 (24)	0.55 (0.248,1.199)	0.131
Multigravida	60 (53.1)	134 (55.4)	0.51 (0.341,0.759)	0.001
Number of ANC visits				
<4	65 (57.5)	50 (20.7)	1 (ref)	
>=4	48 (42.5)	192 (79.3)	4.73 (3.671,6.088)	0.000
ANC visits made according to WHO FANC schedule				
Only 1 in any trimester	33 (29.2)	28 (11.6)	1 (ref)	
At least 1 in any 2 trimesters	64 (56.6)	156 (64.5)	1.90 (1.105,3.279)	0.020
At least 1 in all 3 trimesters	9 (8)	14 (5.8)	0.81 (0.422,1.539)	0.514
WHO-FANC	7 (6.2)	44 (18.2)	2.64 (0.885,7.880)	0.082
Model goodness of fit statistics				
Hosmer-Lemeshow Gof (p-value)			0.7129	
AUROC			0.7446	
AIC			388.8749	

3.5 Indirect association between participant characteristics and implementation fidelity score

3.5.1 GSEM direct effects of participant characteristics on the fidelity score of IPTp-Sp.

Figure 3.11 shows the direct path analysis diagram of the GSEM analysis. The explanatory variables are the same as used for the multivariable logistic regression model. Results of the direct effects are presented in Table 3.13. Just as was revealed in the multivariable logistic regression model, five variables had a statistically significant direct effect on the level of fidelity score. These were the same variables in the multivariable logistic regression model that was significant. Being employed had a positive direct effect on implementation fidelity score compared to being unemployed. Having more than one births (multiparous) had a

positive direct effect on implementation fidelity score compared to having no birth (nulliparous). Also, having a multiple pregnancy experience (multigravida) had a negative direct effect on implementation fidelity score compared to having the first pregnancy experience (primigravida). Making 4 or more ANC visits during pregnancy had a positive direct effect on the level of implementation fidelity score compared to making less than 4 ANC visits during pregnancy. For ANC attendance pattern, attending ANC according to WHO-FANC schedule had a positive direct effect on implementation fidelity compared to those who did not (made only one ANC visit). However, this was only significant at the 10% significance level.

The disadvantage of this direct effects model is that it fails to show the inter-association and the mediation effect between explanatory variables and how this inter-relationship affects the outcome variable ultimately. The indirect model presented in the ensuing sub-section deals with this shortfall.

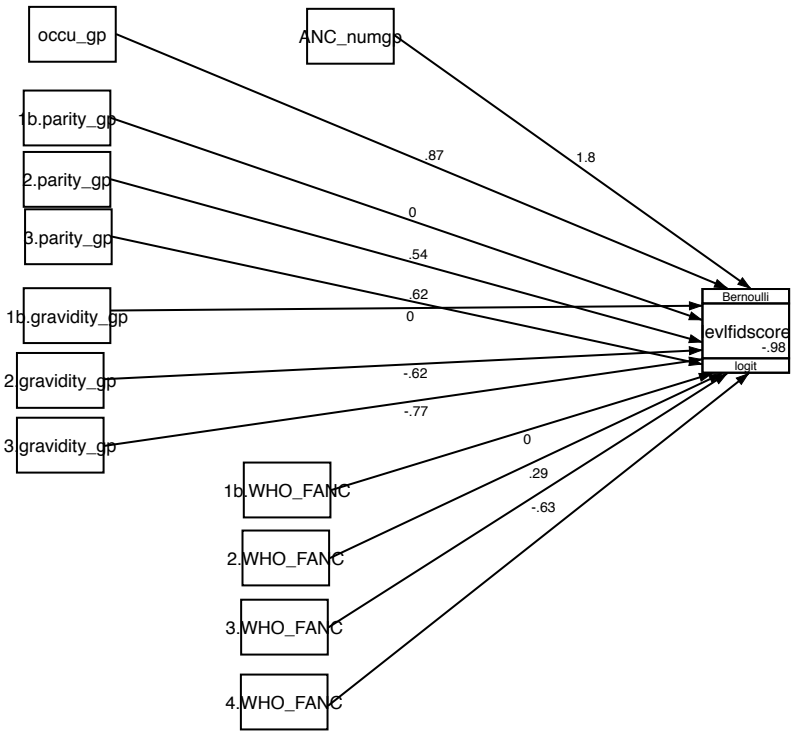


Figure 3.11: GSEM path analysis *(GSEM direct effects of participant characteristics on the fidelity score of IPTp-Sp).*

*The key for variable names: employed versus unemployed (**occu_gp**), primipara versus nullipara (**2. parity_gp**), multipara versus nullipara **3.parity_gp**), Secundigravida versus primigravida (**2.gravidity_gp**) , multigravida versus primigravida (**3.gravidity_gp**), at least 1 ANC in any 2 trimesters versus only 1 ANC visit in any trimester (**2.WHO_FANC**), at least 1 ANC visit in all 3 trimesters versus only 1 ANC visit in any trimester (**3.WHO_FANC**), at least 1 ANC visit in 1st trimester and 1 is the 2nd trimester and 2 in 3rd trimester versus only 1 ANC visit in any trimester (**4.WHO_FANC**). 4 or more ANC visits during pregnancy compared to less than 4 (**ANC_numgp**), high fidelity score compared to low fidelity score (**levlfidscore**)*

Table 3:13: GSEM estimates (GSEM direct effects of participant characteristics on the fidelity score of IPTp-Sp)

	GSEM (Direct effects)				
	Low (fidelity instances<3)	**High (≥3 fidelity instances)**			
Variable	**N (%)**	**N (%)**	**Coefficient (95% CI)**	**Exponentiated Odds (95% CI)**	**p-value**
Employment status					
Unemployed	34(30.1)	44(18.2)	1(ref)	1(ref)	
Employed	79(69.9)	198(81.8)	0.857 (0.585,1.129)	2.36 (1.795,3.093)	0.000
Parity					
Nullipara	36(31.9)	66(27.3)	1(ref)	1(ref)	
Primipara	28(24.8)	67(27.7)	0.539 (-0.321,1.399)	1.71 (0.725,4.050)	0.219
Multipara	49(43.4)	109(45)	0.558 (0.292,0.825)	1.75 (1.339,2.283)	0.000
Gravidity					
Primigravida	25(22.1)	50(20.7)	1(ref)	1(ref)	
Secundigravida	28(24.8)	58(24)	0.606 (-1.394,0.182)	0.55 (0.248,1.199)	0.131
Multigravida	60(53.1)	134(55.4)	-0.67 (-1.076, -0.276)	0.51 (0.341,0.759)	0.001
Number of ANC visits					
<4	65(57.5)	50(20.7)	1(ref)	1(ref)	
>=4	48(42.5)	192(79.3)	1.55 (1.300,1.806)	4.73 (3.671,6.088)	0.000

ANC visits made according to WHO FANC schedule					
Only 1 in any trimester	33(29.2)	28(11.6)		1(ref)	1(ref)
At least 1 in any 2 trimesters	64(56.6)	156(64.5)	0.64 (0.0995,1.188)	1.90 (1.105,3.279)	0.020
At least 1 in all 3 trimesters	9(8)	14(5.8)	-0.22 (0.862,0.431)	0.81 (0.422,1.539)	0.514
WHO-FANC	7(6.2)	44(18.2)	0.97 (-0.122,2.064)	2.64 (0.885,7.880)	0.082
Goodness of fit statistics					
AIC			388.8749		
BIC			404.3634		

3.5.2 Indirect effects of participant characteristics on implementation fidelity score of IPTp-Sp by ANC providers

The indirect path analysis diagram is presented in figure 3.12. The corresponding results are presented in Table 3.14. All explanatory variables have been drawn to the outcome variable indirectly through the number of ANC visits (4 or more). Thus, there are four main indirect paths in this model all mediating through the number of ANC visits made. These are the indirect paths between employment status, marital status, parity, ANC attendance according to the WHO-FANC schedules each through the number of ANC visits made to the level of fidelity score. Thus, the number of ANC visits made during pregnancy is modelled as the intermediate variable in all indirect paths.

The results show that four variables had a statistically significant indirect effect on the level of fidelity score. Being multiparous, had a negative indirect effect on the level of fidelity score (coefficient -0.17, p=0.000) compared to being nulliparous. Also, having a history of multiple pregnancies (multigravida) had a positive indirect effect on the level of fidelity score compared to having only one pregnancy history (coefficient 0.27, p=0.000). Thirdly, attending ANC visits according to WHO-FANC module had a positive indirect effect on the level of fidelity score compared to not doing so (coefficient 1.12, p=0.000). Fourthly, a multigravida status had a positive indirect effect on the level of fidelity score compared to a primigravida status.

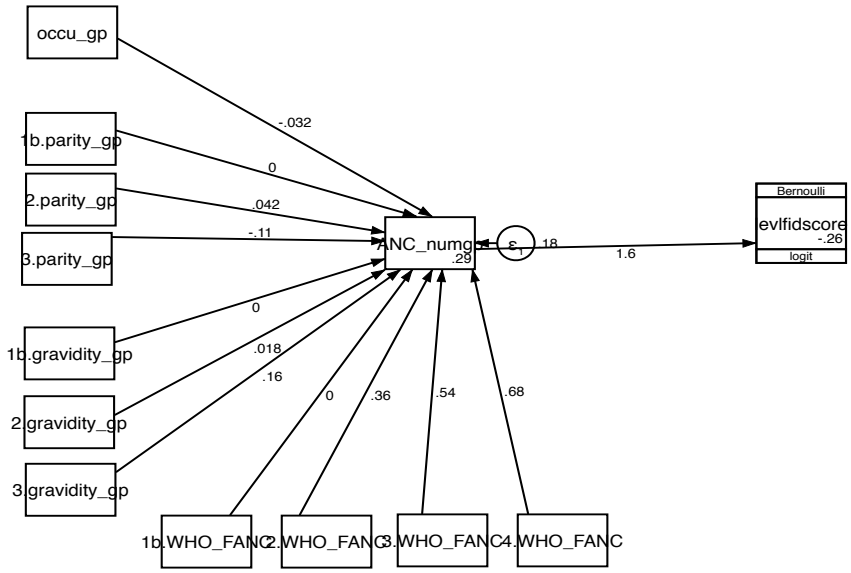


Figure 3.12: GSEM path analysis diagram (GSEM indirect effects of participant characteristics on the fidelity score of IPTp-Sp)

*Key for variable names: employed versus unemployed (**occu_gp**), primipara versus nullipara (**2. parity_gp**), multipara versus nullipara **3.parity_gp**), Secundigravida versus primigravida (**2.gravidity_gp**) , multigravida versus primigravida (**3.gravidity_gp**), at least 1 ANC in any 2 trimesters versus only 1 ANC visit in any trimester (**2.WHO_FANC**), at least 1 ANC visit in all 3 trimesters versus only 1 ANC visit in any trimester (**3.WHO_FANC**), at least 1 ANC visit in 1st trimester and 1 is the 2nd trimester and 2 in 3rd trimester versus only 1 ANC visit in any trimester (**4.WHO_FANC**),4 or more ANC visits during pregnancy compared to less than 4 (**ANC_numgp)** , high fidelity score compared to low fidelity score **(levlfidscore)***

3.5.3 The total effects of participant characteristics on implementation fidelity score of IPTp-Sp by ANC providers.

The total effect is the combined effect of the direct and indirect estimates. Results of the total effects are presented in Table 3.14.

The results show that five variables had a statistically significant total effect on the level of fidelity score. Being multiparous, had a negative total effect on the level of fidelity score (coefficient 0.50, p=0.000) compared to being nulliparous. Also, having a history of multiple pregnancies (multigravida) had a negative total effect on the level of fidelity score compared to having only one pregnancy history (coefficient -0.79, p=0.001). Attending ANC visits according to WHO-FANC module had a positive marginally significant total effect on the level

of fidelity score compared to not doing so (coefficient 1.63 p=0.079). Being employed had a total positive total effect on the level of fidelity score compared to being unemployed (coefficient 0.83 p=0.000).

In considering the findings of the GSEM models, it is important to note that the direct GSEM model is a better model in terms of model quality compared to the indirect effects GSEM model. The AIC and BIC post estimation statistics are better for the direct GSEM model compared to the indirect GSEM model.

Table 3:14: GSEM estimates (Direct, Indirect and total effects of participant characteristics on Implementation fidelity)

Variable	Direct Effects (coefficient (p value))			Indirect Effects (coefficient (p value))	Total Effects (coefficient (p value))
	4 or more ANC visits	3 or more visits made at 1-month intervals	WHO-FANC model	Level of fidelity(high) (outcome)	Level of fidelity(high) (outcome)	Level of fidelity(high) (outcome)
Employment Status						
Unemployed	ref			ref	ref	ref
Employed	-0.03 (0.203)			0.857*** (0.000)	-0.05 (0.219)	0.83 (0.000)
Parity						
Nullipara	ref			ref	ref	ref
Primipara	0.04 (0.417)			0.539 (0.219)	0.07 (0.415)	0.56 (0.197)
Multipara	-0.11 (0.001) **			0.558*** (0.000)	-0.17 (0.000))	0.50 (0.000) ***
Gravidity						
Primigravida	ref			ref	ref	ref
Secundigravida	0.018 (0.718)			-0.606 (0.131)	0.03 (0.709)	-0.62 (0.133)
Multigravida	0.16 (0.007) *			-0.676*** (0.001)	0.27 (0.000)	-0.79 (0.001)
Number of ANC visits made						
Less than 4	ref			ref		ref

4 or more		1.55*** (0.000)		
ANC visits made according to WHO-FANC model				
Only 1 in any trimester		ref		ref
At least 1 in any 2 trimesters	0.35 (0.000) ***	0.64* (0.020)	0.59 (0.002)	0.87 (0.030)
At least 1 in all 3 trimesters	0.54 (0.000) ***	-0.22 (0.514)	0.89 (0.001)	-0.33 (0.496)
WHO-FANC	0.68 (0.000) ***	0.971 (0.082)	1.12 (0.000)	1.63 (0.079)
The goodness of fit statistics	**Direct GSEM model**		**Indirect GSEM model**	
AIC	388.8749		800.5878	
BIC	404.3634		816.0763	

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

Indirect effects computed as the product of coefficients along related pathways towards the main outcome.

Total effects computed as the sum of direct and indirect effects.

4.0 CHAPTER FOUR: DISCUSSION CONCLUSION AND RECOMMENDATIONS

4.1 Introduction

The aim of this study was to assess whether the delivery of IPTp-Sp by ANC providers to pregnant women in the Ningo-Prampram District of Ghana was done as prescribed by the Ghana IPTp-Sp intervention manual.

The primary objective of this study was therefore to evaluate the implementation fidelity of IPTp-Sp as delivered by ANC providers in the Ningo-Prampram District of Ghana. The level of implementation fidelity that was realized, revealed the bottlenecks and gaps in IPTp-Sp delivery by ANC providers. These bottlenecks formed a basis for recommendations for policy and further research.

This chapter also includes the study strengths and limitations as well as the conclusions based on the study findings.

4.2 Implementation fidelity of IPTp-Sp

The study found that implementation fidelity coverage was high at all stages of IPTp-Sp. The overall implementation fidelity of IPTp-Sp was 86.70%. Thus, in terms of IPTp-Sp guidelines adherence, ANC providers adhered to about 86% of the time when they encountered an opportunity to deliver IPTp-Sp to pregnant women. Implementation fidelity score was moderately high and not as high as the fidelity coverage. About 68% of pregnant women were delivered with IPTp-Sp with fidelity at least 3 times during pregnancy. Thus, 68% of pregnant women had a moderately high level of fidelity score. The estimates for fidelity coverage and the fidelity score indicate that the implementation of IPTp-Sp by ANC providers in the Ningo-Prampram District of Ghana seem to be relatively higher than as generally portrayed in the literature. Provider delivery or adherence to IPTp-Sp guidelines have been depicted in the literature with reports of large gaps between ANC attendance coverage and IPT receipt coverage. Thus, low coverage of IPTp-Sp has been reported in the literature with a relatively high ANC attendance coverage (2, 22, 23, 38, 39). However, gaps in ANC attendance coverage versus IPT receipt coverage are not enough to fully determine the delivery gaps in IPTp-Sp. This is because ANC attendance is only a necessary condition for the receipt of IPTp-Sp delivery with fidelity. The sufficient condition for IPTp-Sp delivery is the eligibility status of the pregnant woman with respect to IPTp-Sp implementation guidelines. The large gaps so

portrayed between ANC attendance coverage and IPT receipt coverage might not be a true reflection of the level of adherence to IPTp-Sp guidelines by ANC providers.

4.3 Sensitivity, Specificity and the bottlenecks in IPTp-Sp delivery by ANC providers

Even though implementation fidelity was revealed to be high in this study, overall implementation fidelity is not enough to fully assess adherence bottlenecks. Sensitivity and specificity analysis concerning IPTp-Sp delivery revealed bottlenecks in the delivery of IPTp-Sp by ANC providers. There was a generally high sensitivity (92.61%) and relatively low specificity (65.17%) of IPT delivery. The sensitivity of IPTp-Sp delivery was highest at the first three stages of IPT but declined at the last two stages. Also, specificity of IPTp-Sp delivery was lowest at the first two stages of IPT (all less than 35%). Thus generally, IPTp-Sp delivery was able, to a larger extent target pregnant woman who qualified or were eligible to receive IPT.

On the other hand, however, IPT delivery was not able to ignore those who were not eligible to receive IPT at that same extent. Thus, one of the main barriers to adherence is the delivery of IPT to pregnant women who were not eligible, and this should be a significant area to be addressed to improve effective IPTp-Sp delivery. The other barrier of adherence was the failure to deliver IPT to eligible pregnant women. These two barriers represent the non-adherence components of IPT delivery. Of the total non-adherence instances, 43.64% was the failure by ANC providers to deliver IPT to pregnant women who were eligible or qualified to receive. The other components of non-adherence involved delivery of IPT within the first trimester of gestation and also the delivery of IPT at a time interval less than one month after a previous dose. These were the bottlenecks in IPTp-Sp delivery, and these areas should be focused to improve IPTp-Sp delivery. These non-adherence components as revealed by this study, boarder more on the timing of IPTp-Sp delivery by ANC providers. This finding is consistent with a systematic review of interventions to prevent malaria in pregnancy in sub-Saharan Africa (26). The review focused on the factors that affect the delivery of these interventions (26). The review found that healthcare provider performance issues that affect the delivery of IPTp-Sp included confusion over the timing of each IPTp dose (26). The World Health Organisation also cites health care provider uncertainty about IPTp-Sp administration for IPTp-Sp as a delivery barrier and recommends the use of simplified IPTp messages and health worker training as proven solutions (21).

4.4 Participant characteristics and implementation fidelity of IPTp-Sp

The second and third objectives of the study were to find out whether pregnant women characteristics had an effect or association with implementation fidelity of IPTp-Sp by ANC providers. Both the direct, indirect and the total effects were explored. This objective was to find out whether the pregnant woman has a role to play concerning the receipt of IPTp-Sp services the right way and to reveal any possible discrimination of IPTp-Sp delivery by ANC providers.

This study found that provider delivery of IPTp-Sp with fidelity was influenced by a combination of factors at the level of the pregnant woman. These factors include employment status, parity, gravidity, number of ANC visits made as well as ANC visits made according to recommended schedules and timelines. Making 4 or more ANC visits during pregnancy had the most significant direct impact on being delivered with IPTp-Sp with fidelity. This finding is partly consistent with studies in sub-Saharan Africa and in Ghana that found an association between increased ANC visits during pregnancy and receipt of the optimal 3 or more doses of IPT (26, 40-42). In contrast to this study, the outcome variable of these studies in the literature was receipt of the optimal three doses of IPT irrespective of whether it was with fidelity or not. However, receipt or otherwise of IPT is a significant component of fidelity of IPT delivery, and hence these studies have something in common with this study howbeit not the same. Also, the employment status of pregnant women and increased parity (multiparous) had a direct influence on being delivered with IPTp-Sp with fidelity. Socioeconomic status of pregnant women, as well as increased parity, have also been found by studies to directly impact the receipt of an optimal dose of IPT during pregnancy (26).

With the indirect effects' analysis, the number of ANC visits was the mediating variable in all pathways. Being multiparous had a negative indirect effect on fidelity compared to being nulliparous. Thus, having more than one child reduces the overall effect on fidelity through the number of ANC visits made. Also, having a history of more than one pregnancy had a positive indirect effect on fidelity compared to first-timers. Thus, multiple pregnancy history worked positively to affect the receipt of IPT with fidelity through the number of ANC visits. ANC visits made according to WHO-FANC model had a positive indirect effect on fidelity. Regular ANC attendance according to the recommended schedule affects fidelity positively through the number of ANC visits. Thus, the underlying factor that influences ANC provider delivery is

the number of ANC visits. The number of ANC visits is then also influenced by other characteristics of the pregnant women. Interventions that seek to promote regular ANC attendance should consider parity, gravidity and ANC scheduling in their design.

4.5 Strengths and limitations of the study

The major strength of this study is the use of documented IPTp-Sp data as against reported IPTp-Sp data which some studies such as the Demographic and health survey (25). The source of information of the variables used for analysis in this study was the MHRB which contains documented information on maternal health services women receive including IPTp-Sp. The documented information is more likely to be accurate than self-reported data on ANC attendance and IPT receipt. Thus, the results of this study are a more accurate reflection of reality.

The additional strength of this study is that it measured the adherence to IPTp-Sp guidelines in a relatively fair manner compared to other studies that use only gaps in ANC attendance and IPT coverage to depict a reflection of IPT delivery (2, 22). This study incorporated other important variables to determine the eligibility of pregnant women to receive IPT and then compared it with whether or not they did receive IPT. Thus, adherence to IPTp-Sp guidelines as analysed in this study is more accurate and fairer to the ANC system. This study has therefore demonstrated a relatively better way of assessing the fidelity of delivery of IPTp-Sp by ANC providers. This method of assessing implementation fidelity can be applied to other healthcare interventions.

In considering the findings of implementation fidelity of IPT-Sp as reported by this study, it is important to note the following limitations. Some variables for the determination of exemption from IPT according to the guidelines were not available by reviewing the MHRB. These were severe anaemia during pregnancy, an acute case of malaria during pregnancy, blood dyscrasias (e.g. neutrophilia, thrombocytopenia) during pregnancy and recent treatment with a Sulphur-containing drug such as Co-trimoxazole (within four weeks). However, the magnitude of the effects of this limitation on the study estimates depends on the prevalence and incidence of these conditions in the pregnant women population in the Ningo-Prampram District as well as Ghana. In 2016, the prevalence of severe anaemia (Hb<7gm/dl) among pregnant women in the Ningo-Prampram District of Ghana was 0.74% at ANC registration and 0.36% at 36 weeks'

gestation (39). In 2017 it was 1.77% at ANC registration and 0.75% at 36 weeks' gestation (34). Thus, the prevalence of severe anaemia in the study population is very minimal, and the effects on study estimates would be minimal as well. Estimates for severe malaria in pregnancy for the district are not available. However, a systematic review of severe malaria in Africa found the incidence rate of severe malaria in the general population of Ghana to be 106.7 per 100,000 person-years (43). Thus, there is an indication of a very low incidence of severe anaemia and severe malaria during pregnancy, and these would not have distorted study estimates to a larger extent. The prevalence of blood dyscrasias and recent treatment with Sulphur containing drugs in the pregnant woman population of Ghana before IPT delivery is not available. Other studies that can include all exception variables are needed to evaluate the fidelity of the delivery of IPT more holistically. Despite this shortfall, this study has gone a step further from using only ANC attendance to evaluate ANC provider delivery of IPTp-Sp. This study included very significant variables in determining the eligibility status of pregnant women to receive IPT to reveal the actual gaps In IPTp-Sp delivery.

4.6 Conclusion and recommendations

In conclusion, this study has found a high level of implementation fidelity of the delivery of IPTp-Sp by ANC providers in the Ningo-Prampram District of Ghana. There was a high level of IPT delivery to eligible pregnant women. There was however a relatively low level of IPT refusal to those who were not eligible. Thus, some pregnant women who were not eligible even received IPT. ANC attendance patterns of pregnant women have also been found to affect the receipt of IPTp-Sp with fidelity.

This study has also demonstrated an excellent way of assessing adherence to IPTp-Sp guidelines. In assessing the fidelity or adherence to a healthcare intervention, it is important to put in much efforts to ascertain the eligibility status to receive the intervention. It is only then that a decision can be made whether there are gaps in delivery or not. Going forward, studies that assess the adherence, fidelity or the gaps in IPT delivery should include important variables to ascertain eligibility status and then compare with the receipt of the intervention.
This approach will reveal the actual gaps in the delivery of IPTp-Sp and strengthen the evidence base by extension. Appropriate recommendations can then be made to solve the delivery problems of IPTp-Sp. Large multi-country studies in sub-Saharan Africa are needed to investigate the implementation fidelity of IPTp-Sp to reveal actual gaps in IPTp-Sp delivery.

Considering the findings of this study, it is recommended that both direct and indirect strategies be implemented as a means to improve on IPTp-Sp delivery and resolve the implementation bottlenecks. The first direct strategy is that routine in-service training and workshops should be organised by the Ghana health service and or other health partners to review IPT guidelines and practices. Training and workshops should also, as a direct strategy, pay particular attention to the delivery of IPT in the first trimester of pregnancy which is a policy violation. This sensitisation will help promote a high level of understanding by ANC providers in terms of IPT delivery to prevent non-adherence to IPTp-Sp guidelines particularly at the early stages of gestation.

Also, job aids or flow charts detailing stages or steps on IPTp-Sp delivery should be developed if not yet developed and made available at ANC clinics to remind ANC providers of the components of the intervention. IPTp-Sp guidelines should be made available at ANC clinics to serve as a reference for ANC providers.

Strategies and interventions should be developed to promote a regular and ordered pattern of ANC attendance during pregnancy as an indirect mechanism to promote provider adherence to IPTp-Sp guidelines. At first contact by ANC providers with pregnant women, the subsequent ANC visits should be scheduled and provided to the women to attend ANC on the scheduled dates. These schedules should be made on recommended ANC models by WHO. These scheduling of ANC visits will allow pregnant women to attend ANC in a regular and ordered pattern that fall within recommended IPTp-Sp compliant timelines. This will indirectly make the delivery of IPTp-Sp by ANC providers to be more likely done with fidelity.

Further large-scale research at the national or country level is needed to investigate Implementation fidelity of IPTp-Sp in general. Such large-scale studies will have enough data to investigate the relationships between other variables and implementation fidelity particularly for those variables that were not statistically significant in this study. Further research is also needed to investigate the relationships between provider as well as health system factors and implementation fidelity of IPTp-Sp.

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6.0 APPENDICES

APPENDIX A: DATA COLLECTION INSTRUMENT

Confidential

Appendix I: Mothers Survey Questionnaire

Record ID	_____
Background Information	
Date of interview	_____
Time of Interview	_____
Sub-district name	◯ Prampram ◯ Old Ningo ◯ Lekpongunor
Community name	_____
Field Staff code	_____
Demographics	
Age of mother (completed years)	_____
What is your highest educational level?	◯ Never been to school ◯ Primary ◯ Middle/JSS/JHS ◯ Secondary/SHS/TECH/VOC ◯ Tertiary or above ◯ Dont know
What is your MAIN occupation?	◯ Public/civil servant ◯ Clerical/Secretarial ◯ Trader/business ◯ Employed tradesman/artisan ◯ Farmer/Labourer/domestic worker ◯ Unemployed
What is your current religion?	◯ Catholic ◯ Anglican/Methodist/Presbyterian ◯ Pentecostal/Charismatic ◯ Other Christianity ◯ Traditional/Spiritualist ◯ Islam/Moslem ◯ No Religion ◯ Other
Specify other religion	_____

What is your current marital status?	◯ Never married ◯ Married ◯ Cohabitating/Living together ◯ Divorced ◯ Separated ◯ Widowed

Last Pregnancy information

Date of last menstrual period	_____ (Review page one of MHRB)
Date of first visit at ANC clinic during the last pregnancy (ANC booking)	_____ (review page 1 of MHRB)
Number of weeks of pregnancy at first visit	_____ (review page 1 of MHRB)
Were you G6PD deficient during your last pregnancy?	◯ Yes ◯ No (review page 1 of MHRB (drug history and allergies))
Were you allergic to sulpha-drugs during your last pregnancy?	◯ Yes ◯ No (review page 1 of MHRB (drug history and allergies))
Were you breastfeeding during your last pregnancy?	◯ Yes ◯ No
Do you have a history of Jaundice?	◯ Yes ◯ No
Do you have a history of liver disease?	◯ Yes ◯ No

Antenatal care visits during last pregnancy

1st ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 1st ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 1st ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility

Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No
2nd ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 2nd ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 2nd ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility
Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No
3rd ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 3rd ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 3rd ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility
Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No
4th ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 4th ANC visit	_____ (review pages 5 and 6 of MHRB)

Name of Health facility of 4th ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility
Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No
5th ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 5th ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 5th ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility
Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No
6th ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 6th ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 6th ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility
Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No

7th ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 7th ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 7th ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility
Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No
8th ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 8th ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 8th ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility
Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No
9th ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 9th ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 9th ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility

Specify other health facility	_____
Another ANC visit?	◯ Yes ◯ No
10th ANC visit date	_____ (review pages 5 and 6 of MHRB)
Gestational age (in weeks) at 10th ANC visit	_____ (review pages 5 and 6 of MHRB)
Name of Health facility of 10th ANC visit	◯ prampram polyclinic ◯ old ningo health centre ◯ new ningo CHPS ◯ Lekpongunor CHPS ◯ Dangme Community Hospital ◯ Other health facility
Specify other health facility	_____

IPTp-Sp doses during pregnancy.

Date of 1st IPTp-Sp dose	_____ (review page 5 of MHRB)
Gestational age (in weeks) at time of taking 1st IPTp-Sp dose.	_____ (review page 5 og MHRB)
Did you take the 1st IPTp-Sp dose during ANC visit?	◯ Yes ◯ No
If no to question above, where did you take it?	_____
Did you take the 1st IPTp-Sp dose under observation by ANC provider at ANC clinic?	◯ Yes ◯ No
If no to question above, how did you take it?	◯ given to me by provider to be taken later ◯ other reason
Specify other reason	_____
Fill 2nd IPTp-Sp information?	◯ Yes ◯ No

Date of 2nd IPTp-Sp dose	_____ (review page 5 of MHRB)
Gestational age (in weeks) at time of taking 2nd IPTp-Sp dose.	_____ (review page 5 og MHRB)
Did you take the 2nd IPTp-Sp dose during ANC visit?	◯ Yes ◯ No
If no to question above, where did you take it?	_____
Did you take the 2nd IPTp-Sp dose under observation by ANC provider at ANC clinic?	◯ Yes ◯ No
If no to question above, how did you take it?	◯ given to me by provider to be taken later ◯ other reason
Specify other reason	_____
Fill 3rd IPTp-Sp information?	◯ Yes ◯ No
Date of 3rd IPTp-Sp dose	_____ (review page 5 of MHRB)
Gestational age (in weeks) at time of taking 3rd IPTp-Sp dose.	_____ (review page 5 og MHRB)
Did you take the 3rd IPTp-Sp dose during ANC visit?	◯ Yes ◯ No
If no to question above, where did you take it?	_____
Did you take the 3rd IPTp-Sp dose under observation by ANC provider at ANC clinic?	◯ Yes ◯ No
If no to question above, how did you take it?	◯ given to me by provider to be taken later ◯ other reason
Specify other reason	_____
Fill 4th IPTp-Sp information?	◯ Yes ◯ No

Date of 4th IPTp-Sp dose	_____ (review page 5 of MHRB)
Gestational age (in weeks) at time of taking 4th IPTp-Sp dose.	_____ (review page 5 og MHRB)
Did you take the 4th IPTp-Sp dose during ANC visit?	◯ Yes ◯ No
If no to question above, where did you take it?	_____
Did you take the 4th IPTp-Sp dose under observation by ANC provider at ANC clinic?	◯ Yes ◯ No
If no to question above, how did you take it?	◯ given to me by provider to be taken later ◯ other reason
Specify other reason	_____
Fill 5th IPTp-Sp information?	◯ Yes ◯ No
Date of 5th IPTp-Sp dose	_____ (review page 5 of MHRB)
Gestational age (in weeks) at time of taking 5th IPTp-Sp dose.	_____ (review page 5 og MHRB)
Did you take the 5th IPTp-Sp dose during ANC visit?	◯ Yes ◯ No
If no to question above, where did you take it?	_____
Did you take the 5th IPTp-Sp dose under observation by ANC provider at ANC clinic?	◯ Yes ◯ No
If no to question above, how did you take it?	◯ given to me by provider to be taken later ◯ other reason
Specify other reason	_____
Fill 6th IPTp-Sp information?	◯ Yes ◯ No

Date of 6th IPTp-Sp dose	_____ (review page 5 of MHRB)
Gestational age (in weeks) at time of taking 6th IPTp-Sp dose.	_____ (review page 5 og MHRB)
Did you take the 6th IPTp-Sp dose during ANC visit?	◯ Yes ◯ No
If no to question above, where did you take it?	_____
Did you take the 6th IPTp-Sp dose under observation by ANC provider at ANC clinic?	◯ Yes ◯ No
If no to question above, how did you take it?	◯ given to me by provider to be taken later ◯ other reason
Specify other reason	_____
Fill 7th IPTp-Sp information?	◯ Yes ◯ No
Date of 7th IPTp-Sp dose	_____ (review page 5 of MHRB)
Gestational age (in weeks) at time of taking 7th IPTp-Sp dose.	_____ (review page 5 og MHRB)
Did you take the 7th IPTp-Sp dose during ANC visit?	◯ Yes ◯ No
If no to question above, where did you take it?	_____
Did you take the 7th IPTp-Sp dose under observation by ANC provider at ANC clinic?	◯ Yes ◯ No
If no to question above, how did you take it?	◯ given to me by provider to be taken later ◯ other reason
Specify other reason	_____
Fill 8th IPTp-Sp information?	◯ Yes ◯ No

Date of 8th IPTp-Sp dose	_____ (review page 5 of MHRB)
Gestational age (in weeks) at time of taking 8th IPTp-Sp dose.	_____ (review page 5 og MHRB)
Did you take the 8th IPTp-Sp dose during ANC visit?	◯ Yes ◯ No
If no to question above, where did you take it?	_____
Did you take the 8th IPTp-Sp dose under observation by ANC provider at ANC clinic?	◯ Yes ◯ No
If no to question above, how did you take it?	◯ given to me by provider to be taken later ◯ other reason
Specify other reason	_____

Delivery Information and History	
How many times have you ever been pregnant? (at the time of the last delivery including still births, abortions, and miscarriages)	_____
How many times have you delivered? (including your last delivery)	_____

APPENDIX B: ETHICS CLEARANCE CERTIFICATE: UNIVERSITY OF THE WITWATERSRAND ETHICS REVIEW ETHICS COMMITTEE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Mr Kwabena Asare

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180145

NAME: (Principal Investigator)	Mr Kwabena Asare
DEPARTMENT:	Epidemiology and Biostatistics Ningo-Prampram District Greater Accra Region, Ghana
PROJECT TITLE:	Implementation Fidelity of Intermittent Preventive Treatment with Sulphadoxine Pyrimethamine for Malaria Control in Pregnant Women in Ghana in 2018
DATE CONSIDERED:	26/01/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Eustasius Musenge
APPROVED BY:	Prof C Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	12/04/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in January and will therefore be due in the month of January each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX C: ETHICS CLEARANCE CERTIFICATE: GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com

MyRef. GHS/RDD/ERC/Admin/App 917
Your Ref. No.

1st March, 2018

Kwabena Asare
University of the Witwatersrand
Johannesburg, South Africa

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC: 019/12/17**
Project Title	Implementation Fidelity of Intermittent Preventive Treatment with Sulphadoxine-Pyremethamine for Malaria Control in Pregnant Women in the Ningo-Prampram District in Ghana in 2018
Approval Date	28th February, 2018
Expiry Date	27th February, 2019
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report **after completion** of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

APPENDIX D

Plagiarism declaration for written work: Master of Science in Epidemiology (Implementation Science)

I **Kwabena Asare** (**Student number: 1304755**) am a postgraduate student registered for **MSc. Epidemiology (Implementation Science)** Programme in the Wits School of Public Health.

I am submitting my written work for assessment for the module:

COMH7065A: Field Based Research Project
_____ (course name and code).
I hereby declare the following:

- I am aware that plagiarism is the use of someone else's work without their permission and/or without acknowledging the original source).
- I am aware that plagiarism is wrong.
- I confirm that the work submitted for assessment for the above course is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is
  a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature: _____ Date: **31-March-2019**

APPENDIX E: STATA SAMPLE SIZE CALCULATION OUTPUT

```
. power oneproportion 0.39 0.47

Performing iteration ...

Estimated sample size for a one-sample proportion test
Score z test
Ho: p = p0  versus  Ha: p != p0

Study parameters:

        alpha =    0.0500
        power =    0.8000
        delta =    0.0800
           p0 =    0.3900
           pa =    0.4700

Estimated sample size:

            N =       296

. display 296/0.8
370
```

APPENDIX F: CREATION OF QUALIFICATION TO RECEIVE IPT VARIABLE AT VARIOUS ANC VISITS.

Table 6:1: Creation of qualification to receive 1st IPT at various ANC visits (variable)

	Qualified (Yes) (if all conditions below are satisfied)	Not qualified (No if conditions below are satisfied)
At ANC1	• A participant makes ANC1 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC1.	• A participant makes ANC1 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC1.
At ANC2	• Participant did not receive IPT1 at ANC1. • But makes ANC2 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC2.	• Participant did not receive IPT1 at ANC1. • But makes ANC2 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC2.
At ANC3	• Participant did not receive IPT1 at ANC1 and ANC2. • But makes ANC3 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders.	• Participant did not receive IPT1 at ANC1and ANC2. • But makes ANC3 visit. **And any of the following is satisfied:** • Participant is G6PD.

	• And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC3.	• Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC3.
At ANC4	• Participant did not receive IPT1 at ANC1, ANC2 and ANC3. • But makes ANC4 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC4.	• Participant did not receive IPT1 at ANC1, ANC2, ANC3. • But makes ANC4 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC4.
At ANC5	• Participant did not receive IPT1 at ANC1, ANC2, ANC3 and ANC4. • But makes ANC5 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC5.	• Participant did not receive IPT1 at ANC1, ANC2, ANC3, ANC4. • But makes ANC5 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC5.

Table 6:2: Creation of qualification to receive 2nd IPT at various ANC visits (variable)

	Qualified (Yes) (if all conditions below are satisfied)	Not qualified (No if conditions below are satisfied)
At ANC2	• Participant has received IPT1. • And makes ANC2 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC2. • And the duration between IPT1 date and ANC2 date is greater or equal to 1 month (28 days).	• Participant has received IPT1. • And makes ANC2 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC2. • Or the duration between IPT1 date and ANC2 date is less than 1 month (28 days).
At ANC3	• Participant has received IPT1. • And did not receive IPT2 at ANC2. • And makes ANC3 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC3. • And the duration between IPT1 date and ANC3 date is greater or equal to 1 month (28 days).	• Participant has received IPT1. • And did not receive IPT2 at ANC2. • And akes ANC3 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC3. • Or the duration between IPT1 date and ANC3 date is less than 1 month (28 days).

At ANC4	• Participant has received IPT1. • And did not receive IPT2 at ANC2, ANC3. • And makes ANC4 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC4. • And the duration between IPT1 date and ANC4 date is greater or equal to 1 month (28 days).	• Participant has received IPT1. • And did not receive IPT2 at ANC2, ANC3. • And makes ANC4 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC4. • Or the duration between IPT1 date and ANC4 date is less than 1 month (28 days).
At ANC5	• Participant has received IPT1. • And did not receive IPT2 at ANC2, ANC3, ANC4. • And makes ANC5 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC5. • The duration between IPT1 date and ANC5 date is greater or equal to 1 month (28 days).	• Participant has received IPT1. • And did not receive IPT2 at ANC2, ANC3, ANC4. • And makes ANC5 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC5. • Or the duration between IPT1 date and ANC5 date is less than 1 month (28 days).

Table 6:3: Creation of qualification to receive 3rd IPT at various ANC visits (variable)

	Qualified (Yes) (if all conditions below are satisfied)	Not qualified (No if conditions below are satisfied)
At ANC3	• Participant has received IPT2. • And makes ANC3 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC3. • And the duration between IPT2 date and ANC3 date is greater or equal to 1 month (28 days).	• Participant has received IPT2. • And makes ANC3 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC3. • Or the duration between IPT2 date and ANC3 date is less than 1 month (28 days).
At ANC4	• Participant has received IPT2. • And did not receive IPT3 at ANC3. • And makes ANC4 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC4. • And the duration between IPT2 date and ANC4 date is greater or equal to 1 month (28 days).	• Participant has received IPT2 • And did not receive IPT3 at ANC3 • And makes ANC4 visit **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC4. • Or the duration between IPT2 date and ANC4 date is less than 1 month (28 days).
At ANC5	• Participant has received IPT2.	• Participant has received IPT2.

	• And did not receive IPT3 at ANC3, ANC4. • And makes ANC5 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC5. • And the duration between IPT2 date and ANC5 date is greater or equal to 1 month (28 days).	• And did not receive IPT3 at ANC3, ANC4. • And makes ANC5 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC4. • Or the duration between IPT2 date and ANC4 date is less than 1 month (28 days).
At ANC6	• Participant has received IPT2. • And did not receive IPT3 at ANC3, ANC4, ANC5. • And makes ANC6 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC6. • And the duration between IPT2 date and ANC6 date is greater or equal to 1 month (28 days).	• Participant has received IPT2. • And did not receive IPT3 at ANC3, ANC4, ANC5. • And makes ANC6 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC6. • Or the duration between IPT2 date and ANC6 date is less than 1 month (28 days).

Table 6:4: Creation of qualification to receive 4th IPT at various ANC visits (variable)

	Qualified (Yes) (if all conditions below are satisfied)	(No if conditions below are satisfied)
At ANC4	• Participant has received IPT3. • And makes ANC4 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC4. • And the duration between IPT3 date and ANC4 date is greater or equal to 1 month (28 days).	• Participant has received IPT3. • And makes ANC4 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC4. • Or the duration between IPT3 date and ANC4 date is less than 1 month (28 days).
At ANC5	• Participant has received IPT3. • And did not receive IPT4 at ANC4. • And makes ANC 5 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC5. • And the duration between IPT3 date and ANC5 date is greater or equal to 1 month (28 days).	• Participant has received IPT3. • And did not receive IPT4 at ANC4. • And makes ANC4 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC5. • Or the duration between IPT3 date and ANC5 date is less than 1 month (28 days).
At ANC6	Participant has received IPT3.	• Participant has received IPT3.

	• And did not receive IPT4 at ANC4, ANC5. • And makes ANC6 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC6 • And the duration between IPT3 date and ANC6 date is greater or equal to 1 month (28 days).	• And did not receive IPT4 at ANC4, ANC5. • And makes ANC6 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC6. • Or the duration between IPT3 date and ANC6 date is less than 1 month (28 days).
At ANC7	• Participant has received IPT3. • And did not receive IPT4 at ANC4, ANC5, ANC6. • And makes ANC7 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC7. • And the duration between IPT3 date and ANC7 date is greater or equal to 1 month (28 days).	• Participant has received IPT3. • And did not receive IPT4 at ANC4, ANC5, ANC6. • And makes ANC7 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC7. • Or the duration between IPT3 date and ANC7 date is less than 1 month (28 days).

Table 6:5: Creation of qualification to receive 5th IPT at various ANC visits (variable)

	Qualified (Yes) (if all conditions below are satisfied)	Not qualified (No if conditions below are satisfied)
At ANC5	• Participant has received IPT4. • And makes ANC5 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC5. • And the duration between IPT4 date and ANC5 date is greater or equal to 1 month (28 days).	• Participant has received IPT4. • And makes ANC5 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC5. • Or the duration between IPT4 date and ANC5 date is less than 1 month (28 days).
At ANC6	• Participant has received IPT4. • And did not receive IPT5 at ANC5. • And makes ANC 6 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC6. • And the duration between IPT4 date and ANC6 date is greater or equal to 1 month (28 days).	• Participant has received IPT4. • And did not receive IPT5 at ANC5. • And makes ANC6 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC6. • Or the duration between IPT4 date and ANC6 date is less than 1 month (28 days).
At ANC7	• Participant as received IPT4.	• Participant has received IPT4

	• And did not receive IPT5 at ANC5, ANC6. • And makes ANC7 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC7 • And the duration between IPT4 date and ANC7 date is greater or equal to 1 month (28 days).	• And did not receive IPT5 at ANC, ANC6. • And makes ANC7 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC7. • Or the duration between IPT4 date and ANC7 date is less than 1 month (28 days).
At ANC8	• Participant has received IPT4. • And did not receive IPT5 at ANC5, ANC6, ANC7. • And makes ANC8 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC8. • And the duration between IPT4 date and ANC8 date is greater or equal to 1 month (28 days).	• Participant has received IPT4. • And did not receive IPT5 at ANC5, ANC6, ANC7. • And makes ANC8 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC8. • Or the duration between IPT4 date and ANC8 date is less than 1 month (28 days).
At ANC9	• Participant has received IPT4. • And did not receive IPT5 at ANC5, ANC6, ANC7, ANC8.	• Participant has received IPT4. • And did not receive IPT5 at ANC5, ANC6, ANC7, ANC8.

	• And makes ANC9 visit. • And is not G6PD. • And has no history of epileptic or seizure disorders. • And has no severe liver disease or unexplained recurrent jaundice. • And has no known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • And is not breastfeeding a child. • And has a gestational age of 16 or more weeks at ANC9. • And the duration between IPT4 date and ANC9 date is greater or equal to 1 month (28 days).	• And makes ANC9 visit. **And any of the following is satisfied:** • Participant is G6PD. • Or has a history of epileptic or seizure disorders. • Or has severe liver disease or unexplained recurrent jaundice. • Or has a known allergy to any Sulphur containing drugs or allergy to Pyrimethamine. • Or is breastfeeding a child. • Or has a gestational age less than 13 weeks at ANC9. • Or the duration between IPT4 date and ANC9 date is less than 1 month (28 days).

APPENDIX G: STATA DO FILE COMMANDS FOR THE CREATION OF VARIABLES

```
**********CREATION OF FIDELITY OF IPT  VARIABLES ******************
*************************************************************************

//combining all clinical IPT exempt variables into a single variable
**yes if any of the variables has 1 yes response and no if none has a yes response
gen exempt_ipt=1 if
g6pd_ms==1|sulpha_ms==1|breastfeed==1|jaundice==1|liver==1|epilepsy==1
replace exempt_ipt=0 if
g6pd_ms==0&sulpha_ms==0&breastfeed==0&jaundice==0&liver==0
label var exempt_ipt "participant exempted from taking ipt"
label define exempt_ipt 1 "yes" 0 "no"
label values exempt_ipt exempt_ipt

label define yesno 1 "Yes" 0 "No"

//FIDELITY AT IPT1
```

//Generate qualification to receive IPT1 variable at the various ANCs(1st,2nd,3rd.....etc) and then overall(IPT1)

**ANC1
**yes=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC1,with gestational age>=16,not IPT exempt
**no=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC1,but did not qualify to receive IPT1 at ANC1
gen qualreciv_IPT1_atanc1=1 if (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16) & gestwk_anc1_ms>=16&ANC1==1&exempt_ipt==0
replace qualreciv_IPT1_atanc1=0 if ANC1==1 &qualreciv_IPT1_atanc1==.& (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)
label values qualreciv_IPT1_atanc1 yesno
label var qualreciv_IPT1_atanc1 "participants who qualified to receive IPT1 at ANC1"
tab qualreciv_IPT1_atanc1

**ANC2
**yes=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC2,with gestational age>=16,not IPT exempt,and have not received IPT1 previously
**no=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC2,but did not qualify to receive IPT1 at ANC2
gen qualreciv_IPT1_atanc2=1 if (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16) & gestwk_anc2_ms>=16&ANC2==1&exempt_ipt==0& (ipt1_date_ms!=date_anc1_ms)
replace qualreciv_IPT1_atanc2=0 if ANC2==1 &qualreciv_IPT1_atanc2==.& (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)&
(ipt1_date_ms!=date_anc1_ms)&gestwk_anc2_ms<13
label values qualreciv_IPT1_atanc2 yesno
label var qualreciv_IPT1_atanc2 "participants who qualified to receive IPT1 at ANC2" // this variable is for those who attended ANC2 and have not received IPT1 already
tab qualreciv_IPT1_atanc2

**ANC3

**yes=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC3,with gestational age>=16,not IPT exempt,and have not received IPT1 previously
**no=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC3,but did not qualify to receive IPT1 at ANC3
gen qualreciv_IPT1_atanc3=1 if (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16) & gestwk_anc3_ms>=16&ANC3==1&exempt_ipt==0& (ipt1_date_ms!=date_anc1_ms)& (ipt1_date_ms!=date_anc2_ms)
replace qualreciv_IPT1_atanc3=0 if ANC3==1 &qualreciv_IPT1_atanc3==.& (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)& (ipt1_date_ms!=date_anc1_ms)& (ipt1_date_ms!=date_anc2_ms)
label values qualreciv_IPT1_atanc3 yesno
label var qualreciv_IPT1_atanc3 "participants who qualified to receive IPT1 at ANC3" // this variable is for those who attended ANC3 and have not received IPT1 already
tab qualreciv_IPT1_atanc3

**ANC4
**yes=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC4,with gestational age>=16,not IPT exempt,and have not received IPT1 previously
**no=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC4,but did not qualify to receive IPT1 at ANC4
gen qualreciv_IPT1_atanc4=1 if (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16) & gestwk_anc4_ms>=16&ANC4==1&exempt_ipt==0& (ipt1_date_ms!=date_anc1_ms)& (ipt1_date_ms!=date_anc2_ms)& (ipt1_date_ms!=date_anc3_ms)
replace qualreciv_IPT1_atanc4=0 if ANC4==1 &qualreciv_IPT1_atanc4==.& (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)& (ipt1_date_ms!=date_anc1_ms)& (ipt1_date_ms!=date_anc2_ms)& (ipt1_date_ms!=date_anc3_ms)
label values qualreciv_IPT1_atanc4 yesno
label var qualreciv_IPT1_atanc4 "participants who qualified to receive IPT1 at ANC4" // this variable is for those who attended ANC4 and have not received IPT1 already
tab qualreciv_IPT1_atanc4

**ANC5

**yes=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC5,with gestational age>=16,not IPT exempt,and have not received IPT1 previously

**no=participants with (IPT1 gestational age<13|IPT1 gestational age>=16) who have attended ANC5,but did not qualify to receive IPT1 at ANC5

```
gen qualreciv_IPT1_atanc5=1 if (gestwk_ipt1_ms<=13|gestwk_ipt1_ms>=16) &
gestwk_anc5_ms>=16&ANC5==1&exempt_ipt==0& (ipt1_date_ms!=date_anc1_ms)&
(ipt1_date_ms!=date_anc2_ms)& (ipt1_date_ms!=date_anc3_ms)&
(ipt1_date_ms!=date_anc4_ms)
replace qualreciv_IPT1_atanc5=0 if ANC5==1 &qualreciv_IPT1_atanc5==.&
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)& (ipt1_date_ms!=date_anc1_ms)&
(ipt1_date_ms!=date_anc2_ms)& (ipt1_date_ms!=date_anc3_ms)&
(ipt1_date_ms!=date_anc4_ms)
label values qualreciv_IPT1_atanc5 yesno
label var qualreciv_IPT1_atanc5 "participants who qualified to receive IPT1 at ANC5" // this variable is for those who attended ANC5 and have not received IPT1 already
tab qualreciv_IPT1_atanc5
```

//overall (qualified to receive IPT1 irrespective of which ANC visit)

**yes=if participant qualified to receive IPT1 at any ANC visit

**no=participant did not qualify to receive IPT1 at all ANC visits

```
gen qualreciv_IPT1=1 if (qualreciv_IPT1_atanc1==1)&
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)&ANC1==1
replace qualreciv_IPT1=1 if (qualreciv_IPT1_atanc2==1)&
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)&ANC2==1
replace qualreciv_IPT1=1 if (qualreciv_IPT1_atanc3==1)&
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)&ANC3==1
replace qualreciv_IPT1=1 if (qualreciv_IPT1_atanc4==1)&
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)&ANC4==1
replace qualreciv_IPT1=1 if (qualreciv_IPT1_atanc5==1)&
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)&ANC5==1
replace qualreciv_IPT1=1 if (gestwk_ipt1_ms>=13&gestwk_ipt1_ms<=15)&exempt_ipt!=1
```

```
replace qualreciv_IPT1=0 if qualreciv_IPT1==.&ANC1==1&
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)
lab def qualreciv_IPT 1 "Qualified" 0 "Not qualified"
label val qualreciv_IPT1 qualreciv_IPT
label var qualreciv_IPT1 "Qualified to receive IPT1?"

//fidelity at IPT1
**yes=if participant qualified to receive IPT1 and received or did not qualify to receive IPT1 and did not receive
**no=if participant qualified to receive IPT1 but did not receive or did not qualify to receive IPT1 but received
tab qualreciv_IPT1 IPT1 if  (gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16),row
gen fidel_IPT1=1 if  (qualreciv_IPT1==1&IPT1==1)| (qualreciv_IPT1==0&IPT1==0) &
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)
replace fidel_IPT1=0 if  (qualreciv_IPT1==1&IPT1==0)| (qualreciv_IPT1==0&IPT1==1)&
(gestwk_ipt1_ms<13|gestwk_ipt1_ms>=16)
label val fidel_IPT1 yesno
label var fidel_IPT1 "Fidelity at IPT1"



//FIDELITY AT IPT2



//Generate qualification to receive IPT2 variable at the various ANCs (1st,2nd, third.....etc.) and then overall (IPT2)

//ANC2
//yes=participants with  (IPT2 gestational age<13|IPT2 gestational age>=16) who have attended ANC2,with gestational age>=16,not IPT exempt,&received IPT1 a min of 28 days ago
//no=participants with  (IPT2 gestational age<13|IPT2 gestational age>=16) who have attended ANC2,but did not qualify to receive IPT2 at ANC2
```

```
gen qualreciv_IPT2_atanc2=1 if  (gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)&round (int (date_anc2_ms-ipt1_date_ms))>=28 &
gestwk_anc2_ms>=16&ANC2==1&exempt_ipt==0&IPT1==1
replace qualreciv_IPT2_atanc2=0 if ANC2==1 &qualreciv_IPT2_atanc2==.&IPT1==1&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)
label values qualreciv_IPT2_atanc2 yesno
label var qualreciv_IPT2_atanc2 "participants who qualified to receive IPT2 at ANC2" // this variable is for those who attended ANC2

//ANC3
//yes=participants with  (IPT2 gestational age<13|IPT2 gestational age>=16) who have attended ANC3,with gestational age>=16,not IPT exempt,&received IPT1 a min of 28 days ago& have not received IPT2 previously
//no=participants with  (IPT2 gestational age<13|IPT2 gestational age>=16) who have attended ANC3,but did not qualify to receive IPT2 at ANC3
gen qualreciv_IPT2_atanc3=1 if  (gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)&round (int (date_anc3_ms-ipt1_date_ms))>=28 &
gestwk_anc3_ms>=16&ANC3==1&exempt_ipt==0&IPT1==1&
(ipt2_date_ms!=date_anc2_ms)
replace qualreciv_IPT2_atanc3=0 if ANC3==1 &qualreciv_IPT2_atanc3==.&IPT1==1&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)& (ipt2_date_ms!=date_anc2_ms)
label values qualreciv_IPT2_atanc3 yesno
label var qualreciv_IPT2_atanc3 "participants who qualified to receive IPT2 at ANC3" // this variable is for those who attended ANC3 and have not received IPT2 already

//ANC4
//yes=participants with  (IPT2 gestational age<13|IPT2 gestational age>=16) who have attended ANC4,with gestational age>=16,not IPT exempt,&received IPT1 a min of 28 days ago& have not received IPT2 previously
//no=participants with  (IPT2 gestational age<13|IPT2 gestational age>=16) who have attended ANC4,but did not qualify to receive IPT2 at ANC4
gen qualreciv_IPT2_atanc4=1 if  (gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)&round (int (date_anc4_ms-ipt1_date_ms))>=28 &
```

gestwk_anc4_ms>=16&ANC4==1&exempt_ipt==0&IPT1==1&
(ipt2_date_ms!=date_anc2_ms)& (ipt2_date_ms!=date_anc3_ms)
replace qualreciv_IPT2_atanc4=0 if ANC4==1 &qualreciv_IPT2_atanc4==.&IPT1==1&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)& (ipt2_date_ms!=date_anc2_ms)&
(ipt2_date_ms!=date_anc3_ms)
label values qualreciv_IPT2_atanc4 yesno
label var qualreciv_IPT2_atanc4 "participants who qualified to receive IPT2 at ANC4" // this variable is for those who attended ANC4 and have not received IPT2 already

//ANC5
//yes=participants with (IPT2 gestational age<13|IPT2 gestational age>=16) who have attended ANC5,with gestational age>=16,not IPT exempt,&received IPT1 a min of 28 days ago& have not received IPT2 previously
//no=participants with (IPT2 gestational age<13|IPT2 gestational age>=16) who have attended ANC5,but did not qualify to receive IPT2 at ANC5
gen qualreciv_IPT2_atanc5=1 if (gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)&round (int (date_anc5_ms-ipt1_date_ms))>=28 &
gestwk_anc5_ms>=16&ANC5==1&exempt_ipt==0&IPT1==1&
(ipt2_date_ms!=date_anc2_ms)& (ipt2_date_ms!=date_anc3_ms)&
(ipt2_date_ms!=date_anc4_ms)
replace qualreciv_IPT2_atanc5=0 if ANC5==1 &qualreciv_IPT2_atanc5==.&IPT1==1&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16) & (ipt2_date_ms!=date_anc2_ms)&
(ipt2_date_ms!=date_anc3_ms)& (ipt2_date_ms!=date_anc4_ms)
label values qualreciv_IPT2_atanc5 yesno
label var qualreciv_IPT2_atanc5 "participants who qualified to receive IPT2 at ANC5" // this variable is for those who attended ANC5 and have not received IPT2 already

**overall (qualified to receive IPT2 irrespective of which ANC visit)
//yes=if participant qualified to receive IPT2 at any ANC visit
//no=participant did not qualify to receive IPT2 at all ANC visits
gen qualreciv_IPT2=1 if (qualreciv_IPT2_atanc2==1)&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)&IPT1==1&ANC2==1
replace qualreciv_IPT2=1 if (qualreciv_IPT2_atanc3==1)&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)&IPT1==1&ANC3==1

```
replace qualreciv_IPT2=1 if  (qualreciv_IPT2_atanc4==1)&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)&IPT1==1&ANC4==1
replace qualreciv_IPT2=1 if  (qualreciv_IPT2_atanc5==1)&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)&IPT1==1&ANC5==1
replace qualreciv_IPT2=1 if  (gestwk_ipt2_ms>=13&gestwk_ipt2_ms<=15)&exempt_ipt!=1
replace qualreciv_IPT2=0 if qualreciv_IPT2==.&IPT1==1&ANC2==1&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)
label val qualreciv_IPT2 qualreciv_IPT
label var qualreciv_IPT2 "Qualified to receive IPT2?"

**fidelity at IPT2
//yes=if participant qualified to receive IPT2 and received or did not qualify to receive IPT2 and did not receive
//no=if participant qualified to receive IPT2 but did not receive or did not qualify to receive IPT2 but received
tab qualreciv_IPT2 IPT2 if  (gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16),row
gen fidel_IPT2=1 if  (qualreciv_IPT2==1&IPT2==1)| (qualreciv_IPT2==0&IPT2==0) &
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)
replace fidel_IPT2=0 if  (qualreciv_IPT2==1&IPT2==0)| (qualreciv_IPT2==0&IPT2==1)&
(gestwk_ipt2_ms<13|gestwk_ipt2_ms>=16)
label val fidel_IPT2 yesno
label var fidel_IPT2 "Fidelity at IPT2"


// FIDELITY AT IPT3

//Generate qualification to receive IPT3 variable at the various ANCs (1st,2nd,3rd.....etc) and then overall  (IPT3)

//ANC3
//yes=participants with  (IPT3 gestational age<13|IPT3 gestational age>=16) who have attended ANC3,with gestational age>=16,not IPT exempt,&received IPT2 a min of 28 days ago
```

//no=participants with (IPT3 gestational age<13|IPT3 gestational age>=16) who have attended ANC3,but did not qualify to receive IPT3 at ANC3
gen qualreciv_IPT3_atanc3=1 if (gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)&round (int (date_anc3_ms-ipt2_date_ms))>=28 &
gestwk_anc3_ms>=16&ANC3==1&exempt_ipt==0&IPT2==1
replace qualreciv_IPT3_atanc3=0 if ANC3==1 &qualreciv_IPT3_atanc3==.&IPT2==1& (gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)
label values qualreciv_IPT3_atanc3 yesno
label var qualreciv_IPT3_atanc3 "participants who qualified to receive IPT3 at ANC3" // this variable is for those who attended ANC3

//ANC4
//yes=participants with (IPT3 gestational age<13|IPT3 gestational age>=16) who have attended ANC4,with gestational age>=16,not IPT exempt,&received IPT2 a min of 28 days ago& have not received IPT3 previously
//no=participants with (IPT3 gestational age<13|IPT3 gestational age>=16) who have attended ANC3,but did not qualify to receive IPT3 at ANC4
gen qualreciv_IPT3_atanc4=1 if (gestwk_ipt3_ms<14|gestwk_ipt3_ms>=16)&round (int (date_anc4_ms-ipt2_date_ms))>=28 &
gestwk_anc4_ms>=16&ANC4==1&exempt_ipt==0&IPT2==1&
(ipt3_date_ms!=date_anc3_ms)
replace qualreciv_IPT3_atanc4=0 if ANC4==1 &qualreciv_IPT3_atanc4==.&IPT2==1& (gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)& (ipt3_date_ms!=date_anc3_ms)
label values qualreciv_IPT3_atanc4 yesno
label var qualreciv_IPT3_atanc4 "participants who qualified to receive IPT3 at ANC4" // this variable is for those who attended ANC4 and have not received IPT3 already

//ANC5
//yes=participants with (IPT3 gestational age<13|IPT3 gestational age>=16) who have attended ANC5,with gestational age>=16,not IPT exempt, &received IPT2 a min of 28 days ago& have not received IPT3 previously
//no=participants with (IPT3 gestational age<13|IPT3 gestational age>=16) who have attended ANC5,but did not qualify to receive IPT3 at ANC5

gen qualreciv_IPT3_atanc5=1 if (gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)&round (int (date_anc5_ms-ipt2_date_ms))>=28 &
gestwk_anc5_ms>=16&ANC5==1&exempt_ipt==0&IPT2==1&
(ipt3_date_ms!=date_anc3_ms)& (ipt3_date_ms!=date_anc4_ms)
replace qualreciv_IPT3_atanc5=0 if ANC5==1 &qualreciv_IPT3_atanc5==.&IPT2==1&
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)& (ipt3_date_ms!=date_anc3_ms)&
(ipt3_date_ms!=date_anc4_ms)
label values qualreciv_IPT3_atanc5 yesno
label var qualreciv_IPT3_atanc5 "participants who qualified to receive IPT3 at ANC5" // this variable is for those who attended ANC5 and have not received IPT3 already

//ANC6
//yes=participants with (IPT3 gestational age<13|IPT3 gestational age>=16) who have attended ANC6,with gestational age>=16,not IPT exempt,&received IPT2 a min of 28 days ago& have not received IPT3 previously
//no=participants with (IPT3 gestational age<13|IPT3 gestational age>=16) who have attended ANC6,but did not qualify to receive IPT3 at ANC6
gen qualreciv_IPT3_atanc6=1 if (gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)&round (int (date_anc6_ms-ipt2_date_ms))>=28 &
gestwk_anc6_ms>=16&ANC6==1&exempt_ipt==0&IPT2==1 &
(ipt3_date_ms!=date_anc3_ms)& (ipt3_date_ms!=date_anc4_ms)&
(ipt3_date_ms!=date_anc5_ms)
replace qualreciv_IPT3_atanc6=0 if ANC6==1 &qualreciv_IPT3_atanc6==.&IPT2==1&
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)& (ipt3_date_ms!=date_anc3_ms)&
(ipt3_date_ms!=date_anc4_ms)& (ipt3_date_ms!=date_anc5_ms)
label values qualreciv_IPT3_atanc6 yesno
label var qualreciv_IPT3_atanc6 "participants who qualified to receive IPT3 at ANC6" // this variable is for those who attended ANC6 and have not received IPT3 already

**overall (qualified to receive IPT3 irrespective of which ANC visit)
//yes=if participant qualified to receive IPT3 at any ANC visit
//no=participant did not qualify to receive IPT3 at all ANC visits
gen qualreciv_IPT3=1 if (qualreciv_IPT3_atanc3==1)&
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)&IPT2==1&ANC3==1

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replace qualreciv_IPT3=1 if  (qualreciv_IPT3_atanc4==1)&
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)&IPT2==1&ANC4==1
replace qualreciv_IPT3=1 if  (qualreciv_IPT3_atanc5==1)&
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)&IPT2==1&ANC5==1
replace qualreciv_IPT3=1 if  (qualreciv_IPT3_atanc6==1)&
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)&IPT2==1&ANC6==1
replace qualreciv_IPT3=1 if  (gestwk_ipt3_ms>=13&gestwk_ipt3_ms<=15)&exempt_ipt!=1
replace qualreciv_IPT3=0 if qualreciv_IPT3==.&IPT2==1&ANC3==1&
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)
label val qualreciv_IPT3 qualreciv_IPT
label var qualreciv_IPT3 "Qualified to receive IPT3?"

**fidelity at IPT3
//yes=if participant qualified to receive IPT3 and received or did not qualify to receive IPT3
and did not receive
//no=if participant qualified to receive IPT3 but did not receive or did not qualify to receive
IPT3 but received
tab qualreciv_IPT3 IPT3 if  (gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16),row
gen fidel_IPT3=1 if  (qualreciv_IPT3==1&IPT3==1)| (qualreciv_IPT3==0&IPT3==0) &
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)
replace fidel_IPT3=0 if  (qualreciv_IPT3==1&IPT3==0)| (qualreciv_IPT3==0&IPT3==1)&
(gestwk_ipt3_ms<13|gestwk_ipt3_ms>=16)
label val fidel_IPT3 yesno
label var fidel_IPT3 "Fidelity at IPT3"


//FIDELITY AT IPT4


//Generate qualification to receive IPT4 variable at the various ANCs (1st,2nd,3rd.....etc) and
then overall (IPT4)

//ANC4
```

//yes=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC4,with gestational age>=16,not IPT exempt,&received IPT3 a min of 28 days ago

//no=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC4,but did not qualify to receive IPT4 at ANC4

gen qualreciv_IPT4_atanc4=1 if (gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)&round (int (date_anc4_ms-ipt3_date_ms))>=28 &

gestwk_anc4_ms>=16&ANC4==1&exempt_ipt==0&IPT3==1

replace qualreciv_IPT4_atanc4=0 if ANC4==1 &qualreciv_IPT4_atanc4==.&IPT3==1& (gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)

label values qualreciv_IPT4_atanc4 yesno

label var qualreciv_IPT4_atanc4 "participants who qualified to receive IPT4 at ANC4" // this variable is for those who attended ANC4

//ANC5

//yes=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC5,with gestational age>=16,not IPT exempt,&received IPT3 a min of 28 days ago& have not received IPT4 previously

//no=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC5,but did not qualify to receive IPT4 at ANC5

gen qualreciv_IPT4_atanc5=1 if (gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)&round (int (date_anc5_ms-ipt3_date_ms))>=28 &

gestwk_anc5_ms>=16&ANC5==1&exempt_ipt==0&IPT3==1&

(ipt4_date_ms!=date_anc4_ms)

replace qualreciv_IPT4_atanc5=0 if ANC5==1 &qualreciv_IPT4_atanc5==.&IPT3==1& (gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)& (ipt4_date_ms!=date_anc4_ms)

label values qualreciv_IPT4_atanc5 yesno

label var qualreciv_IPT4_atanc5 "participants who qualified to receive IPT4 at ANC5" // this variable is for those who attended ANC5 and have not received IPT4 already

//ANC6

//yes=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC6,with gestational age>=16,not IPT exempt,&received IPT3 a min of 28 days ago& have not received IPT4 previously

//no=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC6,but did not qualify to receive IPT4 at ANC6

gen qualreciv_IPT4_atanc6=1 if (gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)&round (int (date_anc6_ms-ipt3_date_ms))>=28 &
gestwk_anc6_ms>=16&ANC5==1&exempt_ipt==0&IPT3==1&
(ipt4_date_ms!=date_anc4_ms)& (ipt4_date_ms!=date_anc5_ms)

replace qualreciv_IPT4_atanc6=0 if ANC6==1 &qualreciv_IPT4_atanc6==.&IPT3==1&
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)& (ipt4_date_ms!=date_anc4_ms)&
(ipt4_date_ms!=date_anc5_ms)

label values qualreciv_IPT4_atanc6 yesno

label var qualreciv_IPT4_atanc6 "participants who qualified to receive IPT4 at ANC6" // this variable is for those who attended ANC6 and have not received IPT4 already

//ANC7

//yes=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC7,with gestational age>=16,not IPT exempt,&received IPT3 a min of 28 days ago& have not received IPT4 previously

//no=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC7,but did not qualify to receive IPT4 at ANC7

gen qualreciv_IPT4_atanc7=1 if (gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)&round (int (date_anc7_ms-ipt3_date_ms))>=28 &
gestwk_anc7_ms>=16&ANC7==1&exempt_ipt==0&IPT3==1&
(ipt4_date_ms!=date_anc4_ms)& (ipt4_date_ms!=date_anc5_ms)&
(ipt4_date_ms!=date_anc6_ms)

replace qualreciv_IPT4_atanc7=0 if ANC7==1 &qualreciv_IPT4_atanc7==.&IPT3==1&
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16) & (ipt4_date_ms!=date_anc4_ms)&
(ipt4_date_ms!=date_anc5_ms)& (ipt4_date_ms!=date_anc6_ms)

label values qualreciv_IPT4_atanc7 yesno

label var qualreciv_IPT4_atanc7 "participants who qualified to receive IPT4 at ANC7" // this variable is for those who attended ANC7 and have not received IPT4 already

**overall (qualified to receive IPT4 irrespective of which ANC visit)

//yes=if participant qualified to receive IPT4 at any ANC visit

//no=participant did not qualify to receive IPT4 at all ANC visits

```
gen qualreciv_IPT4=1 if  (qualreciv_IPT4_atanc4==1)&
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)&IPT3==1&ANC4==1
replace qualreciv_IPT4=1 if  (qualreciv_IPT4_atanc5==1)&
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)&IPT3==1&ANC5==1
replace qualreciv_IPT4=1 if  (qualreciv_IPT4_atanc6==1)&
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)&IPT3==1&ANC6==1
replace qualreciv_IPT4=1 if  (qualreciv_IPT4_atanc7==1)&
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)&IPT3==1&ANC7==1
replace qualreciv_IPT4=0 if qualreciv_IPT4==.&IPT3==1&ANC4==1&
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)
label val qualreciv_IPT4 qualreciv_IPT
label var qualreciv_IPT4 "Qualified to receive IPT4?"

**fidelity at IPT4
//yes=if participant qualified to receive IPT4 and received or did not qualify to receive IPT4 and did not receive
//no=if participant qualified to receive IPT4 but did not receive or did not qualify to receive IPT4 but received
tab qualreciv_IPT4 IPT4 if  (gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16),row
gen fidel_IPT4=1 if  (qualreciv_IPT4==1&IPT4==1)| (qualreciv_IPT4==0&IPT4==0) &
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)
replace fidel_IPT4=0 if  (qualreciv_IPT4==1&IPT4==0)| (qualreciv_IPT4==0&IPT4==1)&
(gestwk_ipt4_ms<13|gestwk_ipt4_ms>=16)
label val fidel_IPT4 yesno
label var fidel_IPT4 "Fidelity at IPT4"


// FIDELITY AT IPT5

//Generate qualification to receive IPT5 variable at the various ANCs (1st,2nd,3rd.....etc) and then overall (IPT4)

//ANC5
```

//yes=participants with (IPT5 gestational age<13|IPT5 gestational age>=16) who have attended ANC5,with gestational age>=16,not IPT exempt,&received IPT4 a min of 28 days ago

//no=participants with (IPT5 gestational age<13|IPT5 gestational age>=16) who have attended ANC5,but did not qualify to receive IPT5 at ANC5

gen qualreciv_IPT5_atanc5=1 if (gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)&round (int (date_anc5_ms-ipt4_date_ms))>=28 &
gestwk_anc5_ms>=16&ANC5==1&exempt_ipt==0&IPT4==1

replace qualreciv_IPT5_atanc5=0 if ANC5==1 &qualreciv_IPT5_atanc5==.&IPT4==1& (gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)

label values qualreciv_IPT5_atanc5 yesno

label var qualreciv_IPT5_atanc5 "participants who qualified to receive IPT5 at ANC5" // this variable is for those who attended ANC5

//ANC6

//yes=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC6,with gestational age>=16,not IPT exempt,&received IPT4 a min of 28 days ago& have not received IPT5 previously

//no=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC6,but did not qualify to receive IPT5 at ANC6

gen qualreciv_IPT5_atanc6=1 if (gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)&round (int (date_anc6_ms-ipt4_date_ms))>=28 &
gestwk_anc6_ms>=16&ANC5==1&exempt_ipt==0&IPT4==1&
(ipt5_date_ms!=date_anc5_ms)

replace qualreciv_IPT5_atanc6=0 if ANC6==1 &qualreciv_IPT5_atanc6==.&IPT4==1& (gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)& (ipt5_date_ms!=date_anc5_ms)

label values qualreciv_IPT5_atanc6 yesno

label var qualreciv_IPT5_atanc6 "participants who qualified to receive IPT5 at ANC6" // this variable is for those who attended ANC6 and have not received IPT5 already

//ANC7

//yes=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC7,with gestational age>=16,not IPT exempt,&received IPT4 a min of 28 days ago& have not received IPT5 previously

```
//no=participants with  (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC7,but did not qualify to receive IPT5 at ANC7
gen qualreciv_IPT5_atanc7=1 if  (gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)&round (int (date_anc7_ms-ipt4_date_ms))>=28 &
gestwk_anc7_ms>=16&ANC7==1&exempt_ipt==0&IPT4==1&
(ipt5_date_ms!=date_anc5_ms)& (ipt5_date_ms!=date_anc6_ms)
replace qualreciv_IPT5_atanc7=0 if ANC7==1 &qualreciv_IPT5_atanc7==.&IPT4==1&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)& (ipt5_date_ms!=date_anc5_ms)&
(ipt5_date_ms!=date_anc6_ms)
label values qualreciv_IPT5_atanc7 yesno
label var qualreciv_IPT5_atanc7 "participants who qualified to receive IPT5 at ANC7" // this variable is for those who attended ANC7 and have not received IPT5 already

//ANC8
//yes=participants with  (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC8,with gestational age>=16,not IPT exempt,&received IPT4 a min of 28 days ago& have not received IPT5 previously
//no=participants with  (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC8,but did not qualify to receive IPT5 at ANC8
gen qualreciv_IPT5_atanc8=1 if  (gestwk_ipt5_ms<=13|gestwk_ipt5_ms>=16)&round (int (date_anc8_ms-ipt4_date_ms))>=28 &
gestwk_anc8_ms>=16&ANC8==1&exempt_ipt==0&IPT4==1&
(ipt5_date_ms!=date_anc5_ms)& (ipt5_date_ms!=date_anc6_ms)&
(ipt5_date_ms!=date_anc7_ms)
replace qualreciv_IPT5_atanc8=0 if ANC8==1 &qualreciv_IPT5_atanc8==.&IPT4==1&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)& (ipt5_date_ms!=date_anc5_ms)&
(ipt5_date_ms!=date_anc6_ms)& (ipt5_date_ms!=date_anc7_ms)
label values qualreciv_IPT5_atanc8 yesno
label var qualreciv_IPT5_atanc8 "participants who qualified to receive IPT5 at ANC8" // this variable is for those who attended ANC8 and have not received IPT5 already

//ANC9
```

//yes=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC9,with gestational age>=16,not IPT exempt,&received IPT4 a min of 28 days ago& have not received IPT5 previously
//no=participants with (IPT4 gestational age<13|IPT4 gestational age>=16) who have attended ANC9,but did not qualify to receive IPT5 at ANC9
gen qualreciv_IPT5_atanc9=1 if (gestwk_ipt5_ms<=13|gestwk_ipt5_ms>=16)&round (int (date_anc9_ms-ipt4_date_ms))>=28 &
gestwk_anc9_ms>=16&ANC9==1&exempt_ipt==0&IPT4==1&
(ipt5_date_ms!=date_anc5_ms)& (ipt5_date_ms!=date_anc6_ms)&
(ipt5_date_ms!=date_anc7_ms)& (ipt5_date_ms!=date_anc8_ms)
replace qualreciv_IPT5_atanc9=0 if ANC9==1 &qualreciv_IPT5_atanc9==.&IPT4==1&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)& (ipt5_date_ms!=date_anc5_ms)&
(ipt5_date_ms!=date_anc6_ms)& (ipt5_date_ms!=date_anc7_ms)&
(ipt5_date_ms!=date_anc8_ms)
label values qualreciv_IPT5_atanc9 yesno
label var qualreciv_IPT5_atanc9 "participants who qualified to receive IPT1 at ANC9" // this variable is for those who attended ANC9 and have not received IPT5 already

**overall (qualified to receive IPT5 irrespective of which ANC visit)
//yes=if participant qualified to receive IPT5 at any ANC visit
//no=participant did not qualify to receive IPT5 at all ANC visits
gen qualreciv_IPT5=1 if (qualreciv_IPT5_atanc5==1)&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)&IPT4==1&ANC5==1
replace qualreciv_IPT5=1 if (qualreciv_IPT5_atanc6==1)&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)&IPT4==1&ANC6==1
replace qualreciv_IPT5=1 if (qualreciv_IPT5_atanc7==1)&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)&IPT4==1&ANC7==1
replace qualreciv_IPT5=1 if (qualreciv_IPT5_atanc8==1)&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)&IPT4==1&ANC8==1
replace qualreciv_IPT5=1 if (qualreciv_IPT5_atanc9==1)&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)&IPT4==1&ANC9==1
replace qualreciv_IPT5=0 if qualreciv_IPT5==.&IPT4==1&ANC5==1&
(gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)
label val qualreciv_IPT5 qualreciv_IPT

```
label var qualreciv_IPT5 "Qualified to receive IPT5?"

**fidelity at IPT5
//yes=if participant qualified to receive IPT5 and received or did not qualify to receive IPT5 and did not receive
//no=if participant qualified to receive IPT5 but did not receive or did not qualify to receive IPT5 but received
tab qualreciv_IPT5 IPT5 if  (gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16),row
gen fidel_IPT5=1 if  (qualreciv_IPT5==1&IPT5==1)| (qualreciv_IPT5==0&IPT5==0) & (gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)
replace fidel_IPT5=0 if  (qualreciv_IPT5==1&IPT5==0)| (qualreciv_IPT5==0&IPT5==1)& (gestwk_ipt5_ms<13|gestwk_ipt5_ms>=16)
label val fidel_IPT5 yesno
label var fidel_IPT5 "Fidelity at IPT5"

// CREATION OF FIDELITY SCORE VARIABLE
egen fidscore= rowtotal (fidel_IPT1 fidel_IPT2 fidel_IPT3 fidel_IPT4 fidel_IPT5)
lab var fidscore "fidelity score"
gen levlfidscore=1 if fidscore>=3
replace levlfidscore=0 if fidscore<=2
label var levlfidscore "Level of fidelity"
label def levlfidscore 1 "High  (>=3 instances of fidelity)" 0 "Low  (<3 instaces of fidelity)"
label val levlfidscore levlfidscore
```

APPENDIX H: UNIVARIATE LOGISTIC REGRESSION RESULTS

Table 6:6: Univariable logistic regression of implementation fidelity score on pregnant women characteristics

	Univariable Logistic regression			
	Low (fidelity instances<3)	**High (≥3fidelity instances)**		
Variable	**N (%)**	**N (%)**	**OR (95% CI)**	**P-value**
Age group			1 (ref)	
15-19	48 (42.5)	91 (37.6)		
20-34	32 (28.3)	79 (32.6)	1.30 (1.166,1.454)	0.007
35+	33 (29.2)	72 (29.8)	1.15 (0.580,2.283)	0.688
Education level				
Not educated	18 (15.9)	29 (12)	1 (ref)	
Basic education	64 (56.6)	134 (55.4)	1.30 (0.774,2.182)	0.322
Post basic education	31 (27.4)	79 (32.6)	1.58 (0.836,2.993)	0.159
Employment status				
Unemployed	34 (30.1)	44 (18.2)	1 (ref)	
Employed	79 (69.9)	198 (81.8)	1.93 (1.392,2.694)	0.000
Religion				
Other religion	3 (2.7)	18 (7.4)	1 (ref)	
Christianity	110 (97.3)	224 (92.6)	0.34 (0.100,1.158)	0.084
Marital status				
Not married	45 (39.8)	108 (44.6)	1 (ref)	
Married	36 (31.9)	81 (33.5)	0.94 (0.581,1.512)	0.791
Cohabitating	32 (28.3)	53 (21.9)	0.69 (0.333,1.429)	0.318
Parity				
Nullipara	36 (31.9)	66 (27.3)	1 (ref)	
Primipara	28 (24.8)	67 (27.7)	1.31 (0.997,1.708)	0.053
Multipara	49 (43.4)	109 (45)	1.21 (0.826,1.783)	0.325
Gravidity				
Primigravida	25 (22.1)	50 (20.7)	1 (ref)	
Secundigravida	28 (24.8)	58 (24)	1.036 (0.595,1.804)	0.901
Multigravida	60 (53.1)	134 (55.4)	1.117 (0.692,1.802)	0.651

Number of ANC visits				
<4	65 (57.5)	50 (20.7)	1 (ref)	
>=4	48 (42.5)	192 (79.3)	5.20 (3.747,7.216)	0.000
Trimester of 1st ANC visit				
1st trimester	44 (38.9)	63 (26)	1 (ref)	
2nd trimester	54 (47.8)	152 (62.8)	1.97 (0.860,4.496)	0.109
3rd trimester	15 (13.3)	27 (11.2)	1.26 (0.623,2.537)	0.523
Number of ANC visits made one month apart				
<3	87 (77)	117 (48.3)	1 (ref)	
≥3	26 (23)	125 (51.7)	3.58 (2.763,4.626)	0.000
ANC visits made according to WHO FANC schedule				
Only 1 in any trimester	33 (29.2)	28 (11.6)	1 (ref)	
At least 1 in any 2 trimesters	64 (56.6)	156 (64.5)	2.84 (1.638,5.038)	0.000
At least 1 in all 3 trimesters	9 (8)	14 (5.8)	1.83 (0.693,4.853)	0.222
WHO-FANC	7 (6.2)	44 (18.2)	7.41 (2.838,19.34)	0.000