An assessment of malaria prevention, diagnosis and treatment services in Uganda

by

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Abstract

Government, donor partners, and the private sector invest large amounts of financial resources annually in malaria prevention and care. Despite substantial spending on malaria prevention programmes by 2019/2020, the disease still accounted for 13.3% Uganda's mortality, as well as 29.8% of outpatient visits and 34.9% of inpatient admissions. To combat malaria more effectively, it is critical to understand whether these substantial investments in malaria prevention and care reach those who are most vulnerable to malaria, and whether approved malaria diagnosis and treatment protocols are followed diligently. This PhD was thus structured to consider three distinct but related issues: (i) the equity of bed net use and ownership in 2009 and 2014, (ii) the uptake of malaria prophylaxis amongst pregnant women, and (iii) the relationship between financial incentives and appropriate malaria diagnosis and case management.

The first essay examines the equity in access to and utilisation of bed nets in 2009 and 2014. It was found that the availability of bed nets increased over time. Access to and use of bed nets became more equitable, with higher levels of access and use amongst poorer households. Households with access to at least one bed net rose from 59.2% to 94.1%. The percentage of households who slept under bed nets increased from 51.8% to 72.6%. The percentage of children under five years who slept under bed nets increased from 45.8% to 81.5%. The percentage of pregnant women who slept under bed nets increased from 78.6% to 83.8%.

Through recentered influence functions (RIF) decomposition method, the study examined whether the demographic factors were associated with the relationship between the wealth index and bed net utilisation in 2009 and 2014. Results suggest that in 2009, place of residence, number of nets in a household, mother's education level, region and household size were associated with the relationship between wealth index and bed net utilisation. In 2014, age of household members, and mother's education level were associated with the relationship between the wealth index and bed net utilisation. In both years having a mother with at least primary level of education was vital in promoting bed net utilisation.

The results further indicate that younger household members, women, household members from the northern region, household members from the poorest wealth quintile, mothers with a post-secondary education, and households with more bed nets and few members were more likely to sleep under bed nets in 2014.

The second essay reviews factors associated with uptake of intermittent preventive treatment (IPT) of three doses of Sulfadoxine-pyrimethamine (SP) (IPT-SP3) during pregnancy. The analysis indicated a double and notable improvement in uptake over time, from 9.91% in 2011 to 17.89% in 2016. However, the uptake was still far below the 79% target of Uganda's Health Sector Strategic Plan (Uganda Ministry of Health (MoH) 2014). Results showed that uptake was higher amongst younger women (under the age of 25 years) than older women (above the age of 34 years), higher amongst women who attended their first antenatal care (ANC) visit early (during the first trimester) than those who attended later (during the third trimester), higher amongst women from the upper wealth quintile than women from the poorest quintile, and higher amongst women from the northern region of Uganda than among women from the central region. Results also indicated that uptake of IPT-SP3 was lower amongst women from the western region than women from the central region. Findings from the pooled model (unrestricted) indicate that the relationship between IPT-SP3 and the covariates in the two different time period (2011 and 2016) have not changed.

The third and final essay focuses on the relationship between financial incentives and the likelihood of private providers adhering to national guidelines on malaria diagnosis and dispensing practices. The specific concern is that volume or revenue-based staff remuneration may provide a strong incentive for provision of malaria drugs to patients who have not yet tested for malaria. This tension is observed in a subsample where facilities do not have malaria testing capabilities and only sell malaria treatment and staff are paid based on the volume of drugs sold or the revenue.

The results suggest that the private healthcare providers who receive salaries are more likely to adhere to malaria treatment protocols. Descriptive findings indicate significant variations between drug-shop attendants and other private healthcare providers with regard to malaria diagnosis, antimalarial dispensing practices, and adhering to malaria treatment procedure.

Opsomming

Die regering, donateursvennote, en die private sektor belê jaarliks groot hoeveelhede finansiële hulpbronne in die voorkoming en behandeling van malaria. Ondanks aansienlike besteding aan malariavoorkomingsprogramme teen 2019/2020 was die siekte steeds verantwoordelik vir 13.3% van Uganda se sterftesyfer, sowel as 29.8% van buitepasiëntbesoeke en 34.9% van opnames van binnepasiënte. Om malaria doeltreffender te bestry, is dit van kritieke belang om

te verstaan of hierdie aansienlike beleggings in die voorkoming en behandeling van malaria diegene bereik wat die kwesbaarste vir malaria is, en of goedgekeurde diagnostiese en behandelingsprotokolle vir malaria nougeset gevolg word. Hierdie PhD was dus gestruktureer om drie verskillende maar verwante kwessies te oorweeg: (i) die ekwiteit van die gebruik en besit van bednette in 2009 en 2014, (ii) die opname van malaria-profilakse onder swanger vroue, en (iii) die verband tussen finansiële aansporings en die toepaslike malariadiagnose en gevallebestuur.

Die eerste opstel ondersoek die ekwiteit van toegang tot bednette en die gebruik daarvan in 2009 en 2014. Daar is bevind dat die beskikbaarheid van bednette oor tyd toegeneem het. Toegang tot en gebruik van bednette het billiker geword, met hoër vlakke van toegang en gebruik onder armer huishoudings. Huishoudings met toegang tot minstens een bednet het van 59.2% tot 94.1% gestyg. Die persentasie huishoudings wat onder bednette geslaap het, het van 51.8% tot 72.6% gestyg. Die persentasie kinders onder die ouderdom van vyf jaar wat onder bednette slaap het van 45.8% tot 81.5% gestyg. Die persentasie swanger vroue wat onder bednette slaap het van 78.6% tot 83.8% toegeneem. Die bevindings dui daarop dat jonger huishoudings, vroue, huishoudelike lede in die noordelike streek, huishoudings in die armste rykdomskwintiel, moeders met naskoolse opleiding, en huishoudings met meer bednette en min lede in 2014 meer geneig was om onder bednette te slaap.

Die tweede opstel ondersoek wat verband hou met die opname van intermitterende voorkomende behandeling tydens swangerskap van drie dosisse sulfadoxine-pyrimethamine. Die ontleding dui op 'n klein maar beduidende verbetering oor tyd, van 9.91% in 2011 tot 17.89% in 2016, in die persentasie vroue wat drie dosisse ontvang het. Die verbetering was egter nog ver onder die teiken van 79% wat deur Uganda se Strategiese Plan vir die Gesondheidsektor gestel is. Bevindinge toon dat die opname hoër was onder jonger vroue (onder die ouderdom van 25 jaar) as onder ouer vroue (bo die ouderdom van 34 jaar), en hoër onder vroue wat hul eerste voorgeboortesorgbesoek vroeg bygewoon het (binne die eerste trimester) teenoor diegene wat dit later bygewoon het (in die derde trimester), hoër onder vroue uit die boonste rykdomskwintiel as onder vroue uit die armste kwintiel, hoër onder opgeleide vroue teenoor dié met geen opleiding, en hoër onder vroue uit die noordelike as die sentrale streek van Uganda. Resultate dui ook aan dat die opname van drie dosisse laer was onder vroue uit die westelike streek, vergeleke met die sentrale streek.

Die derde en laaste opstel fokus op die verband tussen finansiële aansporings en die waarskynlikheid dat private verskaffers die nasionale riglyne ten opsigte van diagnose en reseptering van malaria volg. Beskrywende bevindings dui op beduidende variasies tussen medisynewinkels se assistente en ander private verskaffers van gesondheidsorg rakende malariadiagnose, behandeling, en die nakoming van die prosedure vir die behandeling van malaria. Die resultate van die studie dui daarop dat die finansiële aansporings wat aan private verskaffers van gesondheidsorg gegee word positief verband hou met die nakoming van behandelingsprotokolle vir malaria. Bevindinge toon dat pasiënte met negatiewe resultate van malaria waarskynlik antibiotika ontvang sonder dat volle bloedtellings, soos aanbeveel deur die kliniese riglyne, gedoen word.

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List of abbreviations

ANC	antenatal care
ACT	artemisinin-based combination therapy
CI	concentration index
DHO	District Health Officers
DHMTs	District Health Management Teams
DOT	directly observed therapy
ECI	Erreygers concentration index
FFS	fee for service
GFATM	Global Fund for AIDS, TB, and Malaria
GCI	generalised concentration index
HSDP	Health Sector Development Plan
HSSP	Health Sector Strategic Plan
HC	health centres
HIV	human immunodeficiency virus
ITNs	insecticide-treated nets
IPT	intermittent preventive treatment
LLINs	long-lasting insecticide nets
LPM	linear probability model
MoH	Ministry of Health
MCA	multiple correspondence analysis
ML	maximum likelihood
NDA	National Drug Authority
NMCP	national malaria control programmes
OLS	ordinary least squares
PHP	private health providers
P4P	pay for performance
RDT	rapid diagnostic tests
SCI	standardised concentration index

SE	standard error
SSA	sub-Saharan Africa
SP	Sulfadoxine-pyrimethamine
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic and Health Survey
ULII	Uganda Legal Information Institute
UMIS	Uganda Malaria Indicator Surveys
UNHC	Uganda National Housing Census
UNMCP	Uganda National Malaria Control Program
VIF	variance inflation factor
WHO	World Health Organization

Chapter 1

Introduction and background

Malaria remains a challenge in the sub-Saharan Africa (SSA) region; hence, research contributions towards fighting the disease are vital. In Section 1.1, the thesis provides an overview of the challenges in the SSA region, focusing primarily on the current malaria situation in Uganda. Section 1.2 provides a discussion of the motivation behind the selection of the research questions. The selected research questions linked to the healthcare demand and supply constraints of the disease are then specified in Section 1.2. The structure of the thesis and the methodology used in the research follow, in Section 1.3. The chapter concludes with Section 1.4, which provides a summary of the findings from the three essays.

1.1 Malaria in Uganda

In 2018, 93% of reported malaria cases and 85% of malaria-related deaths globally occurred in SSA (World Health Organization (WHO) 2019). Uganda had the third highest number of reported malaria cases, after Nigeria (25%) and Democratic Republic of Congo (12%) (WHO 2019). Data from public hospital records further indicate that clinically diagnosed malaria in Uganda was responsible for 29.8% of all outpatient department visits, 34.9% of all inpatient department visits, and 13.3% of all hospital deaths in 2019/2020 (Uganda Ministry of Health (MoH) 2020). Given that public healthcare facilities treat only 37% of malaria patients, a considerable number of malaria-related inpatient admissions, outpatient visits, and deaths are not accounted for in the official statistics of the public health sector (Rutebemberwa *et al.* 2009; Konde-Lule *et al.* 2010). The disease remains a burden in Uganda, one that requires substantial preventive and curative healthcare investments by the public- and private sectors, as well as donor partners.

Indeed, under the banner of the Roll Back Malaria campaign, Uganda's MoH, through the Uganda National Malaria Control Program (UNMCP), the government, the private sector, and development partners have made substantial preventive and curative healthcare investments in combating the disease (Uganda MoH 2014). For example, in 2017/2018, malaria accounted for 12% of government's disease expenditure, 32% of the private sector's disease expenditure, and 7% of the development partners' disease expenditure (Uganda MoH 2018a). In all, the government, development partners, private sector and households, are committed to the fight

against malaria, and have invested substantially in preventive and curative healthcare relating to the disease.

1.2 Rationale for assessment of preventive and curative care related to malaria

As noted above, malaria remains a public health concern in SSA, and there is evidence that the disease is negatively associated with economic growth and low wellbeing of households (Gallup and Sachs 2001; Malaney *et al*. 2004; Nabyonga-Orem *et al*. 2012). Gallup and Sachs (2001) showed that malaria-endemic countries grew by 1.3% per year less between 1965 and 1990, and that a 10% reduction in malaria was associated with 0.3% increase in growth per year. Malaney *et al*. (2004) reported that, through direct and indirect costs, malaria limits the ability of households to invest in physical and financial capital.

A study by Nabyonga-Orem *et al*. (2012) suggested that, in Uganda, a unit increase in malaria morbidity (holding other explanatory variables constant) decreased per capita gross domestic product by US$1.93. Although methodologies used by the above studies to estimate the malaria burden were criticised by Chima *et al*. (2003), there is consensus that poor health negatively affects a country's productivity and aggregate output, indicating the need for substantial investment in and provision of quality healthcare.

The prevention and cure of malaria need to be viewed against the broader backdrop of economic theory models of human capital investment. Proponents of the neo-classical consumption and investment theory argue that health consists of stock and flow components (Grossman 1972). Grossman (1972) assumed that people are initially born with a stock of health that increases, deteriorates, or is maintained during the course of a lifetime. The model suggests that mainly age and education level influence households' investment decisions in health (Grossman 1972). In essence, as household members grow older, their health deteriorates, and, hence, greater investments in health are required. Likewise, the more educated household members are, the more efficiently they produce health. Therefore, gains in education (better treatment adherence, reading, and comprehending healthcare information) are associated with more health stock for each unit of health investment. Thus, in short, neo-classical economists believe that age and education positively influence investments in healthcare.

Evidence from empirically grounded studies suggests that the health investment behaviour in low-income countries differs from that suggested by neo-classical economists (Kremer and

Miguel 2007; Ashraf *et al.* 2010; Cohen and Dupas 2010; Dupas 2011b). Researchers have argued that households from low-income countries face different investment healthcare constraints, which is why their healthcare investment behaviours differ. To understand arguments from empirically grounded studies, the section that follows discusses Dupas's (2011b) model of investment in healthcare.

Assume a simple household utility function:

$$U_t = U(H_t C_t L_t) \qquad \text{Equation 1:1}$$

where H_t is the stock of health for households, C_t is the consumption of other goods, and L_t represents leisure. Health stock represents commodities that are valued by households, and households have control over these, for example, households who value sleeping under bed nets and who have control over who utilises bed nets. Dupas (2011b) assumes that households make two types of health investments: preventive and curative. Investment in preventive healthcare reduces the risk of bad health stock, whereas investment in curative healthcare restores the health stock when a disease occurs. Therefore, health stock depends on the previous investments made in preventive healthcare and the investment in curative healthcare to restore health stock.

Researchers cited financial constraints (lack of credit, insufficient savings, and low liquidity) as the primary factor that limits investment in preventive healthcare. In this regard, Kremer and Miguel (2007) found that, in Kenya, the uptake of deworming drugs was approximately 80% when the drugs were provided free of charge via schools. However, uptake reduced to 20% when it was priced at US$0.30. Ashraf *et al*. (2010) found that, in Zambia, the uptake of water-treatment products dropped from 80% to 50% when the prices increased from US$0.10 to US$0.25. Evidence from these studies suggests that financial constraints limit investments in preventive healthcare in low-income countries, despite the fact that the benefits of preventing the disease outweigh the cost.

To counter financial constraints, donor partners and governments have made substantial investments in preventive healthcare in low-income countries. For instance, between 2014 and 2016, 505 million insecticide-treated nets (ITNs) were delivered to the SSA region (WHO 2017a). However, even with this substantial investment in preventative healthcare, ownership and utilisation may be uneven. Hence, it is relevant to establish the level of equity of ownership and utilisation of investments by the population, in order to restore health stock. It is not clear

whether vulnerable subgroups such as children (particularly those younger than five years), pregnant women, and the poor benefitted as much from these mass campaigns, given that they are particularly prone to malaria, often with life-threatening consequences (WHO 2017a).

Therefore, this thesis examines the level of equity ownership and utilisation of bed nets following the mass distribution campaign.

Researchers also cite a lack of information on the returns of investing in preventive healthcare as a factor that limits investment in preventive healthcare in low-income countries. Dupas (2011a) reported that adolescent girls in Kenya changed their sexual behaviour in response to information on the relative risk of contracting the human immunodeficiency virus (HIV) according to type of partner. Evidence from Dupas's (2011a) study suggests that households in low-income countries do indeed respond to preventive healthcare information. However, despite the awareness of the effectiveness of the uptake of three doses of intermittent preventive treatment (IPT) with Sulfadoxine-pyrimethamine (SP) (IPT-SP3) to prevent malaria during pregnancy, its coverage remains low in the SSA region. By 2016, only 23 WHO member states were adhering to the policy, and only 19% of pregnant women had received the recommended dosage of IPT-SP3 (WHO 2017a).

This suggests that awareness of the returns on investing in preventive healthcare alone does not necessarily lead to an increase in coverage of the prevention. On the other hand, understanding demand and supply factors that are associated with uptake of IPT-SP3 should inform policies aimed at increasing the low coverage of IPT-SP3. Hence, this study examines the demand-side factors that are associated with the uptake of IPT-SP3 in 2011 and 2016.

Evidence from literature shows that presentation of information by patient improves healthcare providers' diagnosis and treatment (Satyanarayana *et al*. 2016; Miller *et al*. 2018; Björkman *et al.* 2016). For instance, Satyanarayana *et al.*'s (2016) study in India found that third-party diagnoses presented with a prescription limited problem of imperfect agency, and increased correct case management of tuberculosis. However, studies elsewhere have shown that, despite the burden of malaria and large-scale exposure to messages on malaria diagnoses and treatment in SSA, most patients and private healthcare providers have inadequate information on the transmission and treatment of malaria (Nuwaha 2002; Comoro *et al*. 2003; Uganda MoH 2014).

The substantial information asymmetries with regard to malaria diagnosis and treatment between patients and healthcare providers implies that patients must rely on healthcare

providers for the appropriate malaria diagnosis and treatment (Björkman *et al.* 2016; Fitzpatrick 2020). Healthcare providers may overcharge uninformed patients, provide low-quality and inaccurate malaria diagnosis and therefore unnecessary treatment which is inappropriate provider agency (Björkman *et al.* 2016). For informed patients, providers may slightly lower the prices, but are unlikely to deny sales. Hence, they provide inappropriate malaria diagnoses and treatment services (Fitzpatrick 2020).

Research has shown that, if profit coincides with recommendations, financial incentives may encourage appropriate Imperfect agency (correct diagnosis and treatment) (McGuire 2000). In essence, imperfect agency may limit unnecessary treatment by encouraging providers to advise and sell diagnostic testing (McGuire 2000). McGuire (2000) found that useful agency may aid uptake of more expensive first-line treatment instead of cheaper, ineffective treatment.

Literature also suggests that rare correct diagnoses and incorrect treatment by private healthcare facilities in low-income settings (prevalent in rural areas) are mainly due to differences in doctors' competence and the incentives they receive (Das and Hammer 2007; Das *et al*. 2016; Fitzpatrick 2020). The association between financial incentives and imperfect agency has not been adequately researched in low-income setting when compared to developed economies (Das and Hammer 2007; Das *et al*. 2016).

Hence, the present study assesses the differences in doctors' competence and differences in incentives for private healthcare providers with regard to adherence to malaria diagnosis and treatment practices.

As most countries in the SSA region share similar socio-economic realities and public health challenges, this study provides policy recommendations aimed at improving the uptake of preventive healthcare and provision of high-quality curative healthcare in the SSA region by addressing the following questions:

i. How equitable was ownership and utilisation of long-lasting insecticide nets in Uganda between 2009 and 2014? What are the likely causes of the change in health inequalities in these two periods?
ii. What were the predictors of the uptake of three or more doses of intermittent preventive treatment in Uganda in 2011 and 2016 (given the 2012 change in WHO policy to recommend three doses)?

iii. What is the relationship between the payment mode and the malaria diagnosis and drug-dispensing practices of private healthcare providers in Uganda?

1.3 Structure of the thesis

The thesis comprises three essays. Essay 1 examines equity of household bed net ownership and bed net utilisation by households and malaria-vulnerable groups from 2009 to 2014. Essay 2 assesses the factors associated with the uptake of the recommended IPT-SP3 in 2011 and 2016. Essay 3 investigates the relationship between the payment mode and malaria diagnosis and drug-dispensing practices of private healthcare providers.

Chapter 2: How did the equity of ownership and utilisation of bed nets change between 2009 and 2014 in Uganda?

Investment in the utilisation of long-lasting insecticide nets (LLINs) remains one of the most effective life-saving interventions in the fight against malaria (Noor *et al*. 2008; White *et al.* 2011; Silumbe *et al.* 2015). That is why, with the support of development partners, Uganda rolled out its first countrywide campaign of mass distribution of LLINs from 2013 to 2014, and launched the second in 2017 to 2018 (Uganda Health Monitoring Unit 2014; Uganda MoH 2018a). However, even with the mass distribution of these nets, coverage can be uneven and inequitable, due to various demand- and supply-side obstacles.

As the first objective, the study examined changes in access to bed nets (defined as the percentage of households that owned at least one bed net) and universal coverage (defined as the percentage of households that owned one bed net for every two people). The analysis included the percentage of household members and malaria-vulnerable groups[1] who utilised bed nets in 2009 and 2014. Overall, results indicated there were statistically significant improvements in both access to bed nets (above the 80% Roll Back Malaria target) and universal coverage (but still below the 80% Roll Back Malaria target) in 2014.

Likewise, there were statistically significant changes in the percentage of the population who slept under bed nets between 2009 and 2014 (below the 80% Roll Back Malaria target),

[1] Malaria-vulnerable groups include children younger than five years and pregnant women.

including the percentage of children under five years (above the 80% Roll Back Malaria target) and pregnant women (below the 80% Roll Back Malaria target).

For the second objective, the research utilised the concentration indices of Wagstaff (2005) and Erreygers *et al.* (2012) to measure the level of equity in access to bed nets, in universal coverage, and in the utilisation of bed nets by the population and malaria-vulnerable groups.

Through the recentered influence functions (RIF) decomposition method, the study also examined the covariates of the bednet health inequality in both 2009 and 2014.

Results suggest that, in 2014, access to bed nets improved (although not significantly), and was concentrated amongst households from poorer wealth quintiles. Results also indicate that, in 2014, universal coverage significantly improved, although it was still concentrated amongst households from richer wealth quintiles. Likewise, results show improvements in utilisation of bed nets by households in the poorer wealth quintiles (although not significant). Bed net utilisation amongst malaria-vulnerable groups was concentrated in the poorer wealth quintiles, significantly amongst children under five years, but not significantly amongst pregnant women.

Results from the RIF decomposition suggest that in 2009, place of residence, number of nets in a household, mother's education level, region and household size were associated with the relationship between the wealth index and bed net utilisation. In 2014, age of household members, and mother's education level were associated with the relationship between the wealth index and bed net utilisation.

As a third objective, the study examined intra-household attributes associated with bed net utilisation in 2009 and in 2014. Results showed that the age of household members, age of household head, wealth quintile, region, mother's education level, size of household, and number of nets in the household were significantly associated with the use of bed nets in 2014.

Chapter 3: Predictors of IPT uptake in Uganda

Malaria in pregnancy remains a public health concern in Uganda, despite the update of guidelines on uptake of IPT-SP from two or more doses to three or more (Uganda MoH 2016b). Statistics also suggest that the uptake of IPT-SP3 (16.8% by 2016) was still below the 79% target of Health Sector Development Plan (Uganda MoH 2014; Uganda Bureau of Statistics (UBoS) and ICF International 2017).

Understanding the factors that are associated with the uptake of the recommended IPT-SP3 by women is vital in formulating policy solutions to overcome the low uptake. Hence, this study utilised data from the 2011 and 2016 Uganda Demographic Health Surveys to examine the demand-side factors associated with the uptake of three or more doses of IPT.

Two multivariate regressions analyses (unrestricted and restricted) were employed to examine the factors associated with uptake of the recommended dosage of IPT-SP3 in 2011 and in 2016. The sample was restricted by excluding women who had started attending antenatal care (ANC) late (during their third trimester) and women who had attended fewer than three ANC visits.

Results suggest a double significant improvement in the percentage of women who received IPT-SP3, from 9.91% in 2011 to 17.89% in 2016, which was still below the 80% and 79% operational success targets of the WHO and Health Sector Development Plan respectively (Uganda MoH 2014; WHO 2013). Model estimates indicated that the age of the woman, wealth quintile, parity, region, and timing of first ANC visit were the factors associated with uptake of IPT-SP3 in 2011 and 2016. Pooled model (unrestricted) estimates indicate that the relationship between IPT-SP3 and the covariates in the two different time period (2011 and 2016) did not change.

Chapter 4: Examining the relationship between the reimbursement of private healthcare providers and compliance with malaria diagnosis and drug-dispensing guidelines.

A total of 63% of patients with malaria or fever in Uganda consult private for-profit healthcare providers (these include private hospitals, pharmacies, clinics, and drug shops) (Konde-Lule *et al*. 2010; Rutebemberwa *et al*. 2009). Private for-profit providers in Uganda fill significant service delivery gaps created by staff shortages and regular drug stock-outs at public health facilities. Adherence to standard malaria diagnosis and drug-dispensing practices by private for-profit healthcare providers is critical for effective malaria treatment and the fight against the disease. Thus, this essay examines how deviations from protocols for malaria diagnosis and drug dispensing differ across private healthcare providers, and whether the method of payment and associated incentives help to explain these differences.

Facility survey and patient exit interviews at 101 private healthcare providers in Iganga district, located in the eastern region of Uganda, were conducted between August and October 2018. In the facility survey, data were collected on the characteristics of providers, their method of

payment (either fixed salary or payments based on drug/patient volumes), the malaria knowledge of staff, and their self-reported drug-dispensing practices. The diagnosis and drug-dispensing experiences of 421 exit patients were recorded. Descriptive statistics and logit multivariate analyses were used to examine the relationship between the providers' payment methods and the likelihood of their dispensing malaria treatment without following protocols (Uganda MoH 2016b).

Descriptive results indicated significant variations between other private healthcare providers and drug-shop attendants concerning malaria diagnosis, antimalarial dispensing practices, and adhering to malaria treatment procedures. Results suggested over-prescription of IVs by other private health facilities. Results showed prescription of antibiotics to patients with negative malaria test results in both other private healthcare facilities and drug shops. Multivariate analyses results suggested that the financial incentives given to private healthcare providers are positively associated with adhering to malaria treatment protocols.

1.4 Thesis outline

The structure of the remainder of the thesis is as follows. Chapter 2 (Essay 1) presents research on equity ownership and utilisation of bed nets in 2009 and in 2014. Chapter 3 (Essay 2) provides the analysis of factors associated with the uptake of three or more doses of IPT-SP in 2011 and 2016. Chapter 4 (Essay 3) investigates differences between private for-profit healthcare providers in terms of malaria diagnosis and drug-dispensing practices. Chapter 5 contains the conclusions, the implications for practice, and scope for future research.

Chapter 2

How did the equity of ownership and utilisation of bed nets in Uganda change in 2009 and 2014?

2.1 Introduction

Investment in insecticide-treated nets (ITNs) and, specifically, long-lasting insecticide nets (LLINs) remains the most cost-effective and efficient vector-control strategy in reducing both malaria mortality and morbidity in sub-Saharan Africa (SSA) (Noor *et al.* 2008; Yukich *et al.* 2008; Silumbe *et al.* 2015). However, investment in preventive methods (like LLINs) by households in developing countries is known to be hampered by financial constraints in the form of a lack of credit, insufficient savings, and low liquidity (Dupas 2009, 2011b). There is evidence that pregnant women in Kenya took up a mosquito net when provided one free of charge during antenatal care (ANC) visits, while only 40% purchased the same bed net when the price was US$0.60 (Cohen and Dupas 2010). With the delivery of 505 million LLINs between 2014 and 2016 by development partners to the respective national malaria control programmes of malaria-endemic SSA countries, households' access to and use of malaria-preventive methods were expected to increase (World Health Organization (WHO) 2017a).

This essay considers how the equity of bed nets changed between 2009 and 2014, following the mass distribution of bed nets in 2013. Through recentered influence functions (RIF) decomposition method, the study assessed likely associations between demographic factors and health inequality in 2009 and 2014. The mass distribution of bed nets is expected to have addressed constraints to access and affordability, and brought Uganda closer to its set targets. Although the study design did not allow inference of causality on whether the mass distribution improved bed net distribution and utilisation, it yielded valuable knowledge on whether improvement in access to bed nets was associated with improved equity in ownership and whether having access to nets translated to greater utilisation of the nets. This focus is in line with the observations made by Dupas (2011), highlighting that access is not the only constraint to uptake. Even with the mass distribution of bed nets, household ownership and utilisation of bed nets can remain low, and be uneven and inequitable, due to various demand- and supply-side barriers.

Distribution of LLINs in Uganda

In conformity with the Roll Back Malaria initiative, the Abuja Declaration, and the United Nations Millennium Goals, the Ugandan government established the Uganda National Malaria Control Program (UNMCP) in 1995 (Uganda MoH 2014). The primary role of the UNMCP was to increase universal coverage (access and use) of malaria control strategies. The UNMCP adopted vector-control strategies like LLINs, chemoprevention (providing drugs that destroy the infection), intermittent preventive treatment (IPT), and case management (Uganda MoH 2014). The UNMCP adopted LLINs as the primary vector-control strategy (Uganda Health Monitoring Unit 2014).

The UNMCP has distributed LLINs mainly through mass distribution campaigns and in ANC and immunisation clinics, although there are other distribution channels, such as the distribution of vouchers in public areas and schools (WHO 2013; Uganda Health Monitoring Unit 2014).

In 2002, the UNMCP provided free ITNs to malaria-vulnerable groups (pregnant women and children under the age of five years) in areas of high malaria transmission during ANC visits (Mpeka *et al.* 2007). The UNMCP also provided subsidised bed nets through the private sector, and full-cost bed nets were commercially available (Mpeka *et al.* 2007). By 2006, 34% of households had access to at least one bed net ('access'), and 13% of households had one bed net for every two people ('universal coverage'), both still below the 80% Roll Back Malaria target. Utilisation of bed nets by the population was at 17%, use by children under the age of five years was at 22%, and use by pregnant women stood at 24%, again below the 80% Roll Back Malaria target (WHO 2005; Uganda Bureau of Statistics (UBOS) and Macro International 2007).

From 2007 to 2009, funded by the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), the UNMCP carried out its first campaign of targeted community distribution of 7 million bed nets (Mpeka *et al.* 2007). The objective of the campaign was to increase bed net coverage among the most vulnerable groups (children under the age of five years and pregnant women) to at least 90% by the end of 2010 (Mpeka *et al.* 2007). However, despite this free and targeted distribution, the 80% Roll Back Malaria target set by the WHO (2005) was not achieved. Overall, 74% of households had access to bed nets, and 38% of households had

universal coverage (see Figure 2.1). A total of 50% of children under five years, 59% of pregnant women, and 44% of the population utilised bed nets (see Figure 2.2).

The UNMCP launched its first countrywide campaign to distribute 21 million LLINs to over 41 million individuals in May 2013 (Uganda Health Monitoring Unit 2014). Development partners like the GFATM, the United Kingdom's Department for International Development, the USA's President's Malaria Initiative, and the Malaria Consortium supported this campaign (Uganda Health Monitoring Unit 2014). The strategy of the mass distribution campaign was universal coverage. In Uganda, universal coverage was defined as one LLIN for every two persons in a household (Uganda Health Monitoring Unit 2014). Nets were brought into the country and stored at a central location. The nets were then transported to districts and, thereafter distributed at sub-county level (Uganda Health Monitoring Unit 2014). From 2017 to November 2018, a second mass distribution campaign distributed 24 million LLINs (Uganda MoH 2018b).

This essay studies whether, following the 2013 mass distribution campaign, there was a change in horizontal equity in household ownership of bed nets and vertical equity in utilisation of bed nets[2] by the household members and malaria-vulnerable groups, by comparing data for 2009 and 2014.

Horizontal equity would require that individuals or social groups with the same level of need are treated equally (Mooney and Jan 1997). This means that poorer households should have access to bed nets following mass distributions. Vertical equity requires that individuals or social groups with unequal needs are treated proportionately differently (Mooney and Jan 1997). The WHO (2017b, 2018) considers children under five years and pregnant women to be in greater need of bed nets than other household members.

The rationale for the choice of these two groups is as follows. In high transmission areas like Uganda, partial immunity to the disease is acquired during childhood. In such settings, the majority of malaria cases, and particularly severe cases with rapid progression to death, occur in young children without acquired immunity (WHO 2018). Women in high transmission areas where levels of acquired immunity tend to be high, plasmodium falciparum infection causes malaria to usually be asymptomatic during pregnancy. However, parasites may be present in the placenta, and may contribute to maternal anaemia, even in the absence of documented

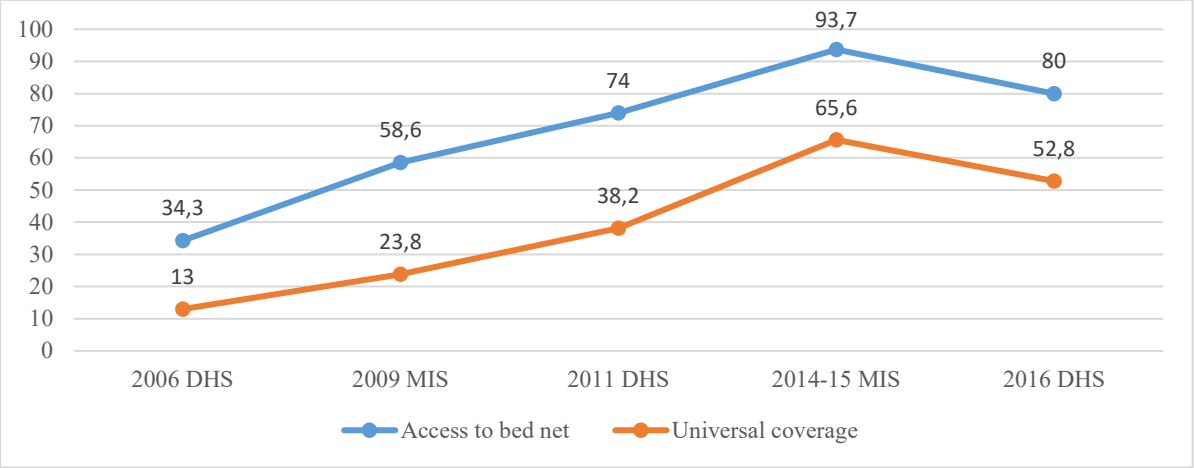
[2] Bed nets for this study include LLINs, ITNs, and all other mosquito bed nets.

peripheral parasitaemia (WHO 2017b). Therefore, it is essential to examine the change in utilisation and ownership of bed nets of these two malaria-vulnerable groups.

Studies elsewhere have reported misuse of bed nets (Minakawa *et al.* 2008; Matovu *et al.* 2009; Pulford *et al*. 2011; Koenker *et al.* 2013), indicating that merely determining levels of ownership is not sufficient to inform campaigns. For example, a study in Kenya showed that households were using the distributed bed nets to dry fish in the fishing villages along Lake Victoria (Minakawa *et al.* 2008). Other studies reported low usage of bed nets amongst adults, due to the discomfort caused by the bed nets (Matovu *et al.* 2009; Pulford *et al*. 2011; Koenker *et al.* 2013). Therefore, it was considered important in the present study to establish whether bed nets were utilised appropriately by the household members.

Thus, this essay assesses the level of horizontal equity (across the different socio-economic groups) and vertical equity (across malaria-vulnerable groups) in ownership and utilisation of bed nets in 2009 and 2014. Additionally, the essay examines intra-household factors associated with bed net utilisation in 2009 and 2014. It should be noted that this was a study to determine the state of affairs before and after the distribution campaign; therefore, no causal claims are made. While this is a limitation, the results reveal the magnitude of the effect, creating a compelling case that the increases may be largely attributable to the 2013 mass distribution campaign. This contributes to existing evidence of the positive contribution of campaigns to distribute bed nets to fight malaria in African countries. More broadly, it also provides observational evidence of how the reduction of availability and affordability constraints can expand the ownership and utilisation of bed nets in areas with a high malaria burden (Cohen and Dupas 2010).

Figure 2.1 Access to bed nets and universal coverage in Uganda from 2011 to 2016

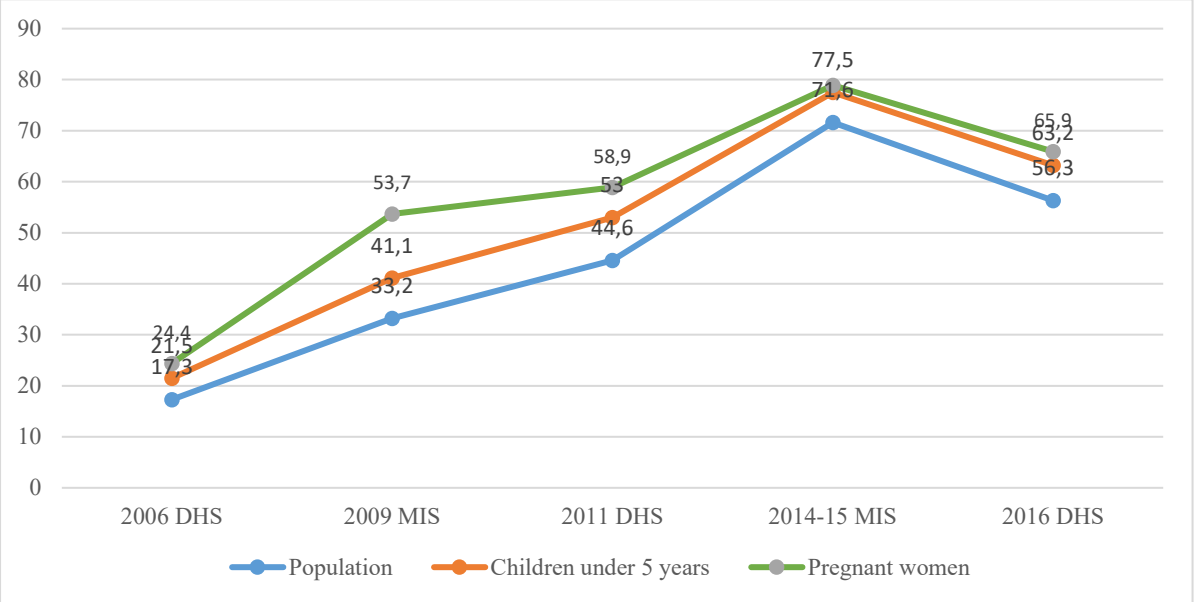


Source: UBOS and ICF International, 2007, 2012, 2015, 2017

Notes

1. *Access to bed nets* refers to households that owned at least one bed net.
2. *Universal coverage* refers to households that owned one bed net per two household members.

Figure 2.2 Utilisation of bed nets by population, children under five years, and pregnant women in Uganda from 2011 to 2016



Source: UBOS and ICF International, 2007, 2012, 2015, 2017

2.2 Literature review

2.2.1 Conceptual approaches to equity in health

Theories of justice

All residents in a political jurisdiction ought to have equal opportunities for healthcare in order to flourish. For people to flourish, justice and fairness in goods distribution, welfare, and rights have to be considered. Hence, the concept of justice in the provision of healthcare services is relevant in understanding the importance of equity in health.

Concepts of equity are grounded in different theories of justice (Pereira 1989; Rawls 1999). The theories commonly applied to equity analysis include distribution according to entitlement, the theory of a decent minimum, Rawlsian maximin theory, utilitarian theory, and egalitarianism theory.

Distribution according to entitlement

The theory of entitlement provides that people deserve to own anything, provided it was obtained fairly, either through hard work, reallocation by the state of things that were obtained illegally, or inheritance (Pereira 1989; Mooney 1992). The theory provides that the well-to-do have no obligation to help the less fortunate, that the distribution of entitlements is mostly a matter of luck, and that the lucky ones have no duty to look after the unlucky (Mooney 1992).

Entitlement theory is essentially a procedural theory, in that whether a distribution is considered equitable depends on how it is reached. If the process of reaching a given distribution is just and fair, then such a distribution is considered equitable, regardless of the final distributional shares across the population. The limitation of applying this theory to health is how to assess equity in health and healthcare (Pereira 1989); that is, how to determine how health or healthcare was acquired. For example, if a baby were born with hereditary disorders, entitlement theory would hold such a condition to be fair because it was inherited (acquired justly), even when the disorder could have been avoided (treated).

The theory also suggests that no one has a right to receive healthcare unless it is obtained competitively, via the marketplace (Pereira 1989). Thus, providing incentives or subsidies to those who are less likely to obtain healthcare services (e.g., the poor) is considered unjust. Similarly, entitlement theory does not consider the role of social goods such as information or pervasion of negative externalities in the healthcare market. Overall, Pereira (1989) concludes

that pursuing such an approach to equity would produce a structure that is disadvantageous to the poor and the sick, as entitlement theory attaches little importance to the disadvantaged.

Theory of the decent minimum

In response to the limitations of the entitlement approach to equity, an approach referred to as the decent minimum, which provides a safety net to everybody, was proposed (Pereira 1989; Mooney 1992). A decent minimum is the lowest level, below which humankind should not be permitted to fall (e.g., distribution of a minimum standard of healthcare). If an acceptable minimum were to be established, then analysing equity based on this approach entails determining the proportion of those below the minimum and the total amount of the goods (healthcare) required to improve the proportion that is below the acceptable minimum level.

The difficulty with applying this approach is that it necessitates evaluation of what comprises the decent minimum (Pereira 1989). Mooney and Jan (1997) and others have commented that it is not clear who in society is to make these value judgments to set a decent minimum level of healthcare. In the absence of a benchmark for a decent minimum, Rawls (1999) advocates a theory that gives the highest priority to the poorest in society, discussed below.

Rawlsian maximin theory

This theory is based on the idea that the worst off in society should be given the highest priority (Mooney 1992; Rawls 1999). Applying the Rawlsian maximin theory to health implies that policies to address inequities in health or healthcare are justified only if they benefit the least advantaged (Pereira 1989). However, this approach presents two practical difficulties. The first is how to determine who is least advantaged — whether it should be based on their general consumption of essential goods, or only with regard to health (or healthcare). The second challenge is to distinguish the health or healthcare inequities that, if addressed, would benefit the least advantaged. These two challenges are the basic critiques of pursuing the Rawlsian maximin theory of equity. The utilitarian theory of justice is reviewed in the next section.

Utilitarianism

The goal of this theory is to serve the greatest good for the largest number (Mooney 1992; Rawls 1999). This implies that resources should be allocated in such a way as to maximise the aggregate utility (e.g., health). The theory is based on the assumption that society is ordered justly (Rawls 1999), that society's institutions are arranged to achieve the most significant net

balance of satisfaction, achieved for all individuals in society. According to Rawls (1999), the right distribution is one that yields the maximum fulfilment. This implies that, in terms of healthcare, if rich people respond better to a given course of treatment, they derive greater utility than poor people do, and, hence, more resources should be directed to rich people to maximise overall utility.

Researchers have criticised the utilitarian approach to equity. For instance, Saxena *et al*. (2002) found that the theory maximises the sum of individual utilities rather than the interpersonal distribution of the sum. Rawls (1999) also contended that utilitarianism does not take the distribution between persons seriously, and that utilitarian theory is primarily concerned with efficiency, not equity. Thus, following such an approach may yield an efficient distribution, but not one that conforms to the concept of equity (Pereira 1989).

Egalitarianism

This theory relates to equalising individual net benefit (e.g., health status) or the opportunities for such benefits (Pereira 1989). Egality holds that an allocation scheme should treat people the same in the allocation or transfer of resources. Egalitarianism has been widely criticised for lacking the specificity required for empirical analysis, and for failing to prove conclusively why equality is necessary (Pereira 1989; Mooney and Jan 1997). For example, Mooney and Jan (1997) argued against the notion of equality of health, considering it an unachievable and undesirable goal. From a practical point of view, questions arise as to whether equality of resources would simply relate to equality of access, or the use of resources in equal quantities, and whether this approach is applicable to both public and private healthcare, or to publicly provided healthcare only. These questions make it difficult to apply the egality approach to specific health policies (Pereira 1989; Mooney and Jan 1997).

Many of the empirical analyses of equity in health and healthcare were based on egalitarian theory; that is, examining deviations from the equal allocation of the variable of interest across population groups (Van Doorslaer *et al*. 1997; McIntyre *et al.* 2002; O'Donnell *et al*. 2008). Therefore, in the present study the egalitarian theory of justice that had been applied in examining deviations from the equal allocation of the variable of interest across population groups (Van Doorslaer *et al.* 1997; McIntyre *et al.* 2002) was applied.

2.2.2 Equity in health

The concept of equity in health is subject to many different interpretations and definitions by researchers. For the context of the present study, the focus was on definitions of equity in terms of access and need.

Equity as access

Some researchers define equity in health as equalisation of opportunity to access health services. For instance, Bryant *et al.* (1997) argued that all human beings have equal rights, irrespective of age, sex, race, religion, and in many other aspects. Thus, for human rights not to be violated, everyone should have an equal opportunity to access services, and should bear an equal burden in terms of costs (both financial and intangible) when accessing health services (Bryant *et al.* 1997). Proponents of equal opportunity to access also reason that people should have access to the same primary service without discrimination based on geographical or economic factors (Kreng and Yang 2011). Researchers have proposed that equalisation of opportunity to access health services should be done according to three domains; the amount of service, the quality of service, and the burden of cost (Kreng and Yang 2011).

Some researchers claim that the number or amount of services made available to groups or individuals should be the same (Culyer and Wagstaff 1993; Kreng and Yang 2011). Others argue that the quality of services made available should be the same (Eaves 1998; Kreng and Yang 2011), while other studies reasoned that the cost burden of making the services available should be equalised (Eaves 1998; Mooney *et al.* 2002).

The description of equity in health as equal opportunity to access services may not suffice in the context of this study, because some groups or individuals have a higher prevalence of malaria than others, such as children under the age of five years and pregnant women (WHO 2005). Therefore, the definition of equity in health in the context of this study may include another dimension, like equalisation in the use of health services.

Equity and need

Equity can also be defined based on differences in needs (Eaves 1998; Mooney 2000; Saxena *et al.* 2002). Differences in needs implies that some sections (or members) of society may require more resources than others to achieve a fair distribution according to the societal norms of social justice (Saxena *et al.* 2002). Therefore, according to this perspective, unequal shares

of health services can be judged fair. For example, Mooney (2000) suggested that groups that are more likely to be ill (children under five years and pregnant women with malaria) should have greater access to healthcare. Bambra *et al.* (2014) argues that groups from lower socio-economic backgrounds might need to have greater access to healthcare than the affluent to achieve equal use of a particular service. This is referred to as *vertical equity* (Culyer and Wagstaff 1993; Musgrove 1999; Culyer 2001).

In terms of healthcare services, this definition of equity means that more services are provided where there is a greater need for these (e.g., poor and sickly people) (Culyer and Wagstaff 1993). For example, due to their low immunity to malaria, the WHO (2013) considers children under five years and pregnant women to be in greater need of mosquito bed nets than other household members. Given these descriptions, pursuing an equity goal may sometimes require distributing resources unequally across socio-economic groups or geographic locations. Hence, equity in utilisation and ownership of bed nets after mass distribution would also require unequal distribution of bed nets to malaria-vulnerable groups across socio-economic groups or geographic locations.

2.2.3 Previous studies examining equity in bed net distribution and utilisation

Several studies have examined equity in ownership and utilisation of bed nets after free-targeted distributions (Njau *et al.* 2013; Wanzira *et al.* 2014; Taylor *et al.* 2017). Njau *et al*. (2013) found that the poorest households in Tanzania and Uganda were, respectively, 21.4% and 2.8% less likely to own bed nets after free-targeted bed net distribution. Taylor *et al.* (2017) compared the 2006 and 2011 Uganda Demographic Health Survey data, and found that ITN ownership remained concentrated among richer households after free-targeted distribution. Wanzira *et al*. (2014) showed that free-targeted bed net distribution[3] in Uganda increased the equity of both ownership and use of bed nets among children under five years. In all, free-targeted bed net distributions may have achieved equity in utilisation and ownership of bed nets in some regions, but registered lower gains in the majority of regions.

Researchers have examined equity of both ownership and utilisation of bed nets after mass distribution. Research by Hailu *et al.* (2016) in the south-central part of Ethiopia found that bed nets were still more likely to be owned by richer households after the mass distribution.

[3] Free-targeted bed net distribution focused on free targeted provision of bed nets to pregnant women and children under five years especially in areas of high malaria transmission (Wanzira *et al*. 2014).

Another study, conducted in the north-western part of Nigeria (Kano state), established that mass distribution of bed nets reduced the disparity of bed net ownership among households from different socio-economic categories (Ye *et al.* 2012).

Studies by Bennett *et al.* (2012), in Sierra Leone, and by Zollner *et al*. (2015), in Burkina Faso, found that poor households as compared to the rich households were more likely to own and use bed nets after free mass distributions. A comprehensive study done by Taylor *et al.* (2017) conducted on 19 SSA countries, indicated that 13 countries exhibited improved equity of ownership, four countries revealed pro-rich equity of ownership, and two countries showed no change in equity of ownership of bed nets after mass distribution.

Both Wanzira *et al*.'s (2014) and Taylor *et al.*'s (2017) studies on equity in Uganda focused on the 2009 free-targeted distribution[4], and both found that, despite the free-targeted distribution of bed nets to the most vulnerable groups, the 80% Roll Back Malaria target set by the WHO (2005) had not been achieved. Equity was achieved only for children under five years in the central region of Uganda, which was targeted (Taylor *et al.* 2017; Wanzira *et al*. 2014).

The above indicates that there is a need to conduct equity analyses for utilisation and ownership of bed nets for the whole country after mass distribution. Given that no other research that included a two-period cross-sectional equity analysis for the case of Uganda could be found, this essay provides the first comprehensive equity analysis that includes access, universal coverage, and utilisation of bed nets in Uganda in 2009 and 2014.

2.2.4 Previous studies examining the factors associated with utilisation of bed nets

Research indicates that there are many factors associated with the use of bed nets[5] at individual, household, and community level in sub-Saharan Africa. Studies reported that age of household members, gender, wealth, and knowledge of malaria are some of the factors associated with bed net utilisation at the individual level (Tchinda *et al.* 2012; Lam *et al.* 2014; Babalola *et al.* 2016; Strachan *et al.* 2016; Wanzira *et al.* 2016; Kanyangarara *et al*. 2018). Babalola *et al.*'s (2016) study in Liberia and Wanzira *et al.*'s (2016) study in Uganda reported that children under five years of age, compared to older children and adults, were prioritised in bed net

[4] Taylor *et al.* (2017) used 2006 Demographic Health Survey data as baseline survey, and 2011 data as endpoint; hence, their analysis reflects the 2009-targeted distribution rather than the mass distribution that commenced in May 2013 and ended in August 2013.

[5] Bed nets, LLINs, and ITNs are synonymous in the context of this study.

utilisation. Lam *et al.*'s (2014) study in Uganda and Babalola *et al.* (2016) found that women were more likely than men to sleep under bed nets. Strachan *et al.*'s (2016) study in three Ugandan districts (Bulisa, Hoima, and Kiboga) established that positive experiences and awareness of derived benefits from bed net use before distribution, like protection against malaria, significantly increased bed net use after the mass distribution campaign.

At the household level, studies have found that household size and number of bed nets in a household are factors associated with bed net utilisation (Babalola *et al.* 2016; Nuwamanya *et al.* 2018; Olapeju *et al.* 2018). Nuwamanya *et al.*'s (2018) study in Mbarara municipality, Uganda, found that the number of bed nets in households and marital status were significantly associated with bed net utilisation. Olapeju *et al.*'s (2018) study in Uganda showed that, when households had enough bed nets, there were smaller disparities in bed net use between age and gender groups within the household. Babalola *et al.* (2016) found a negative association between bed net utilisation and number of household members.

Evidence from the research indicates that there are many factors associated with the non-use of bed nets (Baume *et al.* 2009; Pulford *et al*. 2011; Koenker *et al.* 2013; Ruyange *et al.* 2016). Baume *et al*.'s (2009) study in Oromia and Amhara regional states, Ethiopia, indicated that participants considering ITNs no longer effective, ITNs being in poor condition, and low malaria incidence rates were some of the reasons for non-use of bed nets. Monroe *et al*.'s (2014) study in Uganda reported social barriers such as fear of appearing proud, logistical barriers such as not having a place to hang a net, and resource limitations such as not having an extra net with which to travel as some of the factors associated with non-use of bed nets. Other studies have reported low bed net usage amongst adults due to perceived discomfort (difficulty in breathing or itching/rashes) and discomfort due to heat by older household members (Pulford *et al*. 2011; Koenker *et al.* 2013).

Minakawa *et al*. (2008) reported misuse of bed nets for fishing and drying fish around the region of Lake Victoria. Ruyange *et al.* (2016) showed that, in Rwanda, maintaining universal ITN coverage was not enough to protect the population against malaria, due to factors related to ITN non-use at individual, household, and community level.

Essay 1 provides a comparative study between factors that were associated with bed net utilisation in 2009 and 2014. The analysis provides a broader understanding of the factors associated with bed net utilisation and trends in coverage and utilisation over the period that

preceded and followed the mass distribution campaign of 2013. This study is unique because it includes both ownership and utilisation in equity perspective, and because it used two-period cross-sectional data, enabling comparison over time. Most existing studies relied on a single cross-sectional data set.

2.3 Methods, Data, and Definitions

2.3.1 Data sources

The mass distribution campaign of bed nets under study commenced in May 2013 and ended in August 2013 (Uganda Health Monitoring Unit 2014). Data were drawn from the 2009 and the 2014 Uganda Malaria Indicator Surveys (UMISs). The UMIS was utilised in favour of Uganda Demographic and Health Survey (UDHS) data because UMIS[6] takes into account seasonality factors, which the UDHS does not.

Uganda is divided into administrative districts. Each district is subdivided into counties, and each county into parishes (UBOS and ICF Macro 2010). Each parish is subdivided into convenient areas, called *census enumeration areas*. Each enumeration area is either totally urban or rural.

The 2009 UMIS was stratified into ten survey regions, and two-stage sampling was performed (UBOS and ICF Macro 2010). The first-stage sample consisted of 170 randomly selected enumeration areas — 26 urban and 144 rural areas (UBOS and ICF Macro 2010). In the second stage, the UBOS compiled a systematic sample of 4 421 households for all the selected enumeration areas and 21 606 individuals, based on the 2002 Uganda National Housing Census (UNHC) (UBOS and ICF Macro 2010).

The 2014 UMIS was stratified into ten survey regions, and utilised a two-stage sample design (UBOS and ICF International 2015). The 2014 UMIS utilised 210 randomly selected enumeration areas (44 urban and 166 rural) for the first stage (UBOS and ICF International 2015). The second-stage sample consisted of 5 345 listed households and 27 539 household members, based on the 2014 UNHC (UBOS and ICF International 2015).

[6] Uganda Bureau of Statistics (UBOS) conducted both UMIS data collections after rainy seasons to cater for seasonality.

2.3.2 Descriptive analyses

Descriptive analyses of ownership of bed nets were performed at the household level. Two indicators for household ownership of bed nets,[7] developed by the Roll Back Malaria Monitoring and Evaluation Reference Group (MERG), were used: i) access to bed nets as the percentage of households that own at least one bed net and ii) universal coverage as the percentage of households with at least one bed net for every two people (Lia *et al*. 2018).

The study variable *Access (to bed nets)* was indicated as *1* if the household surveyed the previous night owned at least one bed net, and zero (*0*) if not. The study variable *Universal coverage* was indicated as *1* if the household surveyed the previous night owned at least one bed net for every two people, and *0* if not (Koenker *et al.* 2018; Lia *et al*. 2018).

Descriptive analyses of *Utilisation* of bed nets were done at individual level. The study variable *Equity* (in utilisation of bed nets) was indicated as *1* if there were household members, children under five years, and pregnant women who had slept under a bed net the previous night, and *0* if not (Lia *et al*. 2018).

Operational success for all these indicators is defined as achieving at least the 80% WHO (2013) target and the 85% MoH (2014) target. All descriptive analyses were done using Stata 14.2 software. The *svyset* command was used to account for the characteristics of the survey design.

2.3.3 Equity analysis

Measures of equity in health and healthcare

Measure of socio-economic status

Analysing inequities in health and healthcare involves choosing the appropriate measure of socio-economic status to stratify the population using suitable indices to examine the nature and extent of the inequities across social groups (Culyer and Wagstaff 1993; O'Donnell *et al.* 2008; Wagstaff *et at.* 1991). O'Donnell *et al*. (2008) favoured two methods (direct and indirect) for measuring socio-economic status.

The direct approach requires the use of either household members' income or expenditure. The income of household members refers to wages, salaries, profits from businesses, rent payments,

[7] Bed nets for this study included all ITNs and LLINs.

and any other earnings received (O'Donnell *et al*. 2008). Expenditure of household members includes expenditure on housing, healthcare, education, food, etc. (O'Donnell *et al*. 2008). The indirect method utilises proxy measures, for example, individuals having assets like radios, televisions, cars, bicycles, etc. (O'Donnell *et al*. 2008). Neither the 2009 nor 2014 UMISs collected information on income and expenditure of household members, but used proxy measures to determine socio-economic status (UBOS and ICF International 2010, 2014). This was possible because both data sets contained detailed data on household characteristics and assets.

Three steps were followed to determine socio-economic status (UBOS and ICF International 2010, 2015).

In the first step, household assets common to both urban and rural areas were selected to create wealth scores for households in both areas. The assets were: televisions, bicycles or a car, and dwelling characteristics such as source of drinking water, type of flooring material, source of drinking water, and sanitation facilities (UBOS and ICF International 2010, 2015). The categorical variables were transformed into separate dichotomous variables (*0* and *1*). Principal component analysis was then used to analyse the variables, to produce a common factor score for each household.

In the second step, separate factor scores for households in urban areas and rural areas were calculated, using area-specific indicators.

In the third step, the separate area-specific factor scores were combined to compile a nationally applicable combined wealth index by adjusting the area-specific score through regression on the common factor scores. The resulting combined wealth index had a mean of 0 and a standard deviation of 1. Once the index had been computed, the national-level wealth quintiles were determined by assigning the household score to each *de jure* household member, ranking each person in the population by his or her score, and then dividing the ranking into five equal categories, each including approximately 20% of the population (UBOS and ICF International 2015). The wealth index factor score, a continuous variable derived through principal component analysis, was then computed.

The Comparative Wealth Index and the Harmonized Wealth Index have been used to adjust the UDHS Wealth Index factor score of any household from any survey relative to the baseline survey (Staveteig and Lindsay 2014). However, the Comparative Wealth Index and the

Harmonized Wealth Index are recommended for cases where different questions were used to construct wealth indices in the two UDHS data sets (Staveteig and Lindsay 2014). Given that, for the UMIS (2009 and 2014), the same steps were followed and the same questions were used to construct socio-economic status, the wealth indices are consistent, and can be used to compare household economic status over time. In the present study, the Wealth Index factor score from the UMIS (2009 and 2014) data was used to compute concentration indices and concentration curves. Wealth quintiles from the UMIS (2009 and 2014) were used in the multivariate logistic regression.

The measure of inequity

Concentration curves, concentration indices, Gini coefficients, the Relative Index of Inequality range, equity ratios, and the slope of index inequality are some of the bivariate measures used by researchers to measure inequities in health (Kakwani *et al.* 1997; O'Donnell *et al*. 2008).

In the present study, equity ratios were computed by dividing percentages of poorest quintile by percentages of richest quintile to measure the degree of equity in access to bed nets, universal coverage, and utilisation of bed nets by the population and malaria-vulnerable groups, in 2009 and 2014 (Mackenbach and Kunst 1997). An equity ratio above 1 suggests a pro-poor utilisation or ownership and an equity ratio below 0 suggests a pro-rich utilisation or ownership (Mackenbach and Kunst 1997).

Concentration indices were used to measure the degree of equity in access to bed nets, universal coverage, and utilisation of bed nets by the population and malaria-vulnerable groups, in 2009 and 2014 (Kakwani *et al.* 1997). A concentration index (CI_i) of *0* implies equality in household ownership and utilisation of bed nets by the population and malaria-vulnerable groups. A negative CI_i suggests that household ownership and usage of bed nets are concentrated amongst poorer households. In turn, a positive CI_i implies that household ownership and utilisation of bed nets are concentrated amongst richer households.

Many CIs have been proposed to measure inequities in health (Wagstaff *et al*. 1991; Kakwani *et al*. 1997; Wagstaff 2005; Erreygers 2009; Erreygers *et al.* 2012). A standardised concentration index (SCI) is defined as twice the area between the concentration curve and the line of equality (Kakwani *et al.* 1997). This is defined as:

$$SCI(h/y) = \frac{2cov(h_i S_i)}{\bar{h}} = \frac{1}{n}\sum_{i=1}^{n}\left\{\frac{h_i(2S_i-1)}{\bar{h}}\right\} \qquad 2:1$$

where h_i is the health variable. The SCI ranges from (1 – n)/n, maximum pro-poor (health is concentrated amongst the poorest households), to (n – 1)/n, maximum pro-rich.

S_i is socio-economic status. For health variables that have binary outcomes (for example, *0* = not having bed nets, *1* = having bed nets), a SCI may fail to satisfy the mirror property. The mirror property requires the normalisation function of the shortfall (not having bed nets) to be symmetrical to attainment (having bed nets). Likewise, not sleeping under a bed net should be opposite to sleeping under a bed net (Erreygers *et al.* 2012). SCI measures relative inequities in health variables; hence, it may fail to provide equal proportionate changes in the health variable (invariant) (Wagstaff 2005; Erreygers *et al.* 2012).

Multiplying the SCI by mean health generates the generalised CI (GCI), which is absolute and invariant to additions in the health variable (Wagstaff *et al.* 1991). GCI is expressed as:

$$GCI(h/y) = \frac{1}{n}\sum_{i=1}^{n}\{h_i(2\,S_i - 1)\} \qquad 2{:}2$$

The GCI ranges from $\bar{h}$ (1 - n)/n, maximum pro-poor, to $\bar{h}$ (n - 1)/n, maximum pro-rich. The GCI satisfies the mirror property; however, the GCI estimates may not be invariant to permissible transformation, especially when the health variable of interest is on the ratio or cardinal scale. To counter this problem in the GCI, Erreygers (2009) modified the GCI. This was expressed as:

$$ECI(b/y) = \frac{1}{n}\sum_{i=1}^{n}\{4b_i(2\,S_i - 1)\}$$

$$b_i = \frac{a_i - a^{min}}{a^{max} - a^{min}} \qquad 2{:}3$$

This index ranges between -1 and +1.

Wagstaff (2005) notes that, if the health variable of interest is binary, then the range of the SCI should depend on the mean of the bounded variable. Wagstaff (2005) further suggests that the SCI be rescaled to ensure that it lies within the range of -1 to 1.

$$WCI(b/y) = \frac{1}{n}\sum_{i=1}^{n}\left\{\left(\frac{b_i}{1-\bar{b}}\right)\bar{b}(2\,S_i - 1)\right\} \qquad 2{:}4$$

The choice of concentration index depends on the priority given to either relative inequality invariance or the mirror property (O'Donnell *et al*. 2016). The present study employed Wagstaff's (2005) index, which considers both relative inequities in attainments (having and using bed nets) and relative inequities in shortfalls (not having and not using bed nets) (Wagstaff 2005). Erreygers's index, which focuses on absolute differences, was used as a robustness check. This implies that the poorest and richest should have the same weighting, but with opposite signs (Erreygers *et al.* 2012).

All computations were performed in Stata 14.2. The study used the Stata command *conindex* to estimate both Wagstaff's and Erreygers's normalised concentration indices for bounded variables (cf. O'Donnell *et al*. 2016). The use of *conindex* involves specification of the upper and lower bounds (-1 and +1) for both indices. Since the *conindex* command enables inequity comparisons across the years, data from 2009 and 2014 were appended, and the ECI (Erreygers concentration index) and WCI (Wagstaff concentration index) were estimated for before and after the campaign. The *conindex* command also offers the option of specifying the *svy* option, which takes into account the survey design characteristics when running ECI and WCI estimates. Differences between the concentration indices for 2009 and 2014 were estimated to assess whether the level of equity of household ownership or utilisation had improved (cf. O'Donnell *et al.* 2016).

Concentration curves

Concentration curves for household access to bed nets, households with sufficient bed nets, bed net utilisation by household members and by children under five, in both 2009 and 2014, were plotted to measure inequities. Concentration curves require a health variable and a measure of living standards to provide graphical representation of socio-economic dimensions (cf. Kakwani *et al*. 1997; O'Donnell *et al*. 2008). Concentration curves plot cumulative percentage of ownership and utilisation of bed nets, on the Y axis, against the cumulative percentage of the population ranked according to standards of living, on the X axis (Kakwani *et al.* 1997; O'Donnell *et al*. 2008).

If households or household members, irrespective of their standard of living, have exactly the same value of the health variable, the concentration curve lies at a 45-degree line (line of equality) that runs from the bottom left-hand corner to the top right-hand corner (Kakwani *et al*. 1997; O'Donnell *et al*. 2008). If the concentration curve lies above (or below) the line of

equity, then the health variable is distributed among the poorer (or richer) households or household members. The further the curve is above (or below) the line of equality, the more concentrated the health variable is among the poorer (or richer) households or household members (Kakwani *et al.* 1997; O'Donnell *et al*. 2008).

2.3.4 Decomposing Health Inequality with Recentered Influence Functions (RIF)

After measuring inequalities in bed net utilisation, the study assessed the covariance between bed net utilisation and socioeconomic rank in 2009 and 2014.

Research from past studies has shown that decomposing socioeconomic-related health inequality, can help to unveil specific factors that are potentially adjustable by policy decision makers to achieve socioeconomic-related health equality (Firpo *et al*. 2009; Heckley *et al*. 2016). The rational of decomposition is to explain the distribution of the outcome variable in question by a set of factors that vary systematically with socioeconomic status.

The dominant decomposition approach was proposed by Wagstaff *et al*. (2003). However, Wagstaff's *et al*. (2003) decomposition approach has some limitations. Wagstaff's *et al*. (2003) decomposition method is only applicable to absolute inequality indices, such as the absolute concentration index (even though it was developed for the relative concentration index) (Erreygers and Kessels (2013); Heckley et al. 2016). Wagstaff's *et al*. (2003) decomposition method only explains the degree of variation in health rather than the covariance between health and socioeconomic rank (Erreygers and Kessels (2013). The interpretation of the parameters, and their contributions, within these decompositions with Wagstaff's *et al*. (2003) decomposition method is unclear (Erreygers and Kessels (2013); Heckley et al. 2016).

Firpo et al. (2009) introduced the recentered influence functions (RIF) that focused on the estimation of the unconditional quantile regression (UQR), that allows the researchers to obtain partial effects of explanatory variables on any unconditional quantile of the dependent variable. Researchers have found RIF decomposition method better than Wagstaff's *et al*. (2003) decomposition method (Firpo et al. (2009); Heckley *et al*. (2016); Erreygers and Kessels (2013). RIF decomposition method explains the causes of socioeconomic-related health inequality by directly decomposing the weighted covariance of health and socioeconomic rank variables (Heckley *et al*. 2016). RIF decomposition method decomposes all forms of inequality measures, such as the Erreygers index (EI), the Wagstaff index (WI), the standard concentration index (CI), the absolute concentration index (AC), the attainment relative

concentration index (ARCI), and the shortfall relative concentration index (SRCI) (Firpo *et al*. 2009; Heckley *et al*. 2016). RIF decomposition method requires fewer, and less restrictive assumptions than the Wagstaff decomposition method. RIF decomposition method is simple to estimate and the results are easy to interpret (Firpo *et al*. 2009; Heckley et al. 2016). Heckley s'*et al*. (2016) RIF decomposition method decomposes RIF regressions that offers the cluster option. Since the models consisted of both household and individual-level variables, to account for the correlation of errors within households, clustering was performed at the household level (Heckley *et al*. 2016). The current study, therefore, utilised the RIF decomposition method to decompose the socioeconomic variable (wealth index) and health variable (utilisation of bed net) in Uganda in 2009 and 2014. The study estimated RIF for the Erreygers index (EI), the Wagstaff index (WI), the standard concentration index (CI), the absolute concentration index (AC), and the shortfall relative concentration index (SRCI).

2.3.5 Multivariate logit regression

Multivariate logit regressions were estimated to consider the factors associated with utilisation of bed nets in 2009 (before the campaign) and 2014 (after). The sections that follow describe the methods that were used to assess the factors associated with utilisation of bed nets in 2009 and 2014. In formulating an empirical model for our study we draw from the important work done by Ntuku *et al*. 2017 and Zollner *et al*. 2015 on similar research questions. We have sought to include all controls from their models, including importantly household size, wealth, gender, age and education. However, in both cases they had access to additional data because they had access to primary data generated for the specific purpose of answering this research question and therefore some variables were not available in the UMSI. Ntuku *et al*. 2017 have included information on distance to health facility, which we do not have although this should be captured fairly well with the urban-rural indicator and regional control. They also have controls for access to information, which we did not have in UMIS, but which we do not consider to be a core variable. Zollner *et al*. 2015 included occupation information, which we do not have in the DHS, but is captured well via the wealth quintile and education.

Outcome variable

The primary dependent variable for the multivariate regression was *Utilisation of bed nets*, expressed as *1* if a household member surveyed had slept under a bed net the previous night, or *0* if not.

Independent variables

All the variables that were used to examine the factors associated with utilisation of bed nets in previous studies were considered (Nuwaha 2001; Tchinda *et al.* 2012; Strachan *et al*. 2016; Nuwamanya *et al*. 2018). The present study considered the following individual-level independent variables: age, gender, mother's highest education level, geographical region, and place of residence. The following household independent variables were considered: *size of household, age of household head*, and *number of bed nets in household*.

Choice of model

There are three approaches to fitting models with binary outcome variables: logit and probit models fitted with maximum likelihood (ML) and linear probability models (LPMs) fitted with ordinary least squares (OLS) (Cameron and Trivedi 2010; Wooldridge 2013).

The LPM method may produce estimates outside the range of zero and one (Cameron and Trivedi 2010; Wooldridge 2013). Secondly, the functional form of the LPM method assumes that the first observation of the explanatory variable has the same marginal effect on the dichotomous variable as the *ith*, which is probably not appropriate. Logit and probit models fitted with ML resolve the above problems that might arise from the LPM method by fitting a nonlinear function to the data, and are therefore the best fit to model binary outcome variables (Cameron and Trivedi 2010; Wooldridge 2013). Because the logit and probit models are very similar and the cumulative distribution functions of logit models are simpler, there is usually a slight preference for logits (Cameron and Trivedi 2010; Wooldridge 2013).

Model specifications tests

Before running the logit model, Wald tests, variance inflation factor (VIF) and bivariate analyses were performed (Cameron and Trivedi 2010; Wooldridge 2013). Wald tests were performed to test for joint significance of all the coefficients in the model (Cameron and Trivedi 2010; Wooldridge 2013). The VIF was used to quantify the extent of correlation between one predictor and the other predictors in a model (tests for collinearity/multicollinearity). Only independent variables with VIF values less than 10 were retained in the model (Cameron and Trivedi 2010; Wooldridge 2013). In the final step, bivariate statistics were used to identify potential covariates that were worth testing in the multivariate model, with the assumption that, if the independent variable was associated with the outcome variable (*Utilisation of bed nets*), it might continue to explain the outcome once other covariates were included in the model.

Since most of the covariates were categorical, chi-square statistics were used to test whether the categorical variables were significantly associated, with threshold values of $p < 0.01$, $p < 0.05$, and $p < 0.1$ (Cameron and Trivedi 2010; Wooldridge 2013).

For descriptive analyses of the independent variables, tests of mean differences for continuous variables and differences in proportions for binary and categorical variables were performed. Only for independent variables that were retained after they passed the Wald, VIF, and bivariate analyses. Tests of mean differences with respect to the outcome variable were performed to assess whether there were significant differences at three threshold values, namely $p < 0.01$, $p < 0.05$, and $p < 0.1$.

Study design

This study utilised a two-period cross-sectional analysis to provide a comparative study of factors associated with bed net utilisation in 2009 and 2014. Although this two-period cross-sectional analysis allowed the observation of changes over time, causality cannot be inferred in the absence of a control group (Chambliss and Schutt 2012).

All models were estimated in Stata 14.2 with the *svy* prefix. Stata provides four weights: *fweight* (frequency weight), *aweight* (analytic weight), *iweight* (importance weight), and *pweight* (probability weight) (Thomson 2016). For survey analysis, *pweight* is the recommended sampling weight (Thomson 2016). The *pweight* command causes Stata to use the sampling weight as the number of subjects in the population that each observation represents when computing estimates such as proportions, means, and regression parameters (Thomson 2016).

The *svyset* command was specified where the probability weight was equal to the variable *weight*, the primary sampling unit was equal to the primary sampling unit (households), and the strata was sample domain. The command *svyset (pweight = weight), primary sampling unit (psu) strata (sample domain)* was used to specify the survey design characteristics, which were taken into account via the *svy* prefix for both the descriptive and the multivariate analyses.

Estimation: Individual survey cross-sections and pooled cross-sections

To assess whether there were changes in utilisation of bed nets from 2009 to 2014, two models were run for the two individual survey years, as well as pools of the two-cross sectional UMIS 2009 and 2014 data sets. To assess the time effect of the campaign, a pooled model was estimated by allowing interaction on the time dummy variable with the wealth index variable.

Clustering

The models consisted of both household- and individual-level variables. To account for the correlation of errors within households, clustering[8] was performed at the household level when specifying the survey characteristics with the *svyset* command (Cameron and Trivedi 2010; Wooldridge 2013). To obtain heteroskedasticity-robust and cluster-robust standard errors, the *svy* prefix was added to all models (Cameron and Trivedi 2010; Wooldridge 2013).

Postestimation tests

For better interpretation of the coefficients of the independent variables, the logit models were transformed to marginal effects (Cameron and Trivedi 2010; StataCorp 2017; Muller and MacLehose 2014; Wooldridge 2013). Four postestimation tools (estat gof, estat classification, iroc, and isens) are recommended after multivariate logit estimations (Cameron and Trivedi 2010; StataCorp 2017; Wooldridge 2013). Goodness-of-fit tests were performed by using the postestimation *estat gof* command, and goodness-of-fit measures based on classification were obtained by using the postestimation *estat classification* command (Cameron and Trivedi 2010; StataCorp 2017; Wooldridge 2013).

Robustness checks were performed by comparing coefficients of the independent variables from the logit, probit, and LPM models (See Table 2.10; Appendix A to chapter 2) . Summaries of predicted probabilities are presented for all the models (2009, 2014, and pooled data). Marginal predictive plots are presented for interactions between regions and wealth quintiles for 2009 and 2014. For the pooled cross-sectional data, marginal predictive plots are presented for the interaction between the time dummy variable (year) and wealth quintiles.

[8] Clustering involves errors that are correlated within a cluster or group and are uncorrelated across clusters.

2.4 Results

The analysis included 4 421 households for 2009 and 5 345 households for 2014. Section 2.4.1 presents the results of the descriptive analyses of access to bed nets, universal coverage, and utilisation of bed nets. Results of equity analyses are presented in Section 2.4.2, and multivariate estimates are presented in Section 2.4.3.

2.4.1 Descriptive analysis results

Results of descriptive analysis in Table 2.1 indicate an increase in access to bed nets above the 80% WHO (2013) target and the 85% Uganda MoH (2014) target, from 59.24% (95% confidence interval; 57.79% to 60.69%) in 2009 to 94.18% (95% confidence interval; 93.55% to 94.81%) in 2014, after the campaign. Universal coverage increased, although it was below the 80% WHO (2013) target and the 85% Uganda MoH (2014) target, from 24.27% (95% confidence interval; 23.01% to 25.53%) in 2009 to 63.57% (95% confidence interval; 62.28% to 64.86%) in 2014. The estimated differences in proportions in terms of access to bed nets and universal coverage suggest that there were significant improvements in both access to bed nets ($\overline{X}_b - \overline{X}_a$ 34.94; $p < 0.01$) and universal coverage ($\overline{X}_b - \overline{X}_a$ 39.30; $p < 0.01$) from 2009 to 2014.

Results in Table 2.2 suggest that there were improvements in the percentage of household members who utilised bed nets, increasing from 33.56% (95% confidence interval; 32.93% to 34.19%) in 2009 to 70.75% (95% confidence interval; 70.21% to 71.28%) in 2014. However, the utilisation rates remained below the 80% WHO (2013) and 85% Uganda MoH (2014) targets.

The percentage of children under five years who utilised bed nets increased from 46.38% (95% confidence interval; 45.59% to 47.17%) in 2009 to 82.73% (95% confidence interval; 82.21% to 83.26%) in 2014, with the latter exceeding the 80% WHO (2013) target, but remaining below the 85% Uganda MoH (2014) target.

The percentage of pregnant women who utilised bed nets after the mass distribution increased from 51.46% (95% confidence interval; 46.51% to 56.40%) in 2009 to 78.85% (95% confidence interval; 74.95% to 82.40%) in 2014. The number thus moved closer to the 80% WHO (2013) target and the 85% Uganda MoH (2014) target, but still fell short of both. The estimated differences in proportions (between 2014 and 2009) in terms of bed net utilisation by household members, children under five, and pregnant women suggested a significant

improvement for household members $(\overline{X}_b - \overline{X}_a\ 37.19;\ p < 0.01)$, children under five years $(\overline{X}_b - \overline{X}_a\ 36.35;\ p < 0.01)$, and pregnant women $(\overline{X}_b - \overline{X}_a\ 27.39;\ p < 0.01)$.

Table 2.1 Descriptive statistics of bed net ownership by households in 2009 and 2014

Ownership	2009 (*N* = 4 421)		2014 (*N* = 5 345)		Difference in Proportions $\overline{X}_b - \overline{X}_a$ (%)
	Mean % $\overline{X}_a$	95% confidence interval	Mean % $\overline{X}_b$	95% confidence interval	
Access to[1] bed nets	59.24	57.79 to 60.69	94.18	93.55 to 94.81	34.94*** (0.000)
Universal[2] coverage	24.27	23.01 to 25.53	63.57	62.28 to 64.86	39.30*** (0.000)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes

1. Households that had access to bed nets
2. Households that had universal coverage, defined as at least one net per two persons in the household

Table 2.2 Descriptive statistics of bed net utilisation for population, children under five, and pregnant women in 2009 and 2014

Utilisation (sleeping under bed nets)	2009 (*N* = 21 606)		2014 (*N* = 27 539)		Difference in Proportions $(\overline{X}_b - \overline{X}_a$ %) (*p*-values)
	Mean $\overline{X}_a$%	95% confidence interval	Mean $\overline{X}_b$%	95% confidence interval	
Household members	33.56	32.93 to 34.19	70.75	70.21 to 71.28	37.19*** (0.000)
Children under five years	46.38	45.59 to 47.17	82.73	82.21 to 83.26	36.35*** (0.000)
Pregnant women	51.46	46.51 to 56.40	78.85	74.95 to 82.40	27.39*** (0.000)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

2.4.2 Equity analysis

Descriptives for equity analyses showed that, in 2009, access to bed nets was highest (74.93%) amongst households in the richest wealth quintile (pro-rich equity ratio 0.79). In 2014, access

to bed nets improved for all households, and was highest (97.03%) amongst households in the poor wealth quintile (pro-rich equity ratio 0.94) (see Table 2.3 and Figure 2.3).

Descriptives for equity analyses indicated that, in 2009, universal coverage was highest (31.5%) amongst households in the richest wealth quintile (pro-rich equity ratio 0.29). In 2014, universal coverage improved for all households, and was highest (60.17%) amongst households in the richest wealth quintile (pro-rich equity ratio 0.81) (see Table 2.3 and Figure 2.4).

Table 2.3 Equity ratios for ownership and utilisation of bed nets in 2009 and 2014

	2009			2014		
	Poorest	Richest	Equity Ratio	Poorest	Richest	Equity Ratio
Access	59.26	74.93	0.79	93.11	98.18	0.94
Universal Coverage	9.21	31.5	0.29	48.74	60.17	0.81
Utilization						
Population	30.94	43.54	0.71	70.62	69.65	1.01
Children Under Five	47.8	55.70	0.88	83.63	80.19	1.04
Pregnant Women	52.97	65.29	0.81	80.06	80.62	0.99

Figure 2.3 Percentage of access to bed net ownership for households by wealth quintile

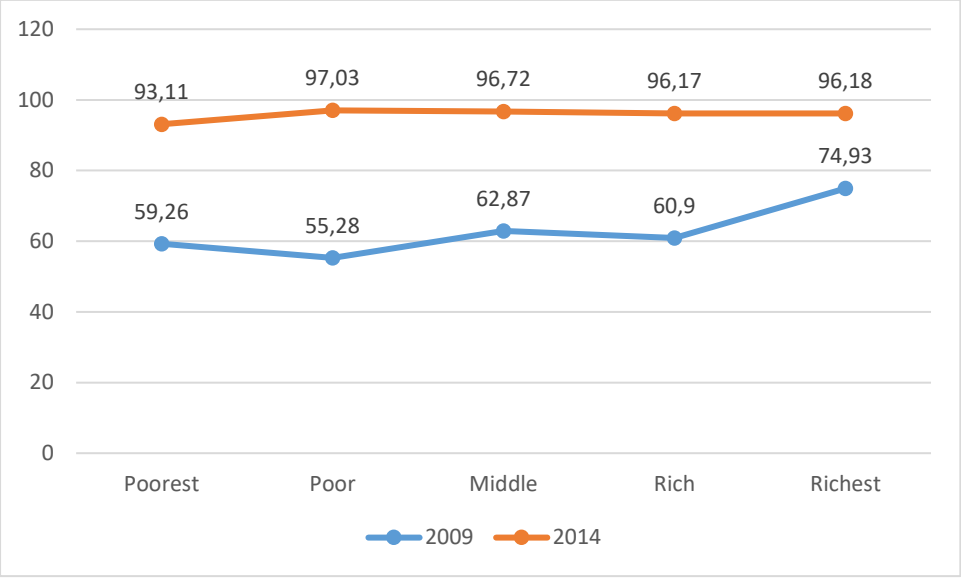
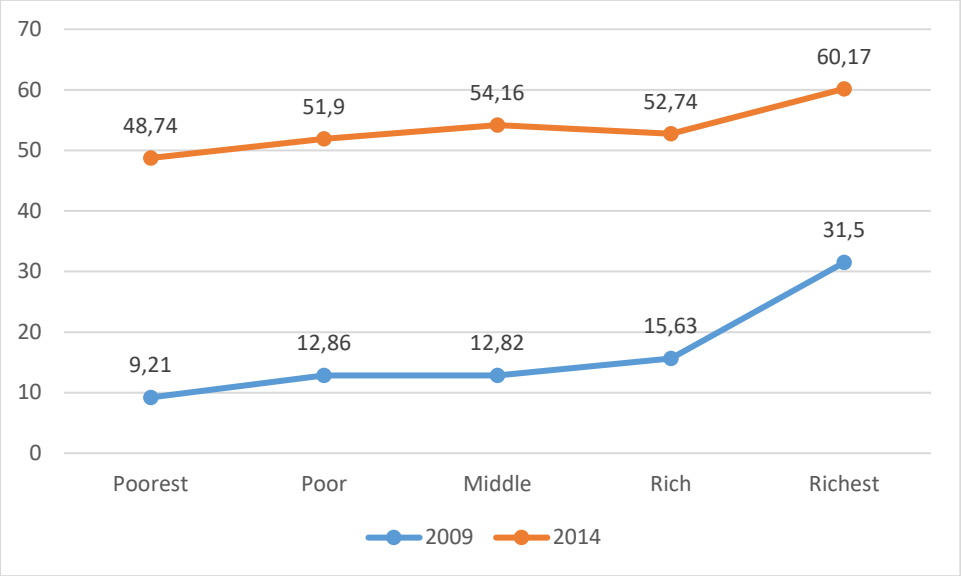


Figure 2.4 Percentage of universal coverage for households by wealth quintile



Results of the descriptive equity analyses showed that, in 2009, utilisation of bed nets was highest (43.54%) amongst household members in the richest wealth quintile (pro-rich equity ratio 0.71). In 2014, utilisation of bed nets improved amongst household members, and was highest (72.38%) amongst household members in the poor wealth quintile (pro-poor equity ratio 1.01) (see Table 2.3 and Figure 2.5).

In 2009, utilisation of bed nets amongst children under five years was highest (55.7%) in the poorest wealth quintile (pro-rich equity ratio 0.88). In 2014, bed net usage amongst children under five years was highest (85.22%) in the poor wealth quintile (pro-poor equity ratio 1.04) (see Table 2.3 and Figure 2.6).

The utilisation of bed nets amongst pregnant women was highest (65.29%) in the richest wealth quintile in 2009 (pro-rich equity ratio 0.81). In 2014, bed net usage amongst pregnant women was highest (86.2%) in the poor wealth quintile (pro-rich equity ratio 0.99) (see Table 2.3 and Figure 2.7).

Figure 2.5 Percentage of bed net utilisation by household members per wealth quintile

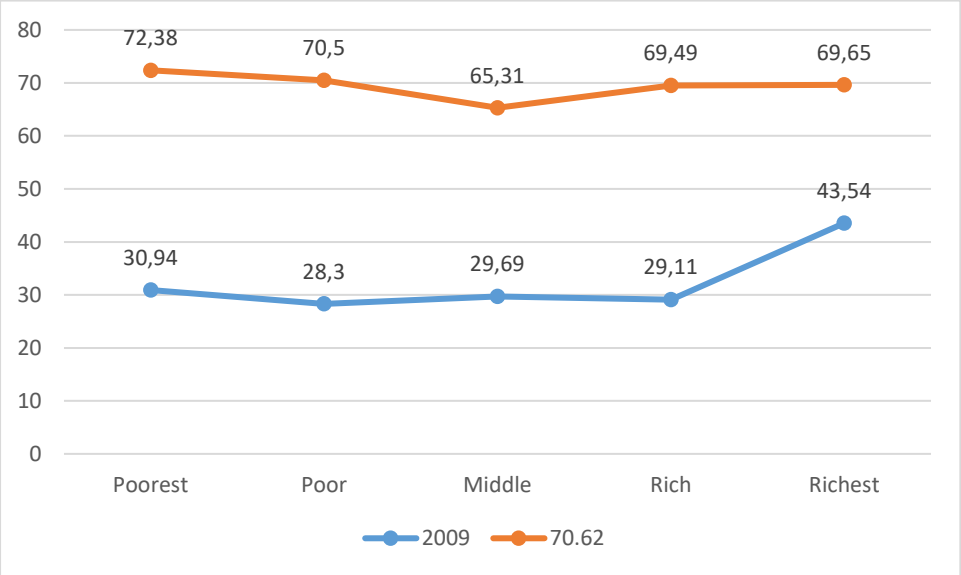


Figure 2.6 Percentage of bed net utilisation by children under five per wealth quintile

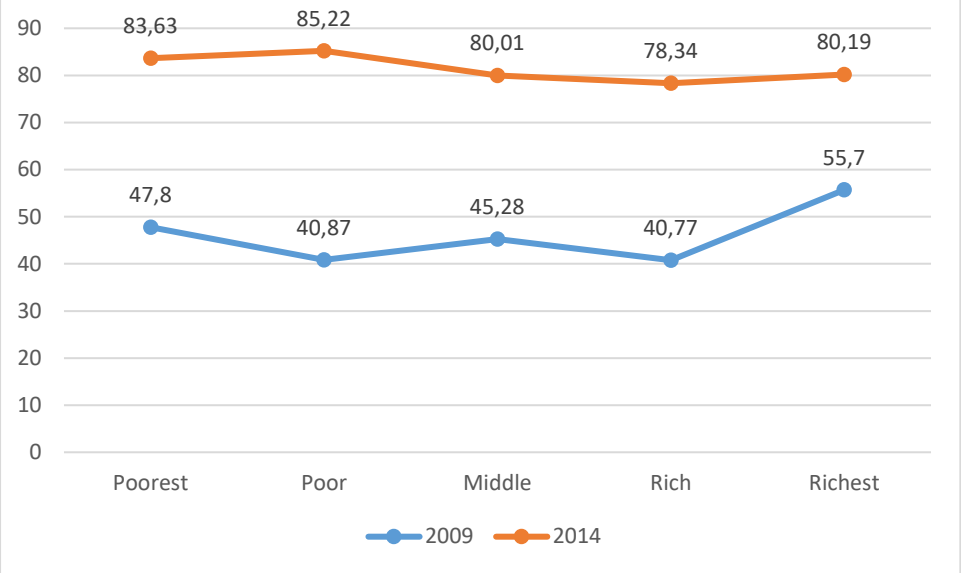
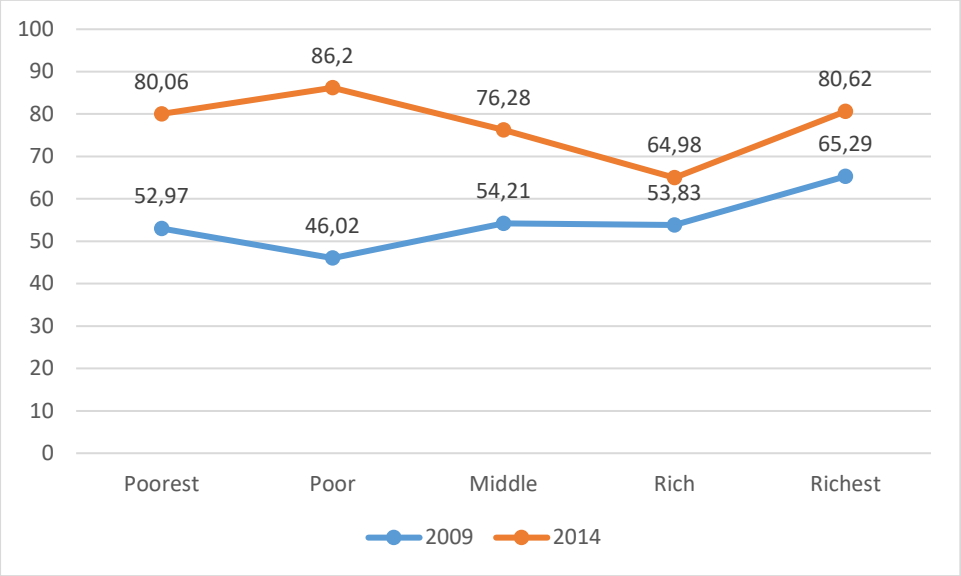


Figure 2.7 Percentage of bed net utilisation by pregnant women per wealth quintile



Concentration indices and Concentration curves for bed net equity

Estimates from the Wagstaff concentration index (CI), 0.125 (standard error (SE): 0.024; $p < 0.01$), and a concentration curve (CC) below the line of equity showed that, in 2009, access to bed nets was significantly more concentrated amongst households in the richer wealth quintile. In 2014, access to bed nets was concentrated amongst households in the poorer wealth quintile, although not significantly, -0.001 (SE: 0.054; $p = 0.987$), with a CC slightly above line of equity. Differences in CIs between 2014 and 2009 for access to bed nets suggested significant improvements ($CI_B - CI_A = - 0.126$; $p < 0.05$) (see Table 2.4 and Figure 2.8).

In 2009, universal coverage was significantly concentrated amongst households in richer wealth quintiles, 0.100 (SE: 0.012; $p < 0.01$), with a CC below the line of equity. In 2014, universal coverage improved significantly, although it was still disproportionately concentrated amongst households in richer wealth quintiles, 0.06 (SE: 0.020; $p < 0.01$), with a CC below the line of equity. Differences between CIs (between 2014 and 2009) showed that equity in universal coverage improved significantly ($CI_B - CI_A = - 0.049$; $p < 0.05$) (see Table 2.4 and Figure 2.9).

In 2009, bed net utilisation amongst household members was significantly concentrated in richer wealth quintiles, 0.051 (SE: 0.019; $p < 0.01$), with a CC below the line of equity. In 2014, equity of bed net utilisation improved (from amongst the richer to the poorer wealth quintiles), although not significantly, 0.025 (SE: 0.02; $p = 0.2$), with a CC slightly above the line of equity. The difference in CIs (between 2014 and 2009) indicated that the level of equity

of bed net utilisation amongst household members improved significantly (CI_B - CI_A = - 0.076; $p < 0.01$) (see Table 2.4 and Figure 2.10).

Table 2.4 Wagstaff CIs for ownership and utilisation of bed nets in 2009 and 2014

	2009		2014		Difference
	CI_A (*p*-values)	Standard Error	CI_B (*p*-values)	Standard Error	($CI_B - CI_A$) (*p*-values)
Ownership					
Access to bed nets	0.125 *** (0.000)	0.024	-0.001 (0.987)	0.054	-0.126** (0.032)
Universal coverage	0.100*** (0.000)	0.012	0.060*** (0.004)	0.020	-0.049** (0.049)
Utilisation					
Household members	0.051*** (0.003)	0.017	-0.025 (0.200)	0.020	-0.076*** (0.003)
Children under five years	0.036 (0.164)	0.026	-0.067* (0.076)	0.038	-0.103** (0.024)
Pregnant women	0.054 (0.458)	0.073	-0.084 (0.172)	0.061	-0.138 (0.146)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

In 2009, equity in bed net utilisation amongst children under five years was concentrated in the richer wealth quintiles, 0.036 (SE: 0.026; $p = 0.016$), with a CC below the line of equity. In 2014, bed net utilisation amongst children under five years was significantly concentrated in the poorer wealth quintiles, 0.067 (SE: 0.038; $p < 0.1$), with a CC slightly above the line of equity. The difference in concentration indices between 2009 and 2014 showed that equity in bed net utilisation by children under five years improved significantly (CI_B - CI_A = - 0.103; $p < 0.05$) (see Table 2.4 and Figure 2.11).

In 2009, bed net utilisation amongst pregnant women was concentrated in the richer wealth quintiles (although not significantly), 0.054 (SE: 0.073; $p = 0.458$), with a CC below the line of equity. In 2014, bed net usage amongst pregnant women was concentrated in the poorer wealth quintiles, 0.084 (SE: 0.061; $p = 0.172$), with a CC slightly above the line of equity. The difference in concentration indices between 2009 and 2014 suggested that equity in bed net utilisation by pregnant women improved over this period, although not significantly (CI_A - CI_B = - 0.138; $p = 0.146$) (see Table 2.4 and Figure 2.12).

Figure 2.8 Concentration curves for access to bed net ownership by households

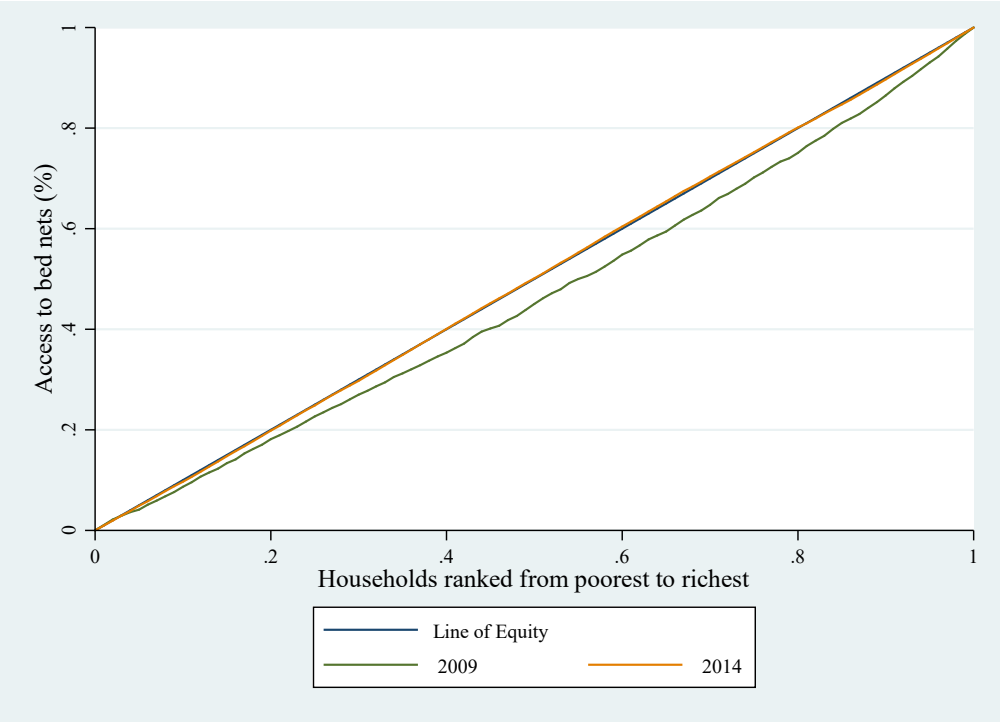


Figure 2.9 Concentration curves for universal coverage by households

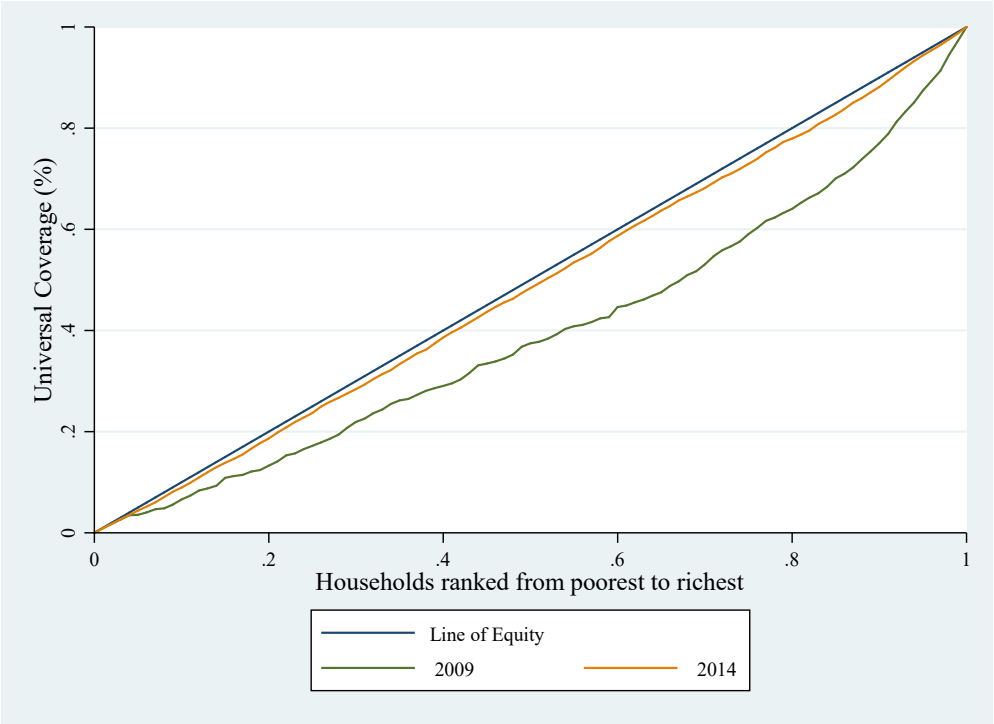


Figure 2.10 Concentration curve for bed net utilisation by household members

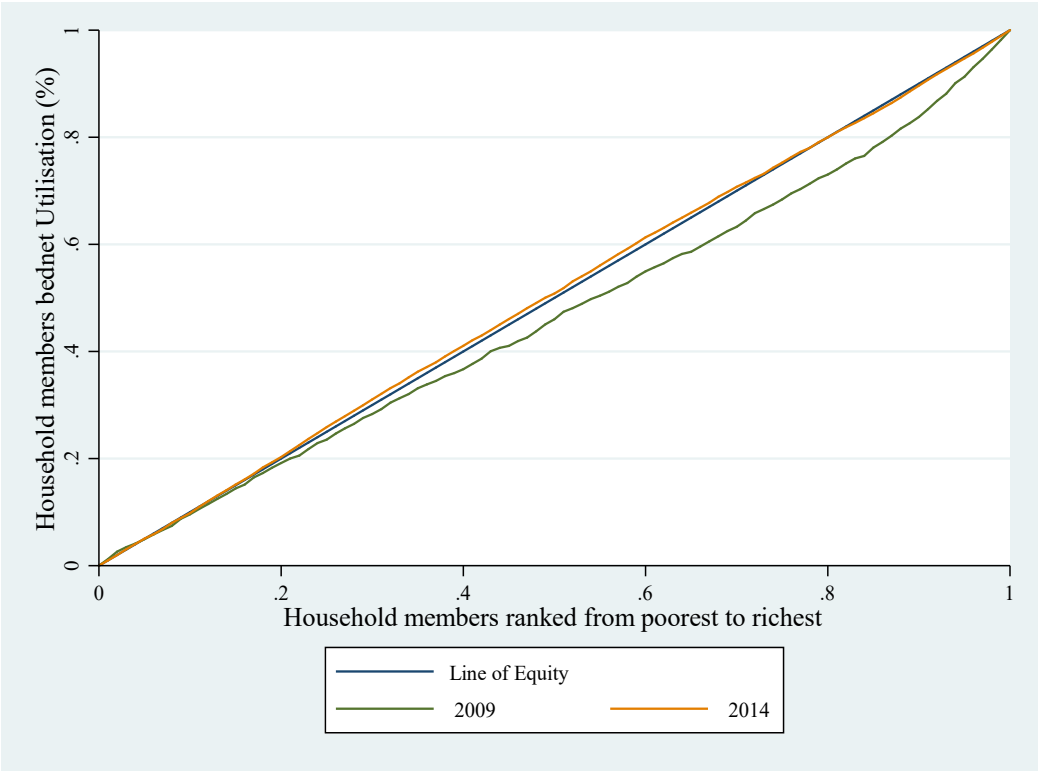


Figure 2.11 Concentration curve for bed net utilisation by children under five years

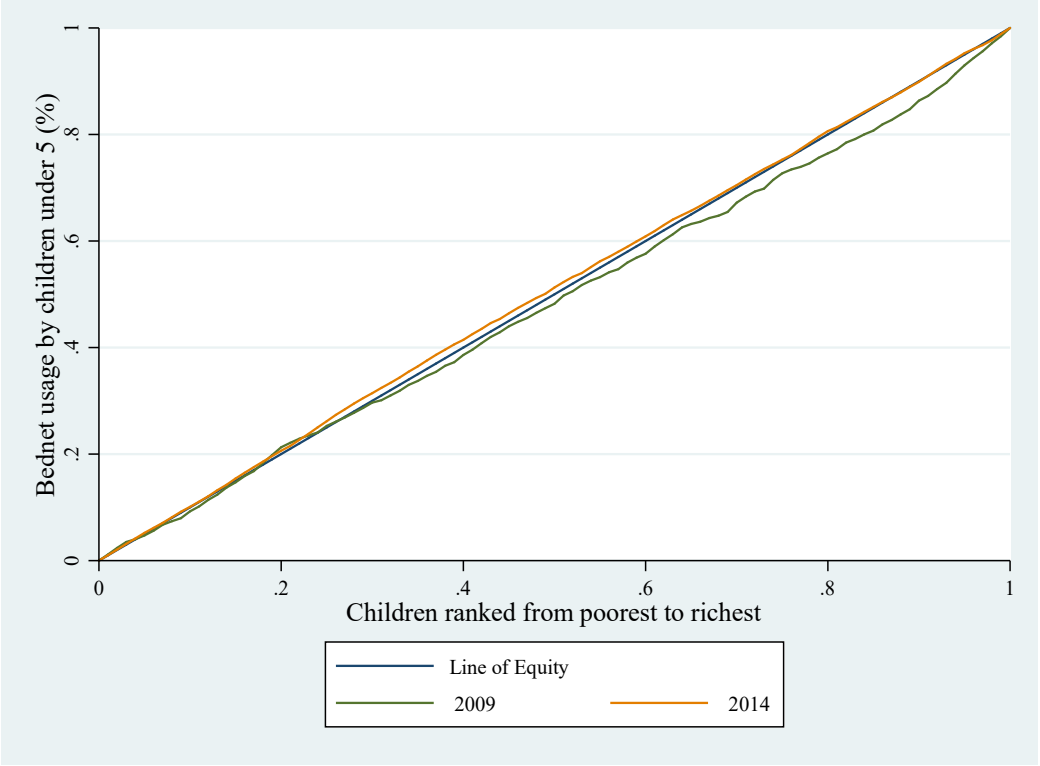
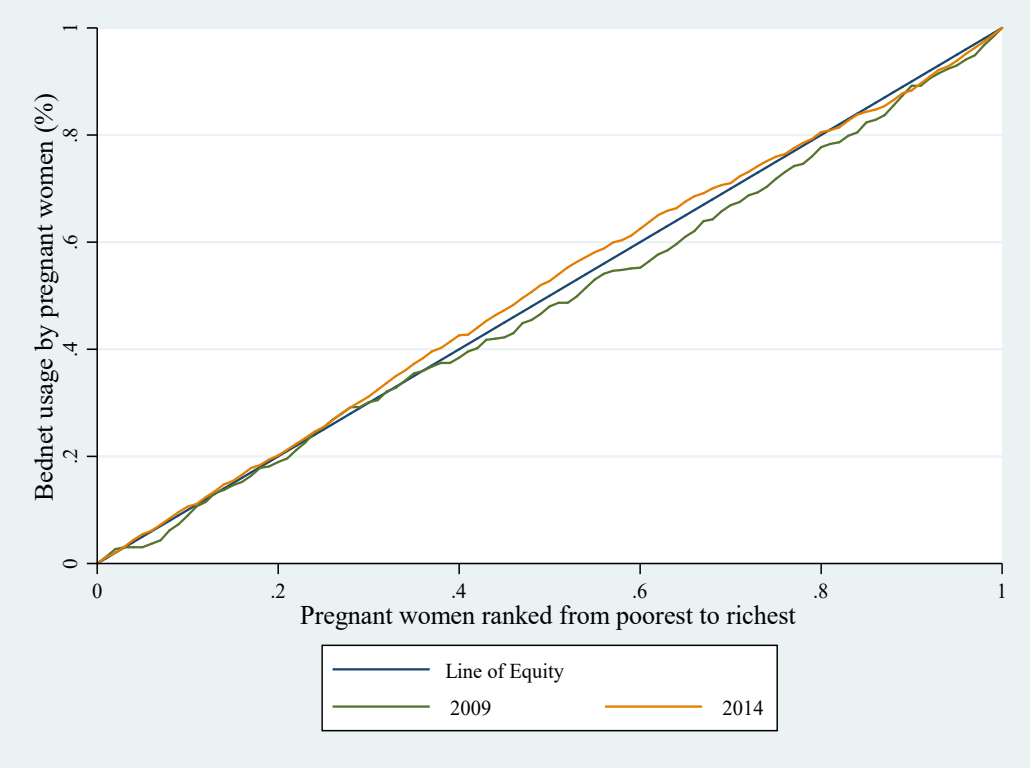


Figure 2.12 Concentration curve for bed net utilisation by pregnant women



2.4.3 Decomposing Health Inequality with Recentered Influence Functions (RIF)

In 2009, place of residence, number of nets in a household, mother's education level, region and household size were associated with the relationship between the wealth index and bednet utilisation. (See Table 2.5).

In 2009, staying in an urban area, owning more bed nets, and having a mother with more education had a positive and significant coefficient. Hence, the share of urban residents, the number of bed nets per households and the education of mothers promote bed net utilisation by the rich and was thus pro-rich.

Residing in the Northern region (cf. the Central region) and having more household members had a negative coefficient in the RIF regressions, implying that it was associated with health inequality becoming more pro-poor.

In 2014, age of household members, household size and mother's education level were associated with the health inequality indices (See Table 2.6). Age of household members, household size and mothers with secondary and post-secondary education (cf. no education) were positively associated with the health inequality indices. Hence, an increase in the age of

household members, household size and mothers with secondary and post-secondary education would promote bed net utilisation by the rich (and was thus pro-rich).

Table 2.5 RIF-I-OLS decomposition of other forms of rank dependent inequality indices for 2009

	Erreygers RI	Absolute RI	Shortfall RI	Wagstaff RI
VARIABLES				
Age of Household members	0.001	0.000	0.000	0.001
	(0.001)	(0.000)	(0.000)	(0.001)
Sex of Household members				
0. Female				
1. Male	-0.003	0.004	-0.003	0.001
	(0.018)	(0.013)	(0.007)	(0.019)
Place of residence				
0. Rural				
1. Urban	0.420***	0.312***	0.158***	0.470***
	(0.091)	(0.063)	(0.035)	(0.099)
Number of nets	0.071***	0.021**	0.035***	0.055***
	(0.014)	(0.010)	(0.007)	(0.015)
Household size	-0.020***	-0.009*	-0.009***	-0.018**
	(0.007)	(0.005)	(0.003)	(0.008)
Regions				
0. Central				
1. Eastern	-0.026	-0.026	-0.008	-0.034
	(0.066)	(0.044)	(0.027)	(0.073)
2. Northern	-0.181**	-0.147***	-0.065**	-0.213***
	(0.077)	(0.054)	(0.031)	(0.082)
3. Western	-0.026	-0.018	-0.010	-0.028
	(0.072)	(0.048)	(0.029)	(0.077)
Mother's education level				
0. No education				
1. Primary education	-0.093**	-0.091***	-0.030*	-0.120***
	(0.038)	(0.028)	(0.015)	(0.043)
2. Secondary education	0.219*	0.144*	0.087*	0.231*
	(0.121)	(0.085)	(0.048)	(0.130)
3. Post-secondary education	0.925***	0.674***	0.352***	1.026***
	(0.275)	(0.188)	(0.110)	(0.303)
Constant	0.117	0.100	0.041	0.141
	(0.090)	(0.061)	(0.036)	(0.096)
Observations	21,606	21,606	21,606	21,606

Table 2.6 RIF-I-OLS decomposition of other forms of rank dependent inequality indices for 2014

	Erreygers	Absolute	Shortfall	Wagstaff
VARIABLES				
Age of Household members	0.002***	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.001)
Sex of Household members				
0. Female				
1. Male	-0.004	-0.002	-0.000	-0.002
	(0.017)	(0.006)	(0.015)	(0.020)
Place of residence				
0. Rural				
1. Urban	0.047	0.016	0.043	0.059
	(0.053)	(0.019)	(0.047)	(0.065)
Number of nets	-0.004	0.000	-0.012	-0.011
	(0.013)	(0.005)	(0.011)	(0.015)
Household size	0.018	0.005	0.022**	0.027**
	(0.011)	(0.004)	(0.009)	(0.013)
Regions				
0. Central				
1. Eastern	0.106	0.039	0.083	0.122
	(0.102)	(0.035)	(0.087)	(0.121)
2. Northern	0.020	0.009	0.007	0.016
	(0.102)	(0.035)	(0.086)	(0.121)
3. Western	0.010	0.003	0.010	0.014
	(0.100)	(0.035)	(0.085)	(0.120)
Mother's education level				
0. No education				
1. Primary education	-0.049*	-0.015	-0.056**	-0.071**
	(0.027)	(0.010)	(0.025)	(0.033)
2. Secondary education	0.209***	0.076***	0.166***	0.242***
	(0.067)	(0.023)	(0.055)	(0.076)
3. Post-secondary education	0.500**	0.179**	0.412**	0.591**
	(0.203)	(0.072)	(0.174)	(0.248)
Constant	-0.186*	-0.065*	-0.160*	-0.225*
	(0.107)	(0.038)	(0.094)	(0.129)
Observations	27,539	27,539	27,539	27,539

Notes

RIF Erreygers index (EI), RIF Wagstaff index (WI), RIF Absolute Concentration index (AC), and RIF Shortfall relative concentration index (SRCI)

2.4.3 Multivariate regression results for determinants of bed net utilisation

Results of the multivariate regression (see Table 2.7) indicated that, in 2009, the following factors were significantly associated with bed net utilisation: age of household members, age of household head, sex, region, size of household, wealth quintile, and number of nets in household. In 2014, the following factors were significantly associated with bed net utilisation: age of household members, age of household head, wealth quintile, region, size of household, mother's highest education level, and number of nets in household. For the pooled data, the following factors were significantly associated with bed net utilisation: age of household members, age of household head, sex, region, size of household, and number of nets in household. The time dummy interacted with the wealth index variable indicated that household members in all wealth quintiles in 2014 were significantly more likely to use bed nets, compared to household members from the poorest quintile in 2009.

An additional year in the age of household members increases the probability of sleeping under bed nets significantly by 0.6 percentage points in 2009, 0.3 percentage points in 2014, and 0.4 percentage points for the pooled data. An additional year in the age of household heads reduces, the probability of sleeping under bed nets significantly by 0.4 percentage points in 2009, 0.3 percentage points in 2014, and 0.4 percentage points for the pooled data.

The probability of a male household member to sleep under a bed net significantly reduced by: 6.4 percentage points in 2009, 4.2 percentage points in 2014, and 5 percentage points for the pooled data, compared to female household members.

The probability of a household member from the northern region of Uganda to sleep under a bed significantly increased by 5.4 percentage points in 2009, 6.5 percentage points in 2014, and 6.3 percentage points for the pooled data, compared to their counterparts in the central region. The probability of a household member from the eastern region of Uganda to sleep under a bed net significantly increased by 6.2 percentage points in 2009 and 3 percentage points for the pooled data, compared to their counterparts in the central region. The probability of household members from western region to sleep under bed nets significantly reduced by 7.4 percentage points in 2014 and 5.8 percentage points for the pooled data, compared to their counterparts in the central region.

In 2014, the probability of household members in the rich and richest wealth quintiles to sleep under a bed net significantly reduced by 6.1 percentage points and 6.2 percentage points respectively than that of their counterparts in the poorest wealth quintile.

A unit increase in the size of household (number of household members) significantly reduced the likelihood of sleeping under a bed net by 4.5 percentage points in 2009, 3.4 percentage points in 2014, and 3.7 percentage points for the pooled data. Additional number of nets in a household significantly increased the likelihood of sleeping under a bed net by 14.7 percentage points in 2009, 9.4 percentage points in 2014, and 10.8 percentage points for the pooled data.

In 2014, the probability of mother with post-secondary education level to sleep under a bed net significantly increased by 9.1 percentage points than that of their counterparts with no education.

There were no significant associations between place of residence and bed net usage in either 2009 or 2014.

Results from pooled data indicated that the likelihood of household members in the poorest, poor, middle, rich, and richest wealth quintiles to sleep under bed nets in 2014 significantly increased by 11.7, 10.3, 9.6, 5.6, and 5.5 percentage points respectively, compared to household members from the poorest wealth quintile in 2009. Predicted probabilities for bed net utilisation by wealth quintiles and year at 95% confidence limits also indicated that the utilisation of bed nets was significantly higher in all the wealth quintiles in 2014 when compared to 2009 (see Figure 2.13)

Figure 2.13 Predicted probability of bed net usage by household members, year and wealth quintile

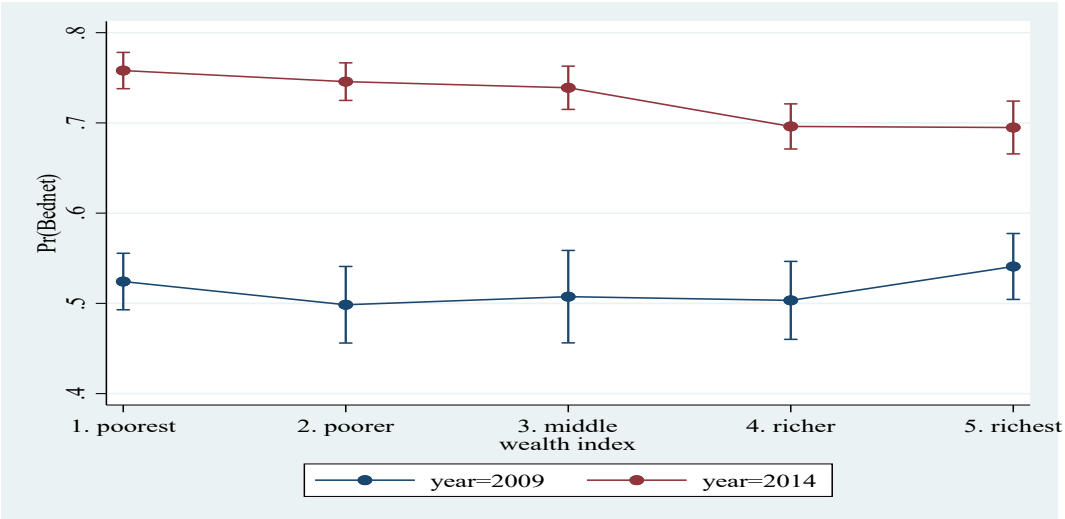


Table 2.7 Estimated Marginal Effects for the Bednet Utilization in Uganda

VARIABLES	2009 N = 21,606	2014 N = 27,539	Pooled Data N = 49,145
Age of Household members	0.006***	0.003***	0.004***
	(0.001)	(0.000)	(0.000)
Age of household head	-0.004***	-0.003***	-0.004***
	(0.000)	(0.000)	(0.000)
Sex of household members			
2. Female			
3. Male	-0.064***	-0.042***	-0.050***
	(0.009)	(0.007)	(0.005)
Regions			
4. Central			
5. Eastern			
	0.062**	0.021	0.030**
6. Northern	(0.028)	(0.016)	(0.014)
	0.054*	0.065***	0.063***
7. Western	(0.031)	(0.013)	(0.013)
	-0.008	-0.074***	-0.058***
	(0.035)	(0.017)	(0.016)
Mother's education level			
4. No education			
5. Primary education	-0.027	0.011	-0.007
	(0.040)	(0.022)	(0.022)
6. Secondary education	-0.058	0.012	-0.013
	(0.067)	(0.030)	(0.034)
7. Post-secondary education	-0.021	0.091**	0.056
	(0.087)	(0.045)	(0.046)
Household size	-0.045***	-0.034***	-0.037***
	(0.003)	(0.002)	(0.001)
Place of residence			
2. Rural			
3. Urban	0.017	0.010	0.011
	(0.029)	(0.018)	(0.016)
Number of nets	0.147***	0.094***	0.108***
	(0.011)	(0.004)	(0.004)
Mother_Education_missing	-0.238***	-0.129***	-0.167***
	(0.030)	(0.015)	(0.015)

Table 2.7 (continued)

Variable	2009 *N* = 21 606	2014 *N* = 27 539	Pooled *N* = 49 145
Year# Wealth quintile			
0. 2009 Poorest			
1. 2009 Poor			-0.022
			(0.020)
2. 2009 Middle			-0.015
			(0.026)
3. 2009 Rich			-0.018
			(0.025)
4. 2009 Richest			0.014
			(0.021)
5. 2014 Poorest			0.117***
			(0.016)
6. 2014 Poor			0.103***
			(0.016)
7. 2014 Middle			0.096***
			(0.017)
8. 2014 Rich			0.056***
			(0.019)
9. 2014 Richest			0.055**
			(0.021)
Wealth quintile			
0. Poorest			
1. Poor	-0.042*	-0.012	
	(0.023)	(0.014)	
2. Middle	-0.048	-0.019	
	(0.029)	(0.015)	
3. Rich	-0.052	-0.061***	
	(0.032)	(0.018)	
4. Richest	-0.021	-0.062***	
	(0.028)	(0.020)	

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes

1. Pooled data were appended for both 2009 and 2014
2. dy/dx = average marginal effect
3. All models were produced with robust standard errors adjusted for 1 466, 2 633, 4 094 clusters for 2009, 2014, and pooled regression respectively
4. All models passed the goodness-of-fit test (see Table 2.9 in Appendix of A to Chapter 2)
5. Wealth quintiles # year = *Wealth quintile* variable was interacted with time dummy variable
6. Mother_Education_missing: control variable showing the effect of not answering or not being asked the question relative to those who answered *0* for education

Differences in proportions in bed net utilisation

For 2009, significant differences in proportions were observed between household members who slept under bed nets and those who did not in terms of age of household members, age of household head, region, wealth quintile, mother's education, sex, and place of residence. In 2014, significant differences in proportions were observed between household members who slept under bed nets and those who did not in terms of age of household members, age of household head, region, wealth quintile, mother's education, and sex, but not for place of residence (see Table 2.8).

Differences in means in bed net utilisation

For 2009, significant differences in means were observed between household members who slept under bed nets and those who did not in terms of age of household members, age of household head, size of household and number of nets. In 2014, significant differences in means were observed between household members who slept under bed nets and those who did not in terms of age of household members, age of household head and size of household and number of nets, (see Table 2.9).

Table 2.8 Differences in proportions and bivariate statistics for potential predictors of bed net usage

	2009					2014				
	Mean	Net(%)	No Net (%)	(Net – No-Net) (%)	χ^2 (*p*-values)	Mean	Net(%)	No Net_1(%)	(Net – No Net) (%)	χ^2 (*p*-values)
Region					406.6***					327.9***
0. Central	26.00	26.90	24.20	-2.70***	(0.001)	21.70	27.20	19.30	-7.90***	(0.000)
1. Eastern	20.80	22.00	18.30	-3.70***		21.40	19.60	22.20	2.60***	
2. Northern	33.50	28.50	43.40	14.90***		37.90	31.70	40.50	8.80***	
3. Western	19.70	22.60	14.10	-8.50***		19.00	21.50	18.00	-3.50***	
Wealth quintile					318.71***					73**
0. Poorest	23.60	21.50	28.50	7.00***	(0.000)	28.20	26.40	31.00	4.60***	(0.038)
1. Poor	17.70	22.40	16.30	-6.10***		20.00	19.30	19.70	0.40	
2. Middle	18.30	16.80	10.50	-6.30***		17.50	17.30	16.50	-0.80*	
3. Rich	19.70	22.40	18.00	-4.40***		17.00	20.60	16.00	-4.60***	
4. Richest	20.70	16.80	26.70	9.90***		17.30	16.40	16.90	0.50	
Mother's education level					40.63***					15.0*
0. No education	23.30	25.10	21.00	-4.10***	(0.007)	23.00	25.60	22.40	-3.20**	(0.0715)
1. Primary	60.80	61.60	59.90	-1.70		57.91	56.90	58.20	1.30	
2. Secondary	14.13	12.60	16.00	3.40***		15.60	15.30	15.60	0.30	
3. Post-secondary	1.77	0.80	3.10	2.30***		3.49	2.20	3.80	1.60**	
Sex of household Members					58.79***					53.1***
0. Female	51.20	49.70	54.40	4.70***	(0.000)	51.70	48.70	52.90	4.20***	(0.000)
1. Male	48.80	50.30	45.60	-4.70***		48.30	51.30	47.10	-4.20***	
Place of residence					278.89***					0.027
0. Rural	87.90	90.70	82.40	-8.30***	(0.000)	82.50	82.70	82.40	-0.30	(0.958)
1. Urban	12.10	9.30	17.60	8.30***		17.50	17.30	17.60	0.30	

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes

1. Net - proportion for household members when bed net = 0
2. No - Net proportion for household members when bed net = 1
3. Differences in proportions Net – No-Net

Table 2.9 Mean differences and bivariate statistics for potential predictors of bed net usage

	2009					2014				
	Mean	No-net(%)	Net (%)	(Net-No net) (%)	χ^2 (*p*-values)	Mean	No-net(%)	Net(%)	(Net – No-net) (%)	χ^2 (*p*-values)
Age of household Members	19.82	19.37	20.7	1.32***	1057.1*** (0.000)	20.10	18.79	20.64	1.85***	727.17*** (0.000)
Age of household Head	42.74	43.87	40.5	-3.67***	647.7*** (0.002)	44.30	46.48	43.4	-3.08***	578.98*** (0.000)
Size of household	6.40	6.56	6.07	-0.496***	237.73*** (0.005)	6.83	7.50	6.56	-0.942***	675.59*** (0.000)
Nets in household	2.13	1.8	2.42	0.620***	903.17*** (0.000)	3.23	2.98	3.32	0.346***	470.6*** (0.000)

Notes

1. No-net mean for household members when bed net = 0
2. Net mean for household members when bed net = 1
3. Differences in mean Net- No-net

Results of the Wald test for the three models (2009, 2014, and pooled model) showed at least one of the coefficients was different from zero hence all the variables were included in the model (see Table 2.12 in Appendix A to Chapter 2). Results indicated that all VIF estimates for the predictors were less than 2.5, indicating that there were no multicollinearity issues (see Table 2.12 in Appendix A to Chapter 2).

The chi-squared results of the bivariate analyses show that (at a threshold of $p < 0.01$), in 2009, all the independent variables were statistically significantly associated with bed net utilisation (see Table 2.7). In 2014, age of household members, age of household head, region, wealth quintile, mother's education, size of household, number of bed nets in household, and sex were statistically significantly associated with bed net utilisation. Place of residence was not statistically significantly associated with bed net utilisation by household members in 2014 (see Table 2.6). Hence, all variables were advanced into the model for multivariate logit analyses, as they had passed the Wald test, VIF test, and bivariate test.

Postestimation results

All the models passed the goodness-of-fit test and correctly classified an acceptable percentage of observations (see Table 2.13 in Appendix A to Chapter 2). Robustness checks indicated that the coefficients across the models (logit, probit, and LPM) for both 2009 and 2014 told a qualitatively similar story about the impact of the predictors on bed net utilisation (see Table 2.14 in Appendix A to Chapter 2).

2.5 Discussion

The objectives of this study were to examine the equity in ownership and utilisation of bed nets, and to determine the predictors of bed net usage in 2009 and in 2014.

Overall, results indicated significant improvement in households' access to bed nets (above the 80% WHO (2013) and the 85% Uganda MoH (2014) targets) in 2014. These results are consistent with those of other studies that found significant improvement in households' access to bed nets following mass distributions (Ntuku *et al*. 2017; Wanzira *et al*. 2018). Although different distribution channels for bed nets are used by the UNMCP (during ANCs and immunisation, as well as to the public and through schools), the achievement of the 80% WHO (2013) and 85% Uganda MoH (2014) targets for access to bed nets may be plausibly attributed to mass distribution, given that other distribution channels were also in place in 2009, but these did not achieve the targets. Therefore, it is recommended that mass distribution campaigns be sustained in the future, in order to maintain the 80% WHO and 85% Uganda MoH targets for access to bed net coverage.

Despite significant improvements in universal coverage, it was still below the 80% WHO (2013) and 85% Uganda MoH (2014) targets in 2014, as reported in other literature (Zollner *et al*. 2015; Ntuku *et al.* 2017; Olapeju *et al.* 2018; Wanzira *et al*. 2018).

Although the percentage of household members and pregnant women who utilised bed nets had improved significantly by 2014, the figures were still below the 80% WHO (2013) and 85% Uganda MoH (2014) targets. Other studies also reported increases in the proportion of household members who utilised bed nets after mass distribution (Wanzira *et al.* 2016a; Ntuku *et al.* 2017; Wanzira *et al.* 2018), noting that the percentage of children under five years who utilised bed nets improved significantly, to above the 80% WHO (2013) target, but remained below the 85% Uganda MoH (2014) target (Wanzira *et al.* 2016a; Olapeju *et al.* 2018; Wanzira *et al.* 2018).

Bed nets remain the most cost-effective and efficient vector-control strategy in reducing both malaria mortality and morbidity in sub-Saharan African countries (Noor *et al.* 2008; Yukich *et al.* 2008; Silumbe *et al.* 2015). Hence, the increase in bed net utilisation by malaria-vulnerable groups and household members in 2014 is critical in the fight against malaria.

Access to bed nets became more pro-poor (more concentrated in poorer households) between 2009 and 2014. Research by Taylor *et al.* (2017) also found that access to bed nets after mass distribution favoured the poorest households in five countries (Congo, Guinea, Nigeria, Sierra Leone, and Zimbabwe). Although the present study could not establish causality, the large improvements over time that coincided with the 2013 mass distribution campaign make a compelling case that mass distribution may explain the large and pro-poor increases in access to bed nets observed.

Likewise, equity in universal coverage improved significantly, although it remained significantly concentrated amongst richer households in 2014. Researchers have reported improvements in equity in universal coverage after mass distribution campaigns (Bennett *et al*. 2012; Zollner *et al*. 2015). These results are in contrast with earlier research that suggested that non-targeting may exacerbate the marginalisation of the poorest and most vulnerable population groups (Gwatkin and Ergo 2011).

The present study found that equity in utilisation of bed nets was pro-poor for household members (although not significant), pro-poor for children under five years (significant), and pro-poor for pregnant women (not significant) in 2014, after the mass distribution. These results imply that more household members and malaria-vulnerable groups from poorer households utilised bed nets in 2014.

The RIF decompositions found that the relationships with socioeconomic-related bed utilisation changed over time. Mother's level of education had a significant effect on health inequality. Secondary and post-secondary education (cf. no education) promoted bed net utilisation by the rich (pro-rich) however, primary education level promoted bed net utilisation by the poor (pro-poor) in both years. Previous studies have yielded different findings on the association between education and socioeconomic related health variables. Chen *et al.* (2014) assessed income- related health inequality and health achievement in children in China and found middle school enrolments could promote health achievement, but primary school enrolments showed no influence. The present study finds that primary education level is

significant in promoting bed net utilisation by the poor. In 2009 the number of nets, household size, place of residence and region were significantly affecting health inequality, but not in 2014.

The regression analysis showed that the following socio-demographic factors were significantly associated with utilisation of bed nets in 2014: age of household members, age of household head, mother's highest level of education, wealth quintile, region, size of household, and number of nets in household. In line with other studies (Sena *et al*. 2013; Andinda *et al*. 2019), the results suggest that, as household heads grew older, the likelihood of sleeping under bed nets reduced significantly. The low bed net usage amongst adults may be due to experiences of discomfort (difficulty breathing, itching/rashes, and heat) by older household members (Matovu *et al.* 2009; Pulford *et al*. 2011; Koenker *et al.* 2013). However, these results may also suggest that household heads were aware that, by prioritising younger household members in bed net utilisation, they would ensure effective protection from mosquito bites for younger household members. Since the WHO (2018) categorises children under five years amongst malaria-vulnerable groups, this is important in the fight against malaria.

In 2014, households in the poorest quintile, compared to their counterparts in the rich and richest quintiles, were significantly more likely to use a bed net. These results are in line with the results for equity in utilisation of bed nets reported in Section 2.4.2. Baume and Franca-Koh (2011) also found that households with a lower socio-economic status were more likely to sleep under bed nets after mass distribution in Ghana (Uganda MoH 2015).

Household members in the northern region of Uganda, compared to their counterparts in the central region, were significantly more likely to sleep under bed nets in both 2009 and 2014. This is vital in the fight against malaria, given that the northern region recorded the highest malaria incidence rate of 450 cases per 1 000 population (Uganda MoH 2018c).

Baume *et al.*'s (2009) study in Oromia and Amhara regional states, Ethiopia, found that the population in areas with low malaria incidence rates were more likely not to sleep under bed nets. Thus, the significantly lower likelihood of sleeping under bed nets by households in the western region of Uganda in 2014, when compared to their counterparts in the central region, may be due to a low malaria incidence of 50 cases per 1 000 people in the region (Uganda MoH 2018c).

In line with other studies, the present study's results suggest that having more bed nets in households significantly increased the likelihood of sleeping under bed nets, in line with the findings of Moon *et al.* (2016) and Olapeju *et al.* (2018). As also reported by Babalola *et al*. (2016), the results of the present study indicate a negative association between household size and bed net utilisation in both 2009 and 2014.

Although the conclusions of the present study are tentative and tempered by identification problems related to the comparison of data from before and after the mass distribution, there is the evidence presented allows the plausible inference that mass distributions played an important role in increasing the number of bed nets in households in order to effectively fight malaria.

Limitations to the study

Results from this study indicate that the change in coverage and utilisation is associated with, but may not be caused by, mass distribution campaigns. The mass distribution campaign under study was a national campaign, and there was no opportunity to use a control group to distinguish the impact of the mass distribution campaign from any other changes that occurred during this period and may have plausibly impacted access to or utilisation of bed nets (cf. Chambliss and Schutt 2012). For example, there may have been an increase over time in the awareness of the importance of bed nets, due to community information channels and earlier campaigns.

The mass distribution campaign of the Advocacy, Communication and Social Mobilization Committee, the Behaviour Change Communication Committee, and the mass media exposed the population to malaria-control messages (especially net use) after the distribution phase of the campaign (Uganda Health Monitoring Unit 2014). Prior to the campaign, the ITN working group of the Inter-agency Coordination Committee for Malaria also communicated malaria-control messages to the population (especially with regard to net usage by children under the age of five years and pregnant women) (Uganda MoH 2014). The present study could not differentiate when the population was exposed to malaria-control messages, either during the five years (from 2009 to 2014) or directly after the mass distribution campaign. This means that the influence of extraneous factors as a cause of the change in utilisation of bed nets cannot be ruled out.

Although distribution through ANC and immunisation clinics and other sources of bed nets was not as prevalent after 2014, these channels remained operational, specifically for pregnant women. This implies that increases in coverage and utilisation of bed nets may also have been due to distribution channels other than the mass distribution. Future surveys should differentiate the sources (mass distribution, ANC and immunisation clinics, and other channels) from which respondents receive bed nets, in order to assess the true impact of mass distribution campaigns.

Previous positive experience of net use and perceived benefits of net use (like protection from malaria) have been found to be positively associated with bed net utilisation (Strachan *et al.* 2016). Neither survey used in the present study had captured respondents' previous positive experiences and perceived benefits of net use. Evidence from the literature shows that these variables are associated with bed net utilisation; therefore, the results of the present study reflect an association, rather than a causal relationship, between bed net coverage and mass distribution (Strachan *et al.* 2016).

In all, it has to be noted that the UMIS data utilised for this study lacked some important variables that might have caused bed net utilisation. Further, the time period of five years between the surveys is long, and other factors might have been associated with bed net utilisation and coverage. Hence, it is recommended that these variables (exposure to malaria messages, source of bed nets, perceived benefits and previous positive use of nets) should be included in future surveys, in order to more accurately assess the impact of mass distribution.

2.6 Conclusion

The objectives of this study were to examine equity in ownership and utilisation of bed nets, and to determine the predictors of bed net usage after the 2014 mass distribution campaign in Uganda. By 2014, the 80% WHO (2013) target and the 85% Uganda MoH (2014) target for access to bed nets by households and utilisation of bed nets by children under five years were largely achieved. However, the targets were not achieved for universal coverage of bed nets for households, utilisation of bed nets by household members and by pregnant women. However, there were significant improvements.

In all, there were improvements in equity in access to bed nets. It had become pro-poor, although not significantly. Universal coverage improved significantly, although it remained significantly concentrated amongst richer households in 2014.

In 2014, utilisation of bed nets was pro-poor for household members (although not significantly) and for malaria-vulnerable groups with unequal need — pro-poor for children under five (significant) and pro-poor for pregnant women (not significant), signifying vertical equity.

Basing on results from the study, mother's primary level of education was vital in in promoting bed net utilisation by the poor in both years, again demonstrating the importance of mother's education and more broadly, the relationship between education and health.

Likewise, household members from the northern region, households with more bed nets, and household members from the poorest wealth quintile had a higher increase in bed net utilisation in 2014.

Overall, the results from this study are encouraging. They present evidence that shows a plausible link between free distribution of preventive healthcare and household coverage and utilisation of such healthcare in low-income countries, which is encouraging of such investment.

Appendix A to Chapter 2

Table 2.10 Erreygers Concentration Indices

	2009		2014		Difference (CIB - CIA) (*p*-values)
	CIA (*p*-values)	Standard Error	CIB (*p*-values)	Standard Error	
Ownership					
Access to bed nets	0.082* (0.082)	0.082	-0.001 (0.987)	0.007	-0.082*** (0.000)
Universal coverage	0.095*** (0.000)	0.012	0.036*** (0.004)	0.012	-0.059*** (0.001)
Utilisation					
Population	0.046*** (0.003)	0.015	-0.013 (0.200)	0.010	-0.059*** (0.001)
Children under five years	0.029 (0.164)	0.020	-0.022* (0.076)	0.013	-0.051** (0.034)
Pregnant women	0.039 (0.458)	0.052	-0.032 (0.172)	0.024	-0.071 (0.212)

*** indicates $p < 0.01$, ** indicates $p < 0.05$, * indicates $p < 0.1$

Table 2.11 Data chart flow for 2009 and 2014 UMISs

	2009	**2014**
Households (*N*)	4 421	5 345
Household access to bed net	2 619	5 034
Household universal coverage	1073	3 398
Population (*N*)	21 606	27 539
Population bed net utilisation	7 250	19 483
Children under five years (*N*)	15 444	19 918
Children under five years[1]	7 163	16 918
Pregnant women (*N*)	276	458
Pregnant women[2]	211	384

Notes

1. Children under five years that slept under bed nets
2. Pregnant women that slept under bed nets

Table 2.12 Model specification tests

	2009	2014	Pooled data
Wald test			
Pearson chi squared	234.3	250	589.3
Prob > chi squared	0.000	0.000	0.000
VIF			
Variable			
Bed net	1.08	1.05	1.07
Age of household members	1.01	1.01	1.01
Age of household head	1.14	1.17	1.16
Sex of household members	1.01	1	1.00
Region			
Central			
Eastern	1.38	1.37	1.31
Northern	1.64	1.42	1.46
Western	1.31	1.28	1.27
Wealth quintiles			
Poorest			
Poor	1.20	1.19	1.19
Middle	1.26	1.21	1.21
Rich	1.32	1.26	1.25
Richest	1.61	1.62	1.56
Mother's highest education level			
No education			
Primary	1.27	1.29	1.28
Secondary	1.39	1.36	1.36

Table 2.12 (continued)

	2009	2014	Pooled data
Post-secondary	1.12	1.18	1.15
Household size	1.23	1.29	1.26
Place of residence	1.2	1.34	1.25
No mosquito nets	1.18	1.20	1.18
Mean VIF	1.61	1.58	1.54

Notes

Wald test

1. H_0: The coefficients are jointly zero
2. H_1: At least one of the coefficients is different from zero
   Hence we reject the null hypothesis (at a threshold of $p > 0.05$) for all the three models.
   .

VIF tests

The VIF estimates for the predictors for all the three models are less than 2.5, indicating that there are no multicollinearity issues.

Table 2.13 Postestimation tests

	2009	2014	Pooled data
Goodness-of-fit			
Pearson chi squared	2292.19	4065.84	6416.51
Prob > chi squared	0.2210	0.2470	0.0458
Correctly classified observations			
Correctly classified	72.51%	83.58%	79.01%

Notes

Goodness of fit test.

1. H_0: Model does not indicate misspecification
   H_1: Model indicates misspecification
   We do not reject the null hypotheses at a threshold of $p < 0.001$ for all three models.
2. Correctly classified = The percentage of correctly specified values for the models (using the estat classification command).

Table 2.14 Robustness checks for 2009 and 2014 models

	2009			2014		
VARIABLES	**Logit**	**Probit**	**LPM**	**Logit**	**Probit**	**LPM**
Age of household members	0.006***	0.006***	0.006***	0.003***	0.003***	0.003***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Age of household head	-0.004***	-0.004***	-0.005***	-0.003***	-0.003***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex of household members						
0. Female						
1. Male	-0.064***	-0.064***	-0.064***	-0.042***	-0.040***	-0.042***
	(0.009)	(0.009)	(0.009)	(0.007)	(0.007)	(0.007)
Region						
0. Central						
1. Eastern	0.062**	0.061**	0.061**	0.021	0.021	0.023
	(0.028)	(0.029)	(0.028)	(0.016)	(0.016)	(0.017)
2. Northern	0.054*	0.054*	0.056*	0.065***	0.066***	0.067***
	(0.031)	(0.031)	(0.031)	(0.013)	(0.014)	(0.014)
3. Western	-0.008	-0.007	-0.010	-0.074***	-0.073***	-0.072***
	(0.035)	(0.036)	(0.035)	(0.017)	(0.017)	(0.018)
Education level						
0. No education						
1. Primary	-0.027	-0.028	-0.029	0.011	0.011	0.012
	(0.040)	(0.041)	(0.043)	(0.022)	(0.021)	(0.019)
2. Secondary	-0.058	-0.056	-0.058	0.012	0.011	0.013
	(0.067)	(0.067)	(0.068)	(0.030)	(0.029)	(0.026)
3. Post-secondary	-0.021	-0.027	-0.040	0.091**	0.082*	0.061
	(0.087)	(0.083)	(0.071)	(0.045)	(0.043)	(0.037)
Household size	-0.045***	-0.044***	-0.045***	-0.034***	-0.034***	-0.037***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Place of residence						
0. Rural						
1. Urban	0.017	0.017	0.020	0.010	0.009	0.007
	(0.029)	(0.030)	(0.028)	(0.018)	(0.019)	(0.019)
Number of nets	0.147***	0.144***	0.144***	0.094***	0.091***	0.095***
	(0.011)	(0.010)	(0.010)	(0.004)	(0.004)	(0.004)

Table 2.14 (continued)

	2009			2014		
VARIABLES	Logit	Probit	LPM	Logit	Probit	LPM
Wealth quintile						
0. Poorest						
1. Poor	-0.042*	-0.041*	-0.042*	-0.012	-0.011	-0.010
	(0.023)	(0.024)	(0.025)	(0.014)	(0.014)	(0.014)
2. Middle	-0.048	-0.048	-0.049	-0.019	-0.019	-0.018
	(0.029)	(0.030)	(0.030)	(0.015)	(0.015)	(0.015)
3. Rich	-0.052	-0.052	-0.049	-0.061***	-0.062***	-0.064***
	(0.032)	(0.033)	(0.032)	(0.018)	(0.018)	(0.018)
4. Richest	-0.021	-0.018	-0.018	-0.062***	-0.060***	-0.064***
	(0.028)	(0.028)	(0.028)	(0.020)	(0.019)	(0.019)
Education_missing	-0.238***	-0.237***	-0.261***	-0.129***	-0.129***	-0.144***
	(0.030)	(0.032)	(0.039)	(0.015)	(0.015)	(0.017)

Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes

The coefficients across the models (logit, probit, and LPM) for both 2009 and 2014 tell a qualitatively similar story about the impact of bed net utilisation on predictors.

Table 2.15 Summary of predicted probabilities of bed net utilisation for logit, probit, and LPM models

Variable	Observations	Mean	Standard Deviation	Min	Max
2009					
Bed net	21 606	0.334	0.472	0.000	1.000
Logit	21 606	0.372	0.278	0.001	0.997
Probit	21 606	0.371	0.271	0.000	0.999
LPM	21 606	0.383	0.269	-0.572	1.453
2014					
Bed net	27 503	0.707	0.455	0.000	1.000
Logit	27 503	0.677	0.238	0.002	0.997
Probit	27 503	0.667	0.234	0.000	0.999
LPM	27 503	0.669	0.239	-0.460	1.439
Pooled					
Bed net	49 145	0.543	0.498	0.000	1.000
Logit	49 109	0.543	0.298	0.001	0.997
Probit	49 109	0.537	0.291	0.000	0.999
LPM	49 109	0.543	0.289	-0.572	1.453

Notes

The mean and standard deviation are essentially the same in the logit, probit, and LPM models for 2009, 2014, and pooled data. However, the range of the fitted values from the LPM lie outside the (0 1) bounds.

Chapter 3

Predictors of uptake of intermittent preventive treatment in Uganda in 2011 and 2016

3.1 Introduction

Despite the introduction of intermittent preventive treatment (IPT) with sulfadoxine-pyrimethamine (SP) by the World Health Organization (WHO) in 2004, malaria in pregnancy remains a challenge in sub-Saharan Africa (SSA) (WHO 2004). Malaria in pregnancy leads to devastating consequences for both mother and child, including maternal anaemia, stillbirth, and low birth weight that may cause infant mortality and morbidity (Steketee *et al*. 2001; WHO 2017b). Malaria in pregnancy is still a public health concern in Uganda and other SSA countries, and requires appropriate prevention and treatment.

In Uganda, the number of pregnant women who were reported by public healthcare facilities to have died of malaria fell from 426 in 2015 to 179 in 2017 (Uganda Ministry of Health (Uganda MoH) 2016a, 2017a). Likewise, the number of reported cases related to malaria in pregnancy by outpatient departments of public healthcare facilities fell from 261 in 2015 to 228 in 2017, and in inpatient departments from 76 in 2015 to 60 in 2017 (Uganda MoH 2016a, 2017a).

While the downward trend of cases of malaria in pregnancy in public facilities is heartening, the number of incidences remains too high. It should also be noted that private healthcare facilities are preferred to public healthcare facilities for the provision of malaria treatment (Rutebemberwa *et al.* 2009; Konde-Lule *et al.* 2010); thus, there is uncertainty regarding the overall trend.

To help address malaria in pregnancy, the WHO (2004) recommends a combination of interventions suitable for the prevention and treatment of malaria in pregnancy in SSA countries. These interventions include IPT, the use of insecticide-treated nets (ITNs), and effective case management of malaria and anaemia (WHO 2004). The results reported in the preceding chapter and recent studies suggest that about 84% of pregnant women in Uganda utilise bed nets (Uganda Bureau of Statistics (UBOS) and ICF International 2017; Wanzira *et al.* 2018). This suggests improved levels of awareness among pregnant women of the effects of malaria, which is an encouraging sign of progress in the fight against malaria in pregnancy.

In 2004, the WHO (2004) recommended the uptake of IPT-SP as the most effective preventive intervention against malaria in pregnancy. The IPT-SP intervention requires that pregnant women receive at least two doses during their scheduled antenatal care (ANC) visits (WHO 2004). The WHO (2004) policy on IPT uptake also strongly advised that the two doses should be administered at specified intervals by or under the supervision of a skilled attendant. The WHO (2004) highly recommended that all pregnant women from malaria-endemic countries receive two or more doses of IPT-SP during ANC visits.

In 2012, the WHO's 2004 policy was changed from prescribing at least two doses to receiving three or more doses of IPT-SP (WHO 2014, 2015). The WHO's (2012) policy recommended that pregnant women from malaria-endemic countries receive a dosage of three SP tablets (IPT-SP3), as a directly observed therapy (DOT) at each scheduled ANC visit, until they give birth (WHO 2014). In support of the WHO (2012) policy, results from studies indicated that IPT of three or more doses of SP (IPT-SP3), compared to only two doses, was more effective in preventing malaria in pregnancy.

For instance, Kayentao *et al.*'s (2013) systematic review and meta-analysis of seven trials found that IPT with three or more doses of SP, as opposed to two, was more effective in preventing malaria in pregnancy. Kayentao *et al.*'s (2013) study further established positive and significant associations between IPT-SP3 and higher mean birth weights. Fernandes *et al.'*s (2015) meta-analysis of seven studies in SSA further indicated that IPT-SP3 was more effective than IPT-SP2 in the prevention of malaria in pregnancy for all women, irrespective of their human immunodeficiency virus (HIV) status.

Malaria-endemic countries and implementing partners have recently stepped up efforts to increase uptake of three or more doses of SP. By addressing some of the known bottlenecks, such as stock-outs of drugs and commodities at ANC clinics and lack of guidance and supervision for healthcare workers, uptake of three or more IPT-SP doses has increased in SSA. By 2016, 36 African countries had adopted the policy of providing three or more doses of SP to pregnant women (WHO 2017a). However, by 2016, only 23 states had adhered to the policy, and only 19% of pregnant women had received three or more doses (WHO 2017a).

Adherence to IPT-SP3 is hampered in low-resource settings. Dupas (2011b) highlights that, despite its high returns in health, there is widespread underinvestment in preventative care in many developing countries. Based on the current literature, Dupas (2011b) notes a number of

plausible reasons for this underinvestment, including financial constraints, a lack of information about the benefits of such investment, and time horizons that favour immediate benefits and heavily discount long-term benefits.

3.1.1 IPT in Uganda

Uganda is among 36 African countries that have adopted the WHO (2012) policy of providing three or more doses of IPT-SP during ANC visits (WHO 2017a). The new guidelines recommend that women receive IPT-SP3 during their ANC visits (Uganda MoH 2016a). Specifically, the new guidelines recommend that pregnant women receive a single dose of three tablets at 13 weeks, after which treatment is to be continued monthly, either by ANC facilities or other sources (Uganda MoH 2016a). The guidelines recommend that healthcare providers ensure that pregnant women take the doses as DOT. The guidelines also require that healthcare providers record the doses on both the patient's card and in treatment registers, with summaries in the delivery books and monthly returns (Uganda MoH 2016a). Furthermore, the guidelines recommend that pregnant women attend ANC at least four times during their pregnancy (Uganda MoH 2016a).

The percentage of women in Uganda who attended ANC increased from 47% in 2006 to 60% in 2016 (UBOS and ICF Macro 2010; UBOS and ICF International 2017). However, despite the increase in ANC attendance and awareness of the effectiveness of the uptake of IPT-SP3 in the prevention of malaria in pregnancy, coverage of IPT-SP3 remains low in Uganda. The percentage of women in Uganda who had a live birth and had received at least two (46% in 2016), or three or more (17% in 2016) doses of IPT-SP during their ANC visits was still low compared to the respective targets of 93% and 79% stated in the Uganda Malaria Reduction Strategic Plan (Uganda MoH 2014; UBOS and ICF Macro 2010; UBOS and ICF International 2017). The low uptake of three or more doses of IPT-SP is surprising, given that the recommended IPT-SP3 is the most effective treatment in the prevention of malaria in pregnancy (Fernandes *et al.* 2015).

Understanding the demand-side factors that are associated with IPT-SP3 uptake may provide policy-makers with solutions to the disappointingly low uptake of the recommended dosage of three or more doses of SP during pregnancy, especially with reference to low-resource settings.

3.2. Empirical literature on IPT uptake

The sections below present some of the demand-based factors that studies have found to be associated with uptake of the recommended IPT-SP.

Frequency of ANC visits

Studies by Owusu-Boateng and Anto (2017) in Accra, Ghana, and by Anchang-Kimbi *et al*. (2014) in Mount Cameroon found that pregnant women who frequently attended ANC visits were significantly more likely to receive two or more doses of IPT-SP. Aregbesola and Khan's (2018) study in Nigeria, and Nkoka *et al.*'s (2018) study in Malawi also showed that frequent ANC visits were significantly associated with uptake of three or more doses of IPT-SP.

However, some studies have shown that frequency of ANC visits was negatively associated with uptake of two or more doses of IPT-SP. Ndyomugyenyi and Katamanywa's (2010) survey in Kyenjojo district in western Uganda found that frequent ANC visits were not associated with IPT-SP uptake. However, the negative association between frequency of ANC visits and the uptake of two or more doses of IPT-SP identified in Ndyomugyenyi and Katamanywa's (2010) study was due to the presence of supply-related barriers such as drug stock-outs and irregular attendance of healthcare workers.

Timing of first ANC visit

Studies have shown that women who attend their first ANC visit early (in the first or second trimester), when compared with women who attend their first ANC visit in the third trimester, are more likely to receive two or more doses of IPT-SP. Leonard *et al.*'s (2016) study in Buea health district, Cameroon, showed that women who attended their first ANC in the second trimester, compared to those who attended it in the third trimester, were more likely to receive two or more doses of IPT-SP. Okethwangu *et al.*'s 2019 study in Uganda indicated that women who attended their first ANC visit in the third trimester were less likely to receive the recommended three or more doses of IPT-SP. Olugbade *et al.*'s (2019) research in Nigeria found that late initiation of IPT-SP — after the second trimester — was a contributory factor in poor SP utilization. Mchwampaka *et al.*'s (2019) study in three districts in the Arusha region in Tanzania also indicated that early ANC visits by pregnant women were associated with uptake of three or more doses of IPT-SP. Overall, studies have shown that late attendance of the first ANC visit by pregnant women is associated with low uptake of IPT-SP.

Factors associated with timely attendance of ANC visits

Due to the importance of timely attendance of ANC visits in the uptake of IPT-SP3, the section below presents factors that are associated it.

Mother's education level and their socio-economic status are the primary factors that affect the timing of the first ANC visit. Studies have found that educated women are more likely than uneducated women to use ANC, both early and frequently (Beegle *et al*. 2001; Bloom *et al*. 2001). Pregnant women with a good knowledge of ANC and those who received advice before starting ANC are more likely to book early ANC (Tekelab *et al.* 2019; Tufa *et al.* 2020). Studies have also shown that women with an education of secondary or higher status are more likely to book early ANC visits (Tekelab *et al.* 2019; Tufa *et al.* 2020).

Other studies found that the availability, accessibility, acceptability, the family support provided, and previous experiences with the health system also affect the timing of the first ANC visit (Gill *et al*. 2007; Moller *et al*. 2017).

Other demand-side factors associated with uptake of IPT-SP

Studies have shown that knowledge of IPT-SP as a malaria-preventive measure for pregnant women is positively and significantly associated with women receiving two or more doses of IPT-SP. Rassi *et al.*'s (2016) study in the eastern and western Nile regions of Uganda found that, although pregnant women find the burden of travel and the cost associated with ANC visits challenging, they take up IPT-SP due to the perceived benefits. Amoran *et al*.'s (2012) research in western Nigeria and Hill *et al*.'s (2013) study in Nyanza province, Kenya, established that women are significantly less likely to receive two or more doses of IPT-SP if they have little knowledge of malaria.

A study by Dionne-Odom *et al*. (2017) in Cameroon and another by Wanzira *et al.* (2016b) in Uganda indicated that knowledge of IPT-SP is associated with uptake of the recommended dosage. Sanni *et al.*'s (2018) study in eight SSA countries found that uptake of the recommended three or more doses of IPT-SP is significantly associated with level of education and household wealth gradient. Kibusi *et al.*'s (2015) research in Tanzania showed that being married, being between the ages of 30 and 39, and being pregnant with their first or second child were positively associated with uptake of two or more doses of IPT-SP. Overall, frequent

ANC visits, early ANC visits, age, marital status, knowledge of IPT-SP, and parity are some of the demand-based factors that are associated with uptake of IPT-SP.

Supply-side factors associated with uptake of IPT-SP

Studies have shown that IPT-SP uptake is also associated with supply-side factors. Protas and Moshiro's (2016) study in Bukoba, Tanzania, established that timely uptake of the recommended doses of IPT-SP is associated with the availability of drug stocks and discount vouchers. Rassi *et al.*'s (2016) study in Uganda found that a lack of training and supervision opportunities for health workers and drug stock-outs in healthcare facilities accounted for missed opportunities for the provision of IPT-SP.

Some studies found that access to healthcare is associated with higher IPT-SP uptake. For example, Dionne-Odom *et al*.'s (2017) research found that the uptake of IPT-SP is associated with access to healthcare facilities. Few studies have found associations between supply-based factors and uptake of IPT-SP. A plausible explanation for this limited evidence is that nationally representative data have limited variables that capture supply-based factors. Therefore, the current study assessed the demand-side factors associated with uptake of IPT-SP3 in Uganda.

The majority of studies mentioned above do not reflect the uptake of three or more doses of IPT-SP, apart from the studies by Sanni *et al.* (2018) and Nkoka *et al*. (2018). Secondly, the majority of the studies noted above considered the source of uptake of IPT-SP[9] to differentiate between data that captures medication taken for the treatment of malaria and medicine received for the prevention of malaria. Roll Back Malaria's Monitoring and the Evaluation Reference Group (MERG) have updated this specification of the source of IPT uptake, as it was only relevant when the IPT-SP intervention was still new (Lia *et al*. 2018). No study could be found that had analysed demand-side factors associated with uptake of the recommended dosage of IPT-SP3 in Uganda by comparing data on two periods.

3.3 Methods and Data

This section presents the methodological approaches used to examine the difference in the uptake of IPT-SP3 and the demand-based factors that are associated with the uptake of IPT-

[9] Source of IPT-SP refers to information about the place where women received doses of IPT-SP during pregnancy. These sources include ANC visits, visits to other facilities, and other sources.

SP3 in 2011 and 2016. Section 3.3.2 describes the data sources and sampling. Section 3.3.3 specifies the measurement, and Section 3.3.4 describes the multivariate analysis conducted.

3.3.1 Data sources

The 2011 and 2016 UDHS datasets (UBOS and ICF International 2012, 2017) were used. UDHS data were used because it provides information on key variables relevant to this study, for example, the timing and number of ANC visits, place and professional who offered ANC services, the number of doses, and the source of IPT-SP. The UDHS also provides information on socio-demographic factors that may determine women's IPT-SP uptake during ANC visits over time, such as education, wealth status, marital status, access to media, and parity. The UDHS data provide more in-depth coverage with regard to information on socio-demographic factors of the general population than the Uganda Malaria Indicator Survey (UMIS).

3.3.2 Sample design and implementation

The 2011 and 2016 UDHS followed a two-stage sample design (UBOS and ICF International 2012, 2017). The first-stage designs for all UDHSs consisted of complete lists of randomly selected urban and rural enumeration areas, compiled from the 2002 and 2014 Uganda National Housing Census (UNHC) (see Table 3.1). In Uganda, an enumeration area refers to a geographical area that covers 30 to 70 households (UBOS and ICF International 2012, 2017).

In the second stage, systematic sampling of households was conducted for each of the selected enumeration areas. Table 3.1 shows population and sample distribution details based on the 2011 and 2016 UDHS data sets.

Table 3.1 Population and sample distributions of Uganda Demographic and Health Surveys

Year	Census	Sub-regions	EAs	Urban (EAs)	Rural (EAs)	Households	Women (15 – 49 years)
2011	2002	10	404	119	285	10 086	8 674
2016	2014	15	697	162	535	20 880	18 506

Source: UBOS and ICF International (2012, 2017).

3.3.3 Measurement

The analyses in the present study concentrated on two aspects. Descriptive statistics were used to show the percentage changes in the uptake of IPT-SP3 and potential factors that were likely associated with uptake in 2011 and 2016. All computations were performed in Stata 14.2. As

stated under Section 2.3.4, the *svy* command was applied for all descriptive and multivariate analyses. The Uganda Malaria Reduction Strategic Plan, as part of the Health Sector Development Plan (HSDP), specifies 79% as the operational success target for three or more doses of IPT-SP (Uganda MoH 2014), while the WHO's (2013) operational success target for IPT-SP3 is at least 80%. Both operational success targets were considered in the present study.

3.3.4 Multivariate analysis

The study also employed multivariate analysis to assess the factors associated with receiving IPT-SP3 in 2011 and 2016. In setting up an empirical model for this chapter we follow studies by Nkoka *et al.* (2018) and Kibusi *et al* (2015) who have done important work on this topic. We consulted their estimation models and attempted to include all controls from their models, as far as possible. They included rural location, education level, wealth, age, parity, marital status, region and gestational timing of the visit. Hence, this study extends the literature by examining demand-based factors that are associated with uptake of the recommended dosage of IPT-SP3, using data from the Uganda Demographic and Health Surveys (UDHSs) of 2011 and 2016, without necessarily specifying the source of uptake. To examine the role of supply-side factors that may have hampered uptake of the recommended IPT-SP3, the study also provides analysis from a restricted model that excludes women who made fewer than three ANC visits and women who visited ANC facilities only in the third trimester. This study used compared two surveys unlike previous studies that were reliant on a single cross-section. Furthermore, this study is also unique because has conducted an additional analysis that excludes women who made fewer than three ANC visits and women who visited ANC facilities only in the third trimester, thus concentrating on the subsample where there was the opportunity to provide them with three doses. To further differentiate the study from its predecessors and to make optimal use of the two surveys bridging the WHO policy change in terms of the recommended number of doses, I have added a pooled analysis were we interact the time dummy variable with all covariates of interest to assess the change in the significant covariates across the two time periods.

Outcome variable

The outcome variable for the model was *IPT-SP3*, defined as *1* for women who had received three or more doses of IPT during their last pregnancy that led to a live birth in the previous two years, and *0* if otherwise. Previously, the definition of IPT-SP included information on the source of SP dosage, i.e. where the pregnant women received the IPT-SP. Sources of IPT-SP3

during pregnancy included ANC visits, visits to another facility, and other sources. The primary reason for including the information on the source of IPT-SP was to differentiate between antimalarials that were received for preventive care and antimalarials received for curative care, as the intervention was new (Lia *et al*. 2018). Roll Back Malaria's MERG removed this specification (information on the source of IPT-SP uptake), as the IPT-SP intervention was well known (Lia *et al*. 2018). Hence, the present study did not consider the specification (information on the source of IPT-SP uptake) to reflect the updated recommendation of IPT-SP3 (Lia *et al*. 2018).

Model specification

All variables used to examine the relationship between demand-side factors and uptake of IPT-SP in previous studies were considered, as discussed under Section 3.2 (Amoran *et al*. 2012; Nkoka *et al*. 2018; Sanni *et al.* 2018). The present study considered the following independent variables: woman's age, mother's highest level of education, ANC visits, wealth quintile, marital status, timing of first ANC visit, parity, place of residence, and region (see Table 3.2

Table 3.2 Descriptions of independent variables

Variable	Description
1. Woman's age	Women's age was categorised into 15 to 24 years, 25 to 34 years, and > 34 years.
2. Mother's highest level of education	Education was categorised into no formal education, primary, secondary, and post-secondary.
3. Wealth quintile	Wealth quintile was categorised into poorest, poor, middle, rich, and richest.
4. ANC visits	Number of ANC visits ranged from 0 to 20.
5. Timing of first ANC visit (trimester)	Timing was categorised as Trimester 1 (0 to 3 months), Trimester 2 (4 to 6 months), and Trimester 3 (7 to 9 months).
6. Region	Regions were categorised into central, eastern, northern, and western.
7. Parity	Parity was categorised into primigravida (women with one child), secundigravida (women with two children), multigravida (women with three or more children).
8. Sufficient ANC	Sufficient ANC was *1* if a woman attended three or more ANC visits and made the first visit in Trimester 1 or 2, and *0* if otherwise.

Choice of model

As stated in Section 2.3.4, logit or probit models are recommended for binary outcome variables. Hence, since the outcome variable was binary (IPT-SP3), logit models were estimated.

Testing for covariance

Before running the logit model, Wald tests, variance inflation factor (VIF), and bivariate analyses were performed (Cameron and Trivedi 2010; Wooldridge 2013). Wald tests were performed to test for joint significance of all the coefficients in the model (Cameron and Trivedi 2010; Wooldridge 2013).

The VIF was used to quantify the extent of correlation between one predictor and the other predictors in a model (tests for collinearity/multicollinearity). Only independent variables with VIF values less than 10 were retained in the model, and a more conservative threshold of 2.5 was selected for all predictors (Cameron and Trivedi 2010; Wooldridge 2013).

In the final step, bivariate statistics were used to identify potential covariates that were worth testing in the multivariate model. It was assumed that if the independent variable was associated with the outcome variable (bed net utilisation), it might continue to explain the outcome once other covariates were included in the model. Since most of the covariates were categorical, chi square statistics were used to test whether the distribution of the outcome variable varied significantly over values of the categorical variables, with a *p*-value threshold of $p < 0.01$, $p < 0.05$, and $p < 0.1$ (Cameron and Trivedi 2010; Wooldridge 2013).

Estimation of models

Two models were estimated. With the first, the sample was unrestricted. In the second analysis, the sample was restricted to women who had attended early ANC visits (Trimester 1 and 2) and had attended three or more visits.

The second analysis, with the restricted sample, examined the role of supply-side factors by excluding cases where demand-side factors had prevented the achievement of the recommended IPT-SP3. The *Sufficient ANC* variable excluded women who had attended fewer than three visits and women who had attended ANC visits only in Trimester 3. The *Sufficient*

ANC variable was defined as *1* if a woman had attended three or more ANC visits and attended the first visit in the Trimester 1 or 2, and *0* if otherwise.

Pooled models were estimated to assess the change in the covariates in the two periods. All the variables of interest were interacted with the year dummy variable.

Postestimation tests

The logit models were transformed to marginal effects (Cameron and Trivedi 2010; StataCorp 2017; Muller and MacLehose 2014; Wooldridge 2013). Goodness-of-fit tests were performed using the postestimation (*estat gof*) command, and goodness-of-fit measures based on classification were obtained using the postestimation (*estat classification*) command (Cameron and Trivedi 2010; StataCorp 2017; Wooldridge 2013).

Robustness checks were performed by comparing coefficients of the independent variables from the logit, probit, and linear probability models (LPMs). Summaries of predicted probabilities are presented for all the models (2009, 2014, and pooled data). For the pooled cross-sectional data, marginal predictive plots are presented.

3.4 Results

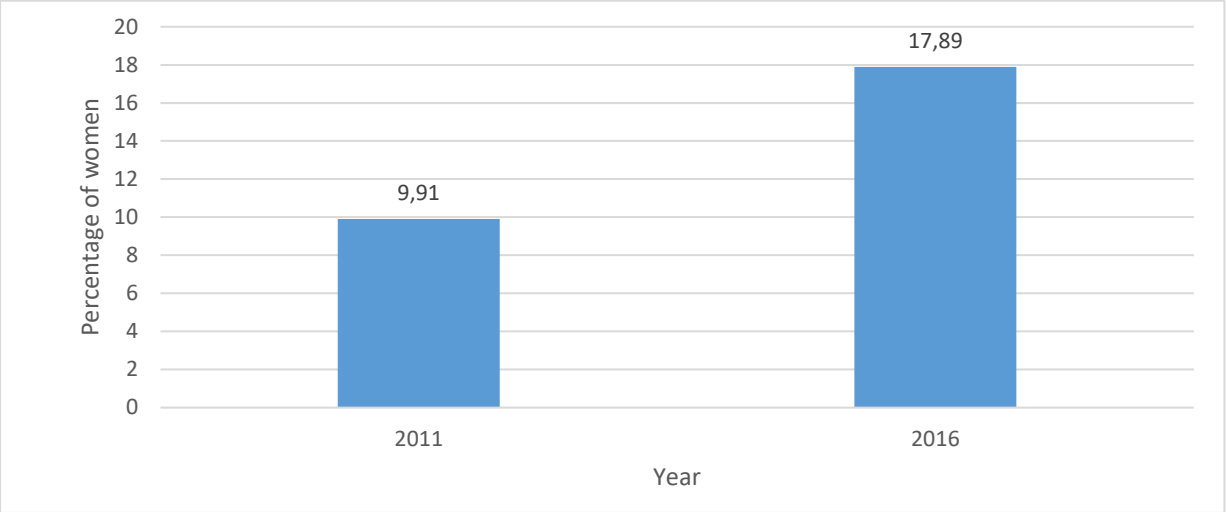
The results of the study are presented in the sections that follow. Section 3.4.1 describes results of descriptive statistics, and Section 3.4.2 presents results of the multivariate regression analysis.

3.4.1 Descriptive analysis

In 2011, 9.91% of 4 855 women[10] received three or more doses of IPT-SP (see Figure 3.1). In 2016, 17.89% of 10 215 women received IPT-SP3 (see Figure 3.1). The improvement was double, however the percentage remained far below the 80% WHO (2013) and 79% HSDP (Uganda MoH 2014) operational success targets.

[10] For this study, *women* refers to women aged between 15 and 49 years who had a live birth in the two years preceding the survey.

Figure 3.1 Percentage uptake of IPT-SP3 by women in 2011 and 2016



Differences in proportion by IPT-SP3 uptake

Results indicated that, in 2011, significant differences in proportions were observed between women who had received and those who had not received the recommended IPT-SP3 with regard to: *Level of education*, *Wealth quintile*, *Region*, *Timing of first ANC visit*, and *Sufficient ANC* (see Table 3.3). In 2016, significant differences in proportions were observed between women who had received and those who had not received the recommended IPT-SP3 with regard to: *Age*, *Level of education*, *Wealth quintile*, *Region*, *Place of residence*, *Timing of first ANC visit*, and *Sufficient ANC* (see Table 3.3).

Chi squared results show that (at thresholds of $p < 0.1$, $p < 0.05$, and $p < 0.01$), for 2011, *Mother's highest level of education*, *Wealth quintile*, *Region*, *Timing of first ANC visit*, *ANC visits*, *Marital status*, and the demand-side variable were statistically significantly associated with uptake of the recommended dosage of IPT-SP3 (see Table 3.3). For 2016, chi squared estimates indicated that *Age*, *Mother's highest level of education*, *Place of residence*, *Region*, *Timing of first ANC visit*, *ANC visits*, and the demand-side variable were statistically significantly associated with uptake of IPT-SP3 (see Table 3.3).

Hence, the following variables were included in the unrestricted model: *Age*, *Mother's highest level of education*, *Wealth quintile*, *Marital status*, *Place of residence*, *Region*, *Timing of first ANC visit*, and *Parity*. For the restricted model, *Age*, *Mother's highest level of education*, *Wealth quintile*, *Marital status*, *Place of residence*, *Region*, the demand-side variable, and *Parity* were included in the model.

Table 3.3 Descriptive statistics and bivariate statistics of potential predictors of IPT-SP3 uptake

	2011 (*N* = 4 855)					2016 (*N* = 10 215)				
	Mean	P_0 < 3 %	P_1 >3+ %	(P_1-P_0)	χ^2 (*p*-values)	Mean	P_0 <3 %	P_1 >3+ %	(P_1-P_0)	χ^2 (*p*-values)
Age (years)					3.41					16.36***
15 – 24	42.60	31.7	32.6	-1.0	(0.287)	43.50	33.80	38.30	-4.50***	(0.001)
25 – 34	31.30	45.4	46.8	-1.4		30.30	43.70	42.70	0.90	
> 34	26.10	23.0	20.6	2.4		26.20	22.50	18.90	3.50***	
Mother's educational Level					2.15*					12.71*
No education	15.40	18.00	11.60	6.30***	(0.095)	11.20	13.00	10.60	2.30***	(0.033)
Primary	55.60	57.90	60.10	-2.20		58.90	61.30	61.30	0.00	
Secondary	22.70	19.40	22.90	-3.40*		22.80	19.70	22.30	-2.60**	
Post-secondary	6.30	4.70	5.40	-0.70		7.10	6.00	5.80	0.30	
Wealth Quintile					19.54*					4.99
Poorest	20.20	24.90	18.30	6.60***	(0.015)	21.00	25.00	24.00	1.00	(0.471)
Poor	16.50	19.00	17.50	1.60		19.70	21.20	22.50	-1.30	
Middle	16.20	16.80	20.40	-3.60**		18.80	19.00	18.80	0.10	
Rich	17.80	16.30	16.20	0.00		18.70	17.10	18.00	-0.90	
Richest	29.30	23.00	27.70	-4.70**		21.80	17.70	16.60	1.10	
Marital status					3.83*					0.45
Unmarried	38.30	16.10	14.30	1.80	(0.09)	38.50	17.90	17.00	1.00	(0.582)
Married	61.70	83.90	85.70	-1.80		61.50	82.10	83.00	-1.00	
Place of Residence					0.18					7.62*
Rural	70.50	76.00	74.40	1.60	(0.827)	76.30	79.80	81.70	-2.00*	(0.072)
Urban	29.50	24.00	25.60	-1.60		23.70	20.20	18.30	2.00*	
Region					21.17*					25.57**
Central	30.40	26.80	27.20	-0.40	(0.012)	23.40	21.50	20.40	1.10	(0.004)
Eastern	21.00	22.70	19.80	3.00		27.20	27.20	30.20	-3.10***	
Northern	27.60	29.70	26.40	3.30		23.60	24.80	26.50	-1.70	
Western	21.00	20.80	26.60	-5.80***		25.80	26.50	22.90	3.70***	
Timing of 1st ANC visit					17.20*					36.89***
Trimester 1	23.90	23.80	25.80	-2.00*	(0.031)	30.50	29.90	32.40	-2.50***	(0.000)
Trimester 2	64.40	64.00	68.00	-4.00*		62.60	62.40	63.90	-1.60	
Trimester 3	11.70	12.20	6.20	6.10***		6.90	7.70	3.70	4.10***	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3.3 (continued)

	2011 (N = 4855)					2016 (N = 10215)				
	Mean	P_0 < 3 %	P_1 >3+%	(P_1-P_0)	χ^2 (*p*-values)	Mean	P_0 < 3 %	P_1 >3+%	(P_1-P_0)	χ^2 (*p*-values)
Parity					1.83					4.857
Primigravida	49.20	48.60	53.00	-4.40*	(0.559)	55.80	55.40	57.00	-1.70	(0.181)
Secundigravida	41.70	41.90	39.90	2.00		37.60	38.00	36.50	1.50	
Multigravida	9.10	9.50	7.10	2.40*		6.60	6.60	6.40	0.20	
					91.12***					198.77**
ANC visits					(0.000)					(0.000)
Sufficient ANC					45.07***					108.43**
					(0.000)					(0.000)
	79.7	78.00	91.00	-12.90***		86.70	81.40	92.80	-11.4***	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes

1. <3 = women who had received less than three doses of IPT-SP
2. >3+ = women who had received three or more doses of IPT-SP
3. P_0 proportion of women who had received less than three doses of IPT-SP over categories
4. P_1 proportion of women who had received more than three doses of IPT-SP over categories
5. **P_1-P_0** = difference in proportion
6. Sufficient ANC
   Sufficient ANC was *1* if a woman attended three or more ANC visits and made the first visit in Trimester 1 or 2, and *0* if otherwise.

3.4.2 Multivariate regression analysis of the determinants of IPT-SP3 uptake

This section presents results for both the unrestricted and restricted models with and without the *ANC visits* variable. Due to the high collinearity between *ANC visits* and *Timing of first ANC visit*, the section discusses the results for both the unrestricted and restricted models without the *ANC visits* variable (see Table 3.4 and Table 3.5). The restricted sample examines the role of supply-side factors by excluding cases where demand-side factors prevented the achievement of targets for uptake of IPT-SP3. The *sufficient ANC* variable excludes women who had attended fewer than three visits and women who had attended ANC only in Trimester 3.

Results from the unrestricted model without the *ANC visit* variable indicate that, in 2011, the following variables were significantly associated with the uptake of IPT-SP3: *Education level of pregnant women, Marital status, Wealth quintile*, *Region* and *Timing of first ANC visit* (see Table 3.4). Estimates from the restricted model without the *ANC visits* variable indicated that, in 2011, uptake of IPT-SP3 was significantly associated with *Wealth quintile* (see Table 3.5).

For 2016, results from the unrestricted model without the *ANC visit* variable suggested that uptake of IPT-SP3 was associated with *Age of woman*, *Wealth quintile*, *Region*, and *Timing of first ANC visit* (see Table 3.4). For 2016, results from the restricted model suggested that uptake of IPT-SP3 was associated with *Age of woman* and *Wealth quintile* (see Table 3.5).

In the unrestricted model, the probability that women older than 34 years received IPT-SP3 reduced significantly, by 3.3 percentage points in 2016 compared with women aged 15 to 24 years. For the restricted model, the figure was 4.9 percentage points in 2016. Overall, results in both the restricted and unrestricted models without the *ANC visits* variable suggested that younger women (between the ages of 15 and 24 years) were more likely to receive IPT-SP3, compared to women in other age categories in 2011 and in 2016.

In the unrestricted model, women in the richest wealth quintile had a 5.4 percentage points likelihood to receive IPT SP3 in 2011 compared to women in the poorest wealth quintile. For the restricted model, the respective probability was 5 percentage points in 2011. In the unrestricted model, women in the middle and rich wealth quintile had a 2.8 and 3.2 percentage points likelihood to receive IPT-SP3 respectively in 2016 compared with their counterparts in the poorest wealth quintile. For the restricted model, the respective likelihoods for the same quintiles were 3.5 and 4.3 percentage points in 2016. In all, estimates suggested that women in the poorest wealth quintile were significantly less likely to receive the recommended IPT-SP3 than their counterparts in other wealth quintiles.

In the unrestricted model, married women had a 2.8 percentage points probability to receive IPT-SP3 in 2011 compared to unmarried women. Women with secondary level of education had a 3.6 percentage point likelihood to receive IPT – SP3 in 2011 compared to women without education. Also, this model showed that in 2016 the probability that women in the northern region received IPT-SP3 was 3.2 percentage points higher cf. their counterparts in the central region.

In the unrestricted model, the probability that women in the western region (cf. central region) received IPT-SP3 was 4 percentage points higher in 2011 and 2.5 percentage points lower in 2016.

In the unrestricted model, women who attended their first ANC visit in the third trimester were 5.3 percentage points less likely to receive IPT-SP3 in 2011, and 9.2 percentage points less likely in 2016 compared with their counterparts who attended their first ANC visit in the first trimester The uptake of IPT-SP3 was significantly higher for women who attended their first ANC visit in Trimester 1 or 2 than those who attended such visits in the third trimester, in both years (also see Figure 3.2). There were no significant associations between uptake of the recommended IPT-SP3 and marital status.

It is also important to consider the time dummy: One may have expected an increase in the uptake of at least three IPT-SPs given that the guidelines were altered in 2012 to recommend 3 doses for all pregnant women. However, the pooled model in Table 3.4 shows that the 2016 time dummy is small and significant, indicating when correlates of demand are taken into account, uptake has not increased much over time. Similarly, the marginal effects on the pooled model with all variables interacted with the 2016 dummy (Table 3.9 in the Appendix) finds no significant difference in the underlying demand-side correlates of uptake either, suggesting that it has not had an impact on these relationships. The relationships and the uptake itself appear to be surprisingly stable over time despite this change in the policy guidelines.

Table 3.4 Estimated marginal effects of IPT-SP3 for the unrestricted model

	Unrestricted Model without *ANC visits*			Unrestricted Model with *ANC visits*		
	2011 dy/dx *N* = 4,855	2016 dy/dx *N* = 10,215	Pooled dy/dx *N* =15,070	2011 dy/dx *N* = 4,855	2016 dy/dx *N* = 10,215	Pooled dy/dx *N* =15,070
Age (years)						
0. 15 – 24						
1. 25 – 34	0.002	-0.015	-0.009	0.004	-0.033***	-0.019**
	(0.013)	(0.010)	(0.008)	(0.012)	(0.011)	(0.008)
2. > 34	-0.013	-0.033***	-0.026***	-0.012	-0.043***	-0.031***
	(0.014)	(0.013)	(0.010)	(0.014)	(0.015)	(0.011)
Educational level						
0. No education						
1. Primary	0.022	0.012	0.017	0.021	0.009	0.015
	(0.015)	(0.015)	(0.012)	(0.016)	(0.017)	(0.012)
2. Secondary	0.036*	0.030	0.034**	0.032	0.019	0.026*
	(0.020)	(0.019)	(0.015)	(0.020)	(0.021)	(0.015)
3. Post-secondary	0.016	-0.002	0.005	0.009	0.006	0.011
	(0.030)	(0.023)	(0.019)	(0.030)	(0.027)	(0.021)
Wealth quintile						
0. Poorest						
1. Poor	0.002	0.020	0.013	0.002	0.018	0.011
	(0.019)	(0.012)	(0.010)	(0.019)	(0.013)	(0.011)
2. Middle	0.031	0.028**	0.029**	0.026	0.025	0.024**
	(0.019)	(0.014)	(0.011)	(0.019)	(0.016)	(0.012)
3. Rich	0.002	0.032**	0.022*	-0.004	0.030*	0.016
	(0.016)	(0.015)	(0.012)	(0.017)	(0.016)	(0.012)
4. Richest	0.054**	0.017	0.030*	0.042*	0.026	0.034**
	(0.024)	(0.020)	(0.016)	(0.023)	(0.021)	(0.016)
Marital status						
0. Unmarried						
1. Married	0.028**	0.010	0.014	0.024*	0.002	0.009
	(0.014)	(0.012)	(0.009)	(0.014)	(0.014)	(0.010)
Place of residence						
0. Rural						
1. Urban	-0.024	-0.016	-0.020	-0.021	-0.013	-0.017
	(0.021)	(0.015)	(0.013)	(0.022)	(0.015)	(0.013)
Region						
0. Central						
1. Eastern	-0.009	0.025	0.015	-0.010	0.019	0.009
	(0.018)	(0.017)	(0.013)	(0.018)	(0.018)	(0.014)
2. Northern	0.008	0.032*	0.025*	0.003	0.026	0.019
	(0.020)	(0.018)	(0.014)	(0.020)	(0.020)	(0.015)
3. Western	0.040**	-0.025*	-0.002	0.038*	-0.022	0.003
	(0.020)	(0.015)	(0.013)	(0.021)	(0.016)	(0.014)

Table 3.4 (continued)

	Unrestricted Model without *ANC visits*			Unrestricted Model with *ANC visits*		
	2011 dy/dx *N* **= 4,855**	**2016 dy/dx** *N* **= 10,215**	**2011 dy/dx** *N* **=15,070**	**2016 dy/dx** *N* **= 4,855**	**2011 dy/dx** *N* **= 10,215**	**2016 dy/dx** *N* **=15,070**
Timing of first ANC visit						
0. Trimester 1						
1. Trimester 2	0.001	-0.008	-0.004	0.015	0.018	0.017**
	(0.013)	(0.011)	(0.009)	(0.013)	(0.012)	(0.009)
2. Trimester 3	-0.053***	-0.092***	-0.079***	-0.021	-0.025	-0.022
	0.001	-0.008	-0.004	0.015	0.018	0.017**
Parity						
0. Primigravida						
1. Secundigravida	-0.003	-0.016	-0.012	0.000	-0.000	0.001
	(0.013)	(0.010)	(0.008)	(0.013)	(0.011)	(0.009)
2. Multigravida	-0.020	-0.021	-0.022	-0.020	-0.009	-0.014
	(0.020)	(0.019)	(0.014)	(0.020)	(0.022)	(0.015)
Year						
0. 2011						
1. 2016			0.015***			0.013***
			(0.002)			(0.002)
ANC visits						
Any ANC visits				0.034***	0.053***	0.046***
				(0.008)	(0.007)	(0.005)
Observations	4,659	9,948	14,607	4,578	7,880	12,458

Figure 3.2 Predicted probability of uptake of IPT-SP3 by year and timing of 1st ANC

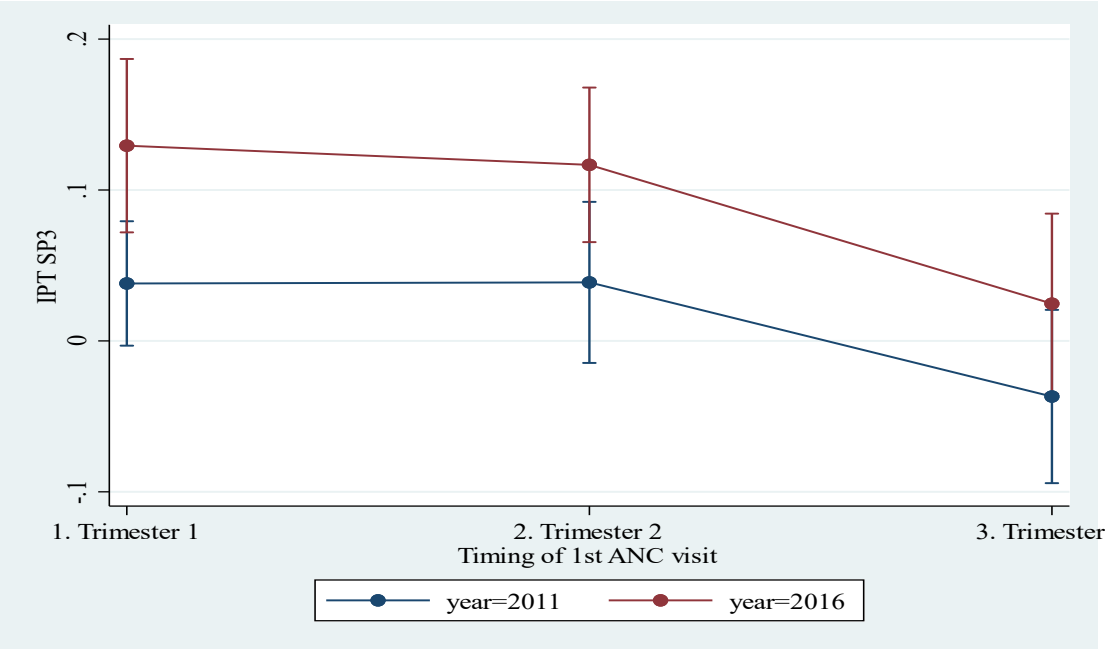


Table 3.5 Estimated marginal effects of IPT-SP3 for the restricted model

	Restricted without ANC visits			Restricted with ANC visits		
	2011 dy/dx N = 3,671	2016 dy/dx N = 6,637	Pooled dy/dx N = 10,308	2011 dy/dx N =3,671	2016 dy/dx N = 6,637	Pooled dy/dx N = 10,308
Age (years)						
0. 15 – 24						
1. 25 – 34	-0.004	-0.044***	-0.030***	-0.004	-0.044***	-0.030***
	(0.015)	(0.013)	(0.010)	(0.015)	(0.013)	(0.010)
2. > 34	-0.018	-0.049***	-0.037***	-0.018	-0.049***	-0.037***
	(0.018)	(0.016)	(0.012)	(0.018)	(0.016)	(0.012)
Educational level						
0. No education						
1. Primary	0.021	0.011	0.016	0.021	0.011	0.016
	(0.020)	(0.019)	(0.014)	(0.020)	(0.019)	(0.014)
2. Secondary	0.023	0.024	0.026	0.023	0.024	0.026
	(0.024)	(0.023)	(0.017)	(0.024)	(0.023)	(0.017)
3. Post-secondary	0.010	-0.001	0.006	0.009	-0.001	0.006
	(0.036)	(0.030)	(0.025)	(0.036)	(0.030)	(0.025)
Wealth quintile						
0. Poorest						
1. Poor	-0.001	0.026*	0.015	-0.001	0.026*	0.015
	(0.022)	(0.015)	(0.012)	(0.022)	(0.015)	(0.012)
2. Middle	0.031	0.035**	0.032**	0.031	0.035**	0.031**
	(0.023)	(0.017)	(0.014)	(0.024)	(0.017)	(0.014)
3. Rich	0.001	0.043**	0.026*	0.000	0.043**	0.026*
	(0.021)	(0.018)	(0.014)	(0.022)	(0.018)	(0.014)
4. Richest	0.050*	0.028	0.038**	0.048	0.028	0.037**
	(0.029)	(0.023)	(0.019)	(0.029)	(0.023)	(0.019)
Marital status						
0. Unmarried						
1. Married	0.027	-0.000	0.009	0.027	-0.000	0.008
	(0.018)	(0.015)	(0.012)	(0.018)	(0.015)	(0.012)
Place of residence						
0. Rural						
1. Urban	-0.014	-0.016	-0.017	-0.014	-0.016	-0.017
	(0.028)	(0.017)	(0.015)	(0.028)	(0.017)	(0.015)
Region						
0. Central						
1. Eastern	-0.011	0.014	0.005	-0.010	0.013	0.005
	(0.024)	(0.020)	(0.016)	(0.023)	(0.020)	(0.016)
2. Northern	-0.002	0.033	0.022	-0.001	0.033	0.022
	(0.024)	(0.022)	(0.017)	(0.024)	(0.022)	(0.017)
3. Western	0.032	-0.022	-0.001	0.033	-0.022	-0.001
	(0.024)	(0.019)	(0.016)	(0.024)	(0.019)	(0.016)

Table 3.5 (continued)

	Restricted without ANC visits			Restricted with ANC visits		
	2011 dy/dx N = 3,671	2016 dy/dx N = 6,637	Pooled dy/dx N = 10,308	2016 dy/dx N = 6,637	2011 dy/dx N = 3,671	Pooled dy/dx N = 10,308
Parity						
0. Primigravida						
1. Secundigravida	0.004	0.005	0.005	0.004	0.005	0.005
	(0.016)	(0.013)	(0.010)	(0.016)	(0.013)	(0.010)
2. Multigravida	-0.007	0.000	-0.003	-0.007	0.000	-0.003
	(0.028)	(0.024)	(0.019)	(0.028)	(0.024)	(0.019)
Trimester						
0. Trimester 1						
1. Trimester 2	0.012	0.014	0.014	0.014	0.014	0.015
	(0.014)	(0.013)	(0.010)	(0.014)	(0.013)	(0.010)
Year						
0. 2011						
1. 2016			0.014***			0.014***
			(0.002)			(0.002)
ANC visits						
Any ANC visits				0.012	0.002	0.006
				(0.013)	(0.012)	(0.009)
Observations	3,632	6,568	10,200	3,632	6,568	10,200

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes:

1. dy/dx = average marginal effect
2. All models passed the goodness-of-fit test (see Table 3.6 in Appendix A to Chapter 3)

The joint Wald test results for the three models (2011, 2016, and pooled data) showed that at least one of the coefficients is different from zero (see Table 3.6 in Appendix A to Chapter 3). The VIF estimates for the other predictors, apart from *ANC visits*, for the three models were less than 2.5. Hence, the *ANC visits* variable was dropped from the model (see Table 3.6 in Appendix A to Chapter 3).

Postestimation results

All the models passed the goodness-of-fit test and correctly classified an acceptable percentage of observations (see Table 3.8 in Appendix A to Chapter 3). Robustness checks indicated that the coefficients across the models (logit, probit, and LPM) for both 2011 and 2016 told a

qualitatively similar story about the impact of the predictors on IPT-SP3 uptake. (see Table 3.8 in Appendix A to Chapter 3).

3.5 Discussion, conclusions, and recommendations

The primary objective of this study was to examine demand-based factors associated with receiving the recommended three or more doses of SP by women in Uganda during their last pregnancy before the surveys in 2011 and 2016. The sections that follow present a discussion of the results, conclusions, and recommendations based on the results.

3.5.1 Discussion

Although there was a statistically significant improvement in the proportion of women who received IPT-SP3, from 9.91% in 2011 to 17.89% in 2016, it was far below the 80% WHO (2013) and the 79% HSSD (Uganda MoH 2014) operational success targets. The low coverage of IPT-SP3 is not unique to Uganda. The WHO report of 2017 on 26 countries showed that only 19% of women had received IPT-SP3. Nkoka *et al*.'s (2018) study also reported that only 30% of women in Malawi had reported receiving the recommended dosage of IPT-SP3.

Women who attended their first ANC visit in the first trimester, compared to women who attended their first ANC visit in the third trimester, were significantly more likely to have received the recommended dosage of IPT-SP3, in both 2011 and 2016. Other studies (Kibusi *et al.* 2015; Protas and Moshiro 2016; Owusu-Boateng and Anto 2017; Okethwangu *et al.* 2019) have also shown that late timing of the first ANC visit significantly reduces the likelihood of women receiving two or more doses of IPT-SP. Pregnant women with good knowledge of ANC and those who have received advice before starting ANC are more likely to book early ANC visits than their uninformed counterparts (Tekelab *et al.* 2019; Tufa *et al.* 2020). Hence, policymakers need to increase awareness of the importance of early ANC visits through malaria-related educational campaigns.

Younger women (15 to 24 years), when compared to older women (older than 34 years), were also more likely to receive the recommended dosage of IPT-SP3 in 2016. Researchers have reported contrasting results in this regard. Kibusi *et al.* (2015) examined the factors associated with the uptake of two or more doses of IPT-SP, and also found that older women in Tanzania were more likely to receive two or more doses of IPT-SP. Okethwangu *et al.* (2019) reported

that younger women (younger than 34 years) were more likely to receive the recommended three or more doses of IPT-SP3 than women older than 34 years. In essence, the present study's results indicate greater awareness amongst younger women regarding the uptake of IPT-SP3 in fighting malaria in pregnancy. The results also suggest that older women may be more complacent. Therefore, policymakers should, through educational campaigns, encourage all pregnant women, irrespective of age, to receive the recommended dosage of IPT-SP3 to prevent malaria in pregnancy.

There were regional variations with regard to the likelihood of women's uptake of IPT-SP3.

Women in the northern region, when compared to their counterparts in the central region, were more likely to have received the recommended dosage of IPT-SP3 in 2016. Given that districts in the northern region recorded the highest malaria incidence rate of 450 cases per 1 000 population in 2017 (Uganda MoH 2018c), this result is vital in the fight against malaria.

On the other hand, women in the western region, when compared to women in the central region, were significantly less likely to have received the recommended dosage of IPT-SP3 in 2016. A possible explanation for this result is that the western region has a lower malaria incidence rate, less than 50 cases per 1 000 population, compared to the central region, which has a rate that varies between 150 and 300 cases per 1 000 population (Uganda MoH 2018c).

While some regional variations with respect to the likelihood of women having received the recommended dosage of IPT-SP3 may be attributable to differences in the regional malaria incidence rates, no areas in the country have been classified as being in the elimination phase. (Uganda MoH 2018c). Thus, women from all regions of Uganda should be encouraged to receive the recommended dosage of IPT-SP3.

In line with results of other studies (Hill *et al*. 2013; Mwandama *et al*. 2015), the results indicated variations in the uptake of IPT-SP3 with regard to wealth quintile. For instance, women in the poorest wealth quintile were less likely than women in the other wealth quintiles to receive IPT-SP3. Also in line with other studies estimates indicate that women with one child were more likely to receive IPT-SP3 compared with women with two or more children (Kibusi *et al.* 2015).

Pooled model findings indicate that the conditional on covariates, uptake only increased by a small (but significant margin) between 2011 and 2016. This is contrary to the strong prior that

the WHO policy recommendation change in 2012 (to support three or more doses) would influence uptake and also the large increase in the total IPT-SP3 as shown by the descriptives (Figure 3.1). The analysis with the 2016 time dummy interactions showed that the relationship between IPT-SP3 and the covariates did not change over time (2011 and 2016).

Limitations of the study

This study was limited to variables that captured supply-based factors (like drug stock-outs and irregular attendance of healthcare workers). Secondly, it was impossible to differentiate between SP that had been taken by pregnant women as a curative or a preventative measure.

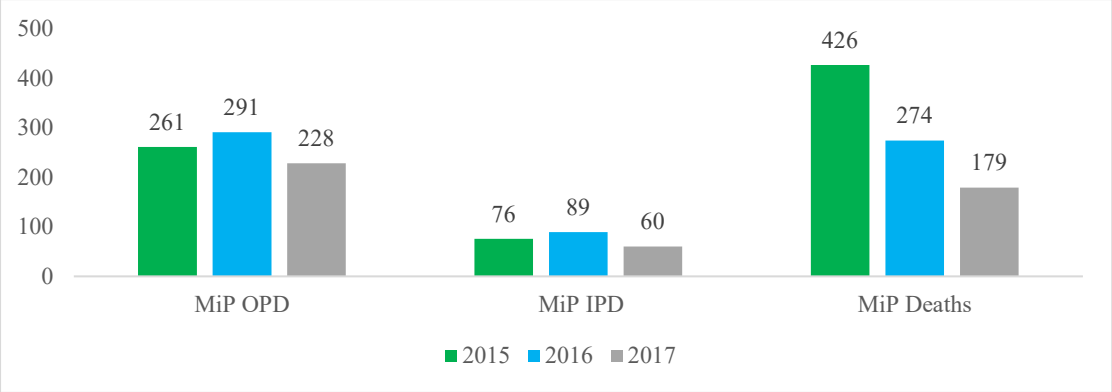
3.5.2 Conclusions and recommendations

The main objective of this study was to examine demand-side factors associated with the uptake of IPT-SP3 in 2011 and 2016 in Uganda. Although there was a large significant improvement in the uptake of IPT-SP3 in 2016, it was still far below the 80% WHO (2013) target and the 79% HSSD (Uganda MoH 2014) target. Overall, the results suggest that, in Uganda, uptake of preventive healthcare remains low, despite its effectiveness in reducing health risks.

The results from pooled data suggest that the change in IPT-SP3 uptake is not explained by changes over time in the relationship between IPT-SP3 uptake and the demand-side factors, but rather by shifts in the underlying demand-side variables themselves. Future research on IPT-SP3 coverage should aim to differentiate between SP taken for curative and for preventive malaria care.

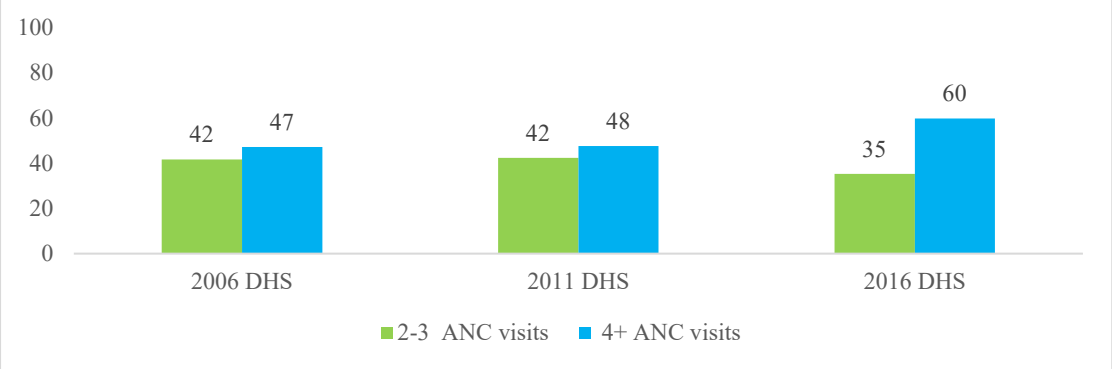
Appendix A to Chapter 3

Figure 3.3 Malaria in pregnancy per 1 000 people for outpatient departments, inpatient departments, and death



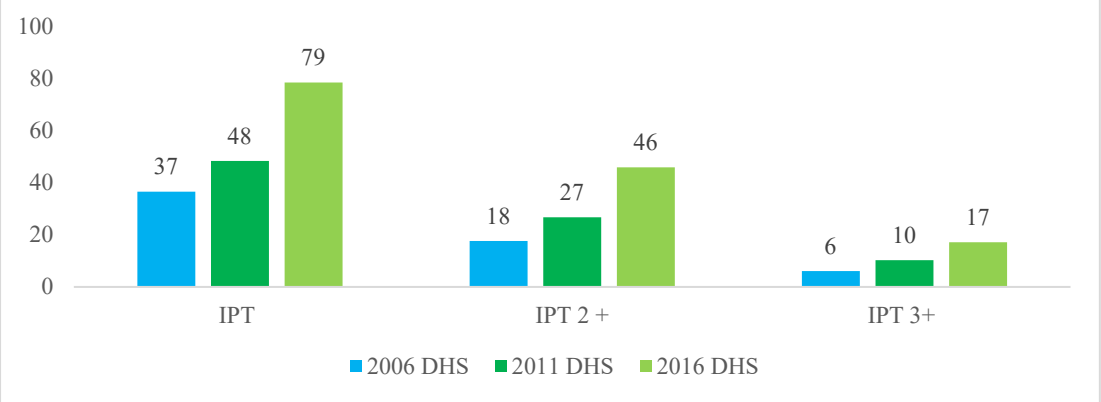
Source: Uganda MoH (2016a, 2017a)

Figure 3.4 Percentage of pregnant women who received ANC from a skilled provider



Source: Uganda Bureau of Statistics (UBOS) and ICF International 2017

Figure 3.5 Pregnant women who received two or more doses of IPT-SP during ANC Visits



Source: Uganda Bureau of Statistics (UBOS) and ICF Macro 2010; Uganda Bureau of Statistics (UBOS) and ICF International 2017

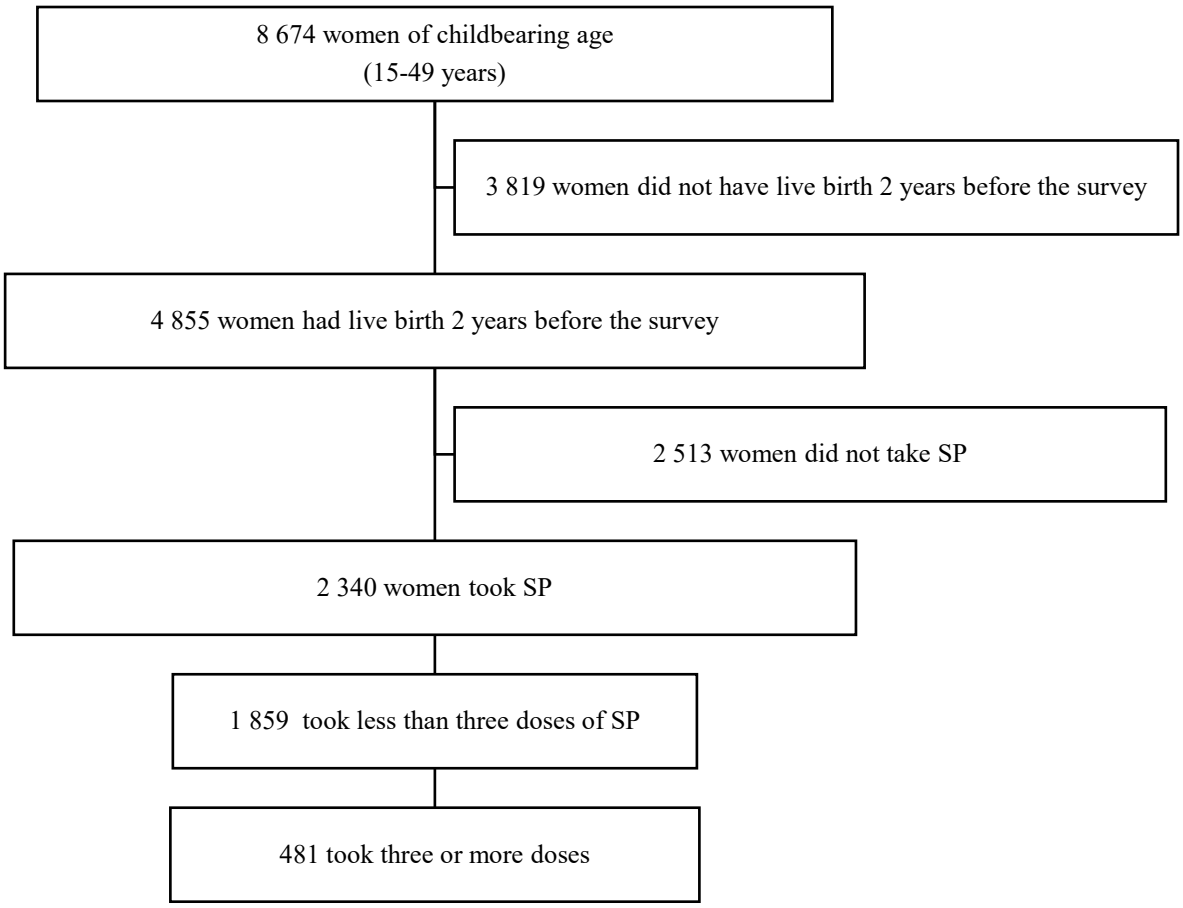


Figure 3.6 Data flow chart for 2011

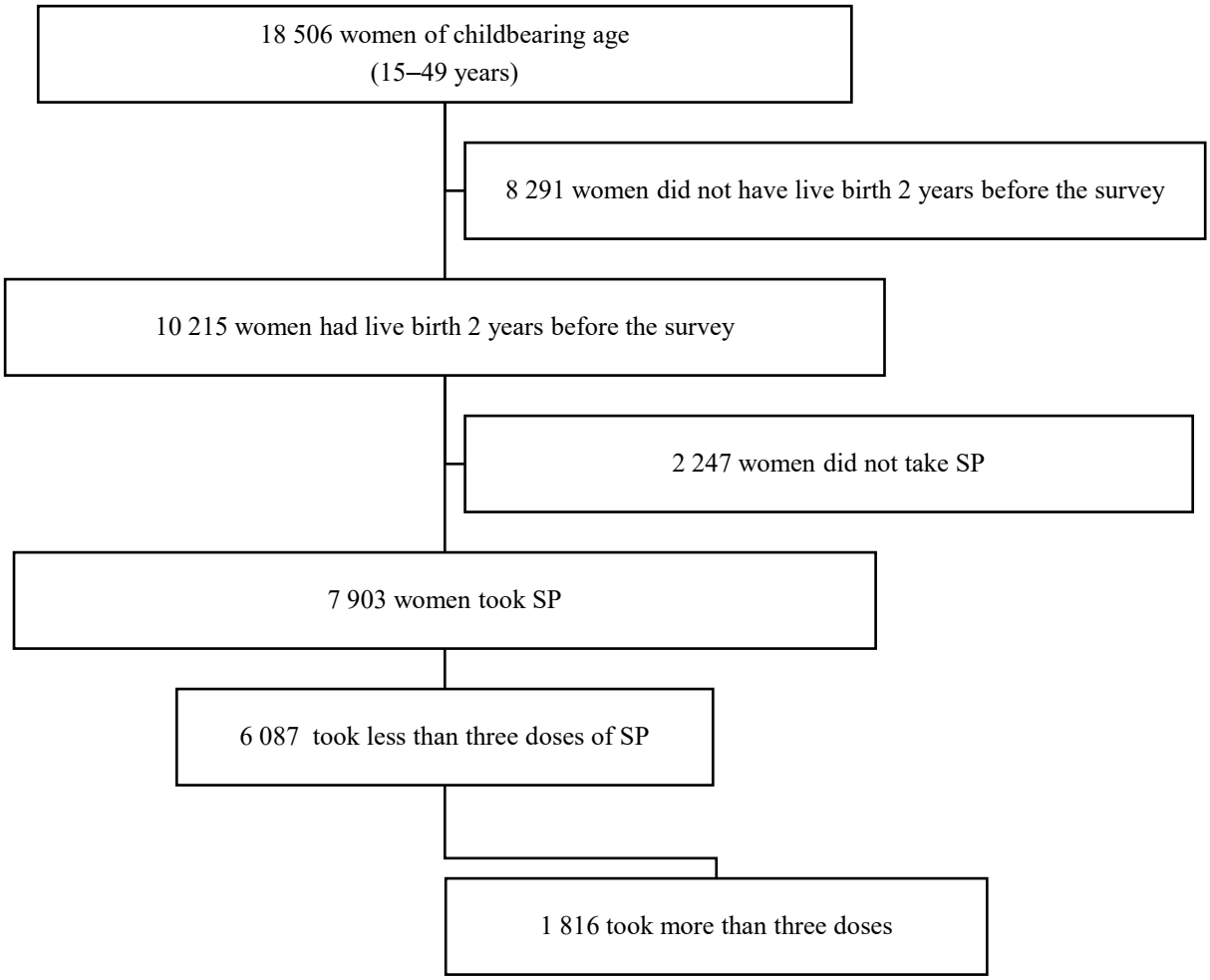


Figure 3.7 Data flow chart for 2016

Table 3.6 Model specification tests of unrestricted and restricted model

	Unrestricted model			Restricted model		
	2011	**2016**	**Pooled data**	**2011**	**2016**	**Pooled data**
Wald Test						
Pearson chi squared	52.69	112.44	156.58	15.72	27.81	35.7
Prob > chi squared	0.000	0.000	0.000	0.027	0.002	0.000
VIF						
Woman's age						
25 – 34	1.4	1.31	1.34	1.39	1.29	1.32
1> 34	1.43	1.38	1.39	1.41	1.35	1.36
Mother's education						
Primary	2.16	2.43	2.3	2.25	2.54	2.53
Secondary	2.46	2.57	2.5	2.59	2.65	2.68
Post-secondary	1.54	1.58	1.55	1.62	1.64	1.74
Wealth quintile						
Poor	1.6	1.58	1.58	1.57	1.60	1.57
Middle	1.76	1.66	1.68	1.74	1.68	1.69
Rich	1.85	1.71	1.74	1.86	1.73	1.75
Richest	3.59	2.43	2.82	3.74	2.45	2.88
Marital status						
Married	1.07	1.06	1.06	1.07	1.05	1.05
Place of residence						
Urban	1.87	1.42	1.57	1.89	1.41	1.56
Region						
Eastern	1.77	2.23	2.04	1.76	2.26	2.16
Northern	2.3	2.56	2.43	2.31	2.60	2.5
Western	1.73	2.09	1.93	1.72	2.11	201

Table 3.6 (continued)

	Unrestricted model			Restricted model		
	2011	2016	Pooled data	2011	2016	Pooled data
Number of ANC visits						
Number of ANC visits	2.40	2.22	1.56			
Parity						
Secundigravida	1.18	1.13	1.14	1.15	1.11	1.12
Multigravida	1.14	1.09	1.1	1.11	1.08	1.08
Timing of 1st ANC visit						
Trimester 2	1.42	1.31	1.36			
Trimester 3	2.63	2.31	2.4			
Sufficient ANC	3.86	3.4	2.62			
VIF	1.96	1.830	1.77	1.82	1.78	1.82

Notes

Wald test

1. H_0: The coefficients are jointly zero
2. H_1: At least one of the coefficients is different from zero
   Hence we reject the null hypothesis (at a threshold of $p > 0.05$) for all the three models.

VIF tests

The VIF estimates for all predictors for the three models are less than 10.

Table 3.7 Postestimation tests

	Unrestricted model			Restricted model		
	2011	2016	Pooled	2011	2016	Pooled
Goodness-of-fit test						
Pearson chi squared	1531.81	2262.52	2790.85	1186	1616.38	1978.95
Prob > chi squared	0.4320	0.0885	0.00.19	0.2436	0.1175	0.0274
Correctly classified observations						
Correctly classified	89.93%	81.87	84.44%	88.35%	80.86%	83.53%
	1					

Goodness of fit test.

1. H_0: Model does not indicate misspecification
   H_1: Model indicates misspecification
   We fail to reject the null hypotheses for all the three models at $p < 0.05$
   Correctly classified = The percentage of correctly specified values for the models (using the *estat* classification command).

Table 3.8 Robustness checks for 2011 and 2016 models; Unrestricted model without ANC Visits

	Unrestricted Model without ANC 20011			Unrestricted Model without ANC 20016		
	Logit	Probit	Logit	Probit	Logit	Probit
Age (years)						
0. 15 – 24						
1. 25 – 34	0.002	0.003	0.002	-0.015	-0.015	-0.015
	(0.013)	(0.012)	(0.013)	(0.010)	(0.010)	(0.010)
2. > 34	-0.013	-0.012	-0.012	-0.033***	-0.034***	-0.034***
	(0.014)	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)
Educational level						
0. No education						
1. Primary	0.022	0.022	0.023	0.012	0.012	0.011
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
2. Secondary	0.036*	0.036*	0.037*	0.030	0.030	0.030
	(0.020)	(0.019)	(0.020)	(0.019)	(0.019)	(0.019)
3. Post-secondary	0.016	0.016	0.017	-0.002	-0.002	-0.002
	(0.030)	(0.030)	(0.034)	(0.023)	(0.023)	(0.023)
Wealth quintile						
0. Poorest						
1. Poor	0.002	0.003	0.002	0.020	0.020	0.021
	(0.019)	(0.018)	(0.019)	(0.012)	(0.012)	(0.013)
2. Middle	0.031	0.031*	0.031	0.028**	0.029**	0.029**
	(0.019)	(0.019)	(0.019)	(0.014)	(0.014)	(0.015)
3. Rich	0.002	0.002	0.002	0.032**	0.032**	0.033**
	(0.016)	(0.016)	(0.017)	(0.015)	(0.015)	(0.015)
4. Richest	0.054**	0.054**	0.054**	0.017	0.017	0.017
	(0.024)	(0.023)	(0.023)	(0.020)	(0.020)	(0.021)
Marital status						
0. Unmarried						
1. Married	0.028**	0.028**	0.028**	0.010	0.010	0.010
	(0.014)	(0.013)	(0.014)	(0.012)	(0.012)	(0.012)
Place of residence						
0. Rural						
1. Urban	-0.024	-0.025	-0.028	-0.016	-0.016	-0.017
	(0.021)	(0.020)	(0.025)	(0.015)	(0.015)	(0.015)
Region						
0. Central						
1. Eastern	-0.009	-0.009	-0.007	0.025	0.026	0.025
	(0.018)	(0.017)	(0.018)	(0.017)	(0.017)	(0.017)
2. Northern	0.008	0.008	0.010	0.032*	0.032*	0.032*
	(0.020)	(0.019)	(0.020)	(0.018)	(0.018)	(0.018)
3. Western	0.040**	0.040**	0.042**	-0.025*	-0.025*	-0.026*
	(0.020)	(0.020)	(0.021)	(0.015)	(0.015)	(0.015)

Table 3.8 (continued)

	Unrestricted Model without ANC 20011			Unrestricted Model without ANC 20016		
	Logit	**Probit**	**Logit**	**Probit**	**Logit**	**Probit**
Timing of first ANC visit						
0. Trimester 1						
1. Trimester 2	0.001	0.001	0.002	-0.008	-0.008	-0.007
	(0.013)	(0.013)	(0.013)	(0.011)	(0.011)	(0.011)
2. Trimester 3	-0.053***	-0.055***	-0.052***	-0.092***	-0.092***	-0.090***
	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.017)
Parity						
0. Primigravida						
1. Secundigravida	-0.003	-0.003	-0.003	-0.016	-0.017	-0.016
	(0.013)	(0.013)	(0.013)	(0.010)	(0.010)	(0.010)
2. Multigravida	-0.020	-0.022	-0.019	-0.021	-0.022	-0.021
	(0.020)	(0.019)	(0.020)	(0.019)	(0.019)	(0.019)
Observations	4,659	4,659	4,659	9,948	9,948	9,948

Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes:

The coefficients across the restricted models (logit, probit, and LPM) for both 2011 and 2016 tell a qualitatively similar story about the impact of the predictors on uptake of three or more doses of IPT-SP.

Table 3.9 Estimated coefficients of IPT-SP3 for the pooled unrestricted model

	Unrestricted Model without ANC Pooled	Unrestricted Model with ANC Pooled
Age (years)		
0. 15 – 24		
1. 25 – 34*2016	-0.117	-0.267*
	(0.146)	(0.152)
2. > 34*2016	-0.091	-0.173
	(0.174)	(0.187)
Educational level		
0. No education		
1. Primary*2016	-0.177	-0.164
	(0.219)	(0.233)
2. Secondary*2016	-0.187	-0.208
	(0.255)	(0.269)
3. Post-secondary*2016	-0.206	-0.064
	(0.372)	(0.404)
Wealth quintile		
0. Poorest		
1. Poor*2016	0.653	0.737
	(0.488)	(0.520)
2. Middle*2016	0.762	0.852*
	(0.475)	(0.502)
3. Rich*2016	0.522	0.643
	(0.508)	(0.530)
4. Richest*2016	0.241	0.511
	(0.519)	(0.546)
Marital status		
0. Unmarried		
1. Married*2016	-0.249	-0.247
	(0.187)	(0.191)
Place of residence		
0. Rural		
1. Urban*2016	0.152	0.142
	(0.263)	(0.271)
Timing of first ANC visit		
0. Trimester 1		
1. Trimester 2*2016	0.055	-0.035
	(0.300)	(0.304)
2. Trimester 3*2016	-0.008	-0.068
	(0.275)	(0.272)
Parity		
0. Primigravida		
1. Secundigravida*2016	-0.080	-0.159
	(0.270)	(0.286)
2. Multigravida*2016	-0.160	-0.161
	(0.257)	(0.273)

Table 3.9 (continued)

	Unrestricted Model without ANC Pooled	Unrestricted Model with ANC Pooled
Region		
0. Central		
1. Eastern*2016	0.572***	0.538**
	(0.216)	(0.227)
2. Northern*2016	0.839***	0.782***
	(0.226)	(0.227)
3. Western*2016	0.689***	0.678***
	(0.217)	(0.220)
Age (years)		
0. 15 – 24		
1. 25 – 34	0.022	0.044
	(0.128)	(0.128)
2. > 34	-0.136	-0.128
	(0.151)	(0.153)
Educational level		
0. No education		
1. Primary	0.257	0.232
	(0.190)	(0.196)
2. Secondary	0.389*	0.345
	(0.222)	(0.227)
3. Post-secondary	0.192	0.107
	(0.338)	(0.354)
Wealth quintile		
0. Poorest		
1. Poor	0.027	0.018
	(0.224)	(0.225)
2. Middle	0.326	0.275
	(0.201)	(0.198)
3. Rich	0.023	-0.044
	(0.197)	(0.198)
4. Richest	0.530**	0.417*
	(0.224)	(0.226)
Marital status		
0. Unmarried		
1. Married	0.314*	0.264
	(0.165)	(0.164)
Place of residence		
0. Rural		
1. Urban	-0.264	-0.232
	(0.244)	(0.252)

Table 3.9 (continued)

	Unrestricted Model without ANC Pooled	Unrestricted Model with ANC Pooled
Timing of first ANC visit		
0. Trimester 1		
1. Trimester 2	0.014	0.156
	(0.127)	(0.135)
2. Trimester 3	-0.688***	-0.239
	(0.249)	(0.250)
Parity		
0. Primigravida		
1. Secundigravida	-0.028	0.001
	(0.137)	(0.136)
2. Multigravida	-0.221	-0.222
	(0.233)	(0.239)
Region		
0. Central		
1. Eastern	-0.102	-0.112
	(0.209)	(0.211)
2. Northern	0.088	0.037
	(0.214)	(0.220)
3. Western	0.391**	0.370*
	(0.197)	(0.202)
ANC		0.371***
		(0.043)
Constant	-2.774***	-4.067***
	(0.347)	(0.390)
Observations	14,607	12,458

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes

1. Pooled data were appended for both 2011 and 2016
2. All variables of interest were interacted with the time variable in the pooled model.

Chapter 4

Examining the relationship between the reimbursement of private healthcare providers and compliance with malaria diagnosis and drug-dispensing guidelines

4.1 Introduction

In acknowledgement of the risk of unnecessary use of malaria drugs, most malaria-endemic sub-Saharan African (SSA) countries have adopted the World Health Organization (WHO 2017a) guidelines on early diagnosis and treatment of malaria. In Uganda, the clinical guidelines on malaria treatment comply by requiring that all suspected malaria patients must have their diagnosis confirmed through microscopy (blood tests) or rapid diagnostic tests (RDTs) before initiating treatment (Uganda Ministry of Health (Uganda MoH) 2016b). The guidelines also recommend that healthcare providers consider the patient's antimalarial treatment history before deciding on treatment (Uganda MoH 2016b).

Healthcare providers' adherence to the above clinical guidelines in Uganda is vital, because the disease is still the leading cause of outpatient visits and hospital admissions (Uganda MoH 2016a, 2017a). Malaria accounted for the highest number of public outpatient visits and public hospital admissions in 2016/2017 and 2017/2018 (Uganda MoH 2016a, 2017a). There was an increase in outpatient visits at public healthcare facilities, from 23% in 2016/2017 to 29.5% in 2017/2018 (see Figure 4.1).[11] Public hospital admissions also increased, from 30% in 2016/2017 to 32.3% in 2017/2018 (see Figure 4.1). Overall, the disease accounted for the largest number of outpatients and hospital admissions in public hospitals in Uganda.

Evidence, however, suggests that, in SSA, private healthcare facilities are preferred to public healthcare facilities for the provision of early malaria diagnosis and treatment (Goodman 2004; Rutebemberwa *et al.* 2009; Konde-Lule *et al.* 2010). Although official statistics for private outpatients visits and inpatient private hospital admissions are not readily available, evidence from literature suggests that volumes of patients are higher in private than in public healthcare facilities. Hence, it is essential to establish whether private healthcare providers provide appropriate healthcare and adhere to the national clinical guidelines (Banerjee *et al.* 2004; Dupas 2011b). The main hypothesis is that economic incentives given to private healthcare

[11] All figures attached in Appendix A to Chapter 4.

providers may distort service delivery and interfere with responsible care and drug-dispensing practices.

Private healthcare providers and malaria treatment

Private healthcare facilities are preferred to public healthcare facilities for the provision of early malaria diagnosis and treatment (Goodman 2004; Rutebemberwa *et al.* 2009; Konde-Lule *et al.* 2010). A study by Goodman (2004) in three districts in Tanzania (Kilombero, Ulanga, and Rufiji) showed that 74% of patients sought fever/malaria treatment from private healthcare facilities, compared to 26% from public healthcare facilities. Rutebemberwa *et al.*'s (2009) study in the Demographic Surveillance Site (Iganga and Mayuge district) reported that 63% of individuals sought first aid treatment for febrile illness in children from private healthcare facilities, compared to 37% having visited public facilities.

Why private healthcare providers are preferred for malaria treatment

Studies have reported that public healthcare facilities are characterised by inaccessibility and resource shortages which is why patients tend to prefer private facilities (Konde-Lule *et al*. 2010; Buregyeya *et al*. 2017). Konde-Lule *et al*.'s (2010) study reported that 59% of patients said that public facilities were inaccessible, and 55% reported that public facilities had shortages of healthcare workers.

Buregyeya *et al*.'s (2017) research in central Uganda (Mukono district) found that private healthcare facilities were better stocked with antimalarials. Studies have shown that private healthcare facilities are accessible, always have drugs in stock, are flexible in terms of operating hours, are trusted, have a wide range of drugs (available with or without prescription), and offer patients the opportunity to purchase medicines on credit (Konde-Lule *et al.* 2010; Goodman *et al.* 2009; Rutebemberwa *et al.* 2009). Goodman *et al.*'s (2009) study in Tanzania found that private healthcare facilities stocked the widest variety of antimalarials (a median of 7) compared to public healthcare facilities (a median of 5).

This means that the public healthcare statistics reported are an underestimation of malaria outpatient visits and hospital admissions in Uganda, as most patients prefer private healthcare facilities for treatment of the disease.

4.2 Practices of private healthcare providers in malaria diagnosis and treatment

Studies have found improved malaria treatment and diagnosis services by private healthcare providers after the introduction of rapid diagnostic tests (RDTs). Research on formal private health facilities from six geo-political zones in Nigeria reported improved RDT prior to malaria diagnosis and treatment — about 74% of fever cases were tested for malaria before treatment (Mokuolu *et al*. 2016). Awor *et al*.'s (2015) study in Eastern Uganda (Kaliro and Kamuli district) found that 94% of all children with positive RDT results received the recommended malaria treatment. Mbonye *et al.*'s (2015) research in central Uganda (Mukono district) found that 85% of drug-shop attendants adhered to malaria RDT results while offering treatment to patients.

Despite playing a vital role in the early treatment and diagnosis of malaria patients in SSA, evidence suggests that most private healthcare malaria diagnosis and treatment practices are inappropriate (Mangham *et al.* 2012; Mbonye *et al.* 2013; Mayora *et al.* 2018). A study in Cameroon (Yaounde and Bamenda cities) found that, of the patients who visited private healthcare facilities, 85% received inappropriate treatment (they were given antimalarials without being tested) (Mangham *et al.* 2012). Mayora *et al.*'s (2018) study in south-western Uganda (Mbarara and Bushenyi districts) found that 79% of healthcare seekers received incorrect malaria diagnoses, and were given antimalarials without being diagnosed with the use of RDT and thermometers. Another study done in central Uganda (Mukono district) established that 66% of patients who visited drug shops received inappropriate malaria diagnosis and treatment — their malaria test results were negative, but they received antimalarials (Mbonye *et al*. 2013).

Overall, it would seem that most private healthcare facilities do not adhere to malaria diagnosis and treatment guidelines, yet few studies have researched the underlying motive for such behaviour (Mangham *et al.* 2012; Mbonye *et al.* 2013; Mayora *et al.* 2018).

Informed patients (patients with appropriate diagnosis and treatment information) may improve healthcare providers' diagnosis and treatment behaviours (Satyanarayana *et al*. 2016; Bauch *et al*. 2013; Björkman *et al.* 2016). Björkman *et al.*'s (2016) study in Uganda found that more educated patients were less likely to be sold counterfeit drugs. Bauch *et al.*'s (2013) study showed that ongoing education of both healthcare providers and residents is necessary to maintain decreases in incidence of malaria in Zanzibar.

However, despite large-scale malaria diagnosis and treatment information campaigns by the Uganda MoH, most patients and healthcare providers have inadequate information about malaria transmission and treatment (Nuwaha 2002; Comoro *et al*. 2003; Uganda MoH 2014). These information asymmetries between patients and healthcare providers may lead to Imperfect agency (Dranove 1988; Dulleck and Kershbamer 2006).

Imperfect agency refers to a situation where healthcare providers overcharge, provide lower-quality medications, or advise unnecessary treatment to uninformed patients in order to maximise profit instead of patient well-being (Dranove 1988; Dulleck and Kershbamer 2006). Imperfect agency may explain overutilisation of antimalarial treatment among those who do not have malaria (Dranove 1988; Dulleck and Kershbamer 2006). Björkman *et al.*'s (2016) study in Uganda found that provider agency may lead to the distribution of ineffective or counterfeit antimalarial drugs. Likewise, Fitzpatrick's (2020) randomised audit study in the Ugandan antimalarial drug market found that, for informed patients, healthcare providers may slightly lower prices, but are unlikely to deny sales, leading to inappropriate malaria diagnoses and treatment services. These information asymmetries need to be addressed in order to improve providers' diagnosis and treatment behaviours.

Apart from information asymmetries between healthcare providers and patients, evidence also suggests that the little correct diagnosis and incorrect treatment by private healthcare facilities in low-income rural settings may also be due to differences in doctors' incentives (Das and Hammer 2007; Das *et al*. 2016; Fitzpatrick 2020). Fitzpatrick (2020) found that decreased financial incentives due to lower prices have a negative effect on the quality of case management. Das and Hammer's (2016) study of rural primary care providers in the Indian state of Madhya Pradesh found that prices charged are positively correlated with provider effort and correct treatment, but also with unnecessary treatment. Das and Hammer's (2007) study in Delhi, India, found that the gap between what doctors know and what they do may be due to incentives.

The impact of incentives on imperfect agency in the form of high-quality healthcare has been extensively researched in developed economies. However, few studies have examined the relationship between incentives and imperfect agency in developing economies. The present study assessed this gap in knowledge by examining differences in the quality of malaria case management between private healthcare providers in Uganda. The study also examined

whether the higher quality of malaria case management by private healthcare providers is due to economic incentives.

Financial incentives and compliance with guidelines

Some background is required to situate this hypothesis on the impact of financial incentives within the existing literature. Policymakers and healthcare funders usually employ four primary mechanisms to reimburse healthcare providers and patients for the achievement of high-quality healthcare (Lagarde *et al.* 2010): payment of individual healthcare providers, payment of healthcare facilities, pay for performance (P4P) and conditional cash transfers (CCTs) to patients. Payment of individual healthcare providers at private healthcare facilities is the most common in low-income countries, and was therefore the focus of this study.

Literature indicates that healthcare funders mainly reimburse individual healthcare providers through a salary, a fee for service (FFS), or capitation (Lagarde *et al.* 2010). Healthcare providers reimbursed through a salary scheme usually agree in advance on the amount to be received and the timing of the payment. As the salary payment mechanism is not based on the volume of activities, healthcare providers do not receive any incentives for extra output (Lagarde *et al.* 2010). The salary payment mechanism limits the unnecessary provision of healthcare services, as it does not provide any incentive for extra effort by healthcare providers.

With the FFS payment mechanism, healthcare funders reimburse healthcare providers for the specific services they offer (Lagarde *et al.* 2010). Since the FFS payment method is based on the volume of activities, providers receive incentives for extra input (Lagarde *et al.* 2010). This method is used in Uganda. Lagarde *et al.* (2010) contrast the FFS and capitation payment methods by stating that, with capitation, healthcare providers are reimbursed for each member that is registered with them. The healthcare provider enters into a contract to provide a specific set of healthcare services for a given period to registered members (Lagarde *et al.* 2010). In general, provider healthcare reimbursements are based on the number of individual members rather than provider inputs. Most private facilities do not provide health insurance in low-income countries, which makes the capitation reimbursement method unfeasible.

In light of the above, individual payment methods (salary and FFS) might be associated with the quality of healthcare that is provided by health workers. Hence, the present study examined whether payment methods of private healthcare providers are associated with malaria diagnosis and dispensing practices in Uganda.

The essay is structured as follows. Section 4.3 reviews the structure of private healthcare providers in Uganda. Section 4.4 presents the methodology used in the study, and Section 4.5 presents the findings. Sections 4.6 and 4.7 provide the discussion, recommendations, and conclusions.

4.3 Structure of the private health sector in Uganda

The private healthcare sector in Uganda is diversified. It comprises all healthcare providers in the clinical, dental, diagnostic midwifery, nursing, pharmacy, and public health professions who provide healthcare services outside of the government healthcare system (Uganda MoH 2013). The main divide within the sector is the distinction between formal and informal providers (Uganda MoH 2013).

Formal private healthcare providers include a range of professionals who have formal training in healthcare, including physicians, nurses and midwives, and clinical officers who are registered or licensed with government, and government regulates their clinical practices (Albertini *et al*. 2012; Uganda MoH 2013; O'Hanlon *et al.* 2017). In Uganda, these include all private, not-for-profit health providers and most private for-profit healthcare providers (Albertini *et al*. 2012; Uganda MoH 2013; O'Hanlon *et al*. 2017).

Informal private healthcare providers include healthcare providers without any formal training in healthcare. The government does not regulate their practices, and they are not registered or licensed with any government agency (Albertini *et al*. 2012; Uganda MoH 2013; O'Hanlon *et al.* 2017). In Uganda, informal private healthcare providers comprise traditional and complementary medicine practitioners and unlicensed private for-profit facilities such as stand-alone drug shops, general retail shops, kiosks, and mobile vendors (see Figure 4. 2) (O'Hanlon *et al.* 2017). Traditional and complementary practitioners were not considered in the present study, because they do not provide diagnosis and treatment of malaria (Uganda MoH 2013), and the services they provide were not related to the scope of the study.

Private not-for-profit providers

Private not-for-profit providers include organisations that provide healthcare services to the population from established, static healthcare facilities, those that work with communities and other counterparts (Uganda MoH 2013). They own 15% of healthcare facilities in Uganda (Uganda MoH 2017b). These providers comprise two categories: faith-based organisations and non-facility-based organisations (Uganda MoH 2013; O'Hanlon *et al.* 2017).

Although private non-profit healthcare organisations provide quality healthcare services, especially in rural areas where access to public health services is limited, at 15%, their share of health facilities is inferior to the 37% of private for-profit health services (Uganda MoH 2017b). Therefore, the present research focused on private for-profit healthcare providers in Uganda, discussed in the next section.

Private for-profit healthcare providers

The private for-profit healthcare sector comprises all personnel within the healthcare profession. They provide healthcare services for profit outside of government and private not-for-profit establishments (Uganda MoH 2013). In the context of the present study, the term *private healthcare providers* is synonymous with *private for-profit facilities*.

Private for-profit healthcare providers play a significant role in the healthcare sector of Uganda, and represent 37% of the country's health facilities (Uganda MoH 2017b). In the context of the present study, for-profit healthcare providers consist of: i) private hospitals and clinics, and ii) drug shops. Pharmacies were not considered for this study, because there were few in the rural district that served as the setting.

The regulatory structure for private hospitals and clinics

As background, it is essential to note that, in Uganda, private for-profit healthcare facilities have different regulatory bodies that monitor and supervise their operations. For example, the Uganda MoH, through health councils, monitors and oversees the operations of private hospitals and private clinics. The National Drug Authority (NDA) supervises the operations of drug shops and pharmacies (NDA 1993; Uganda MoH 2013).

Most privately owned hospitals operate at either Health Centre (HC) III or HCIV level (Uganda MoH 2013; Banyan Global 2015). Most privately owned clinics operate at HCII and HCIII.

A HCII facility is traditionally led by a registered nurse, and provides only outpatient services. A HCIII facility is usually led by a senior clinical officer, and provides essential laboratory services, maternity care, and inpatient care. HCIV facilities are usually managed by a senior medical officer, and operate as mini-hospitals, providing an operating theatre, inpatient and laboratory services, and a referral facility for 20 to 30 HCII and HCIII (primary care) facilities under its jurisdiction.

The government set up the national policy on the public–private partnership in health (PPPH) to enable the public and private sector to work together in the development of healthcare (Uganda MoH 2013). The policy addresses partnerships between the Uganda MoH, local governments, private healthcare providers, and other stakeholders that participate in the development of health. Through the PPPH policy, the Uganda MoH is responsible for monitoring and supervising healthcare services at national and district level (Uganda MoH 2013). The Uganda MoH is, therefore, also responsible for ensuring that private healthcare providers conform to the Uganda MoH clinical and treatment guidelines, increasing public awareness of the scope and quality of healthcare standards expected of private healthcare providers, and awarding accreditation (Uganda MoH 2013).

It is concerning that a recent survey showed that the PPPH policy is unknown outside of Kampala, and that most private healthcare providers are also not aware of the policy (O'Hanlon *et al.* 2017). The survey also highlighted that district health officers are aware of the policy, but are unwilling to implement it, because it conflicts with the goals of developing partners' policy (O'Hanlon *et al.* 2017). The survey further cites the lack of personnel to enforce the objectives of the policy at the district level as the reason for poor operationalisation of the policy at district level (O'Hanlon *et al*. 2017).

The Uganda MoH is meant to fulfil its monitoring and supervision function by collaborating with different professional health councils. These councils include the Uganda Medical and Dental Practitioners Council, the Uganda Nurse and Midwives Council, the Uganda Pharmacists Council, and the Uganda Allied Health Professional Council (Uganda MoH 2013). The interests of private healthcare providers are represented with these councils by two associations: the Uganda Private Medical Association, which represents doctors, and the Uganda Private Midwives Association, which represents midwives (Uganda MoH 2013). The Medical and Dental Practitioners Statute (1996), the Nurses and Midwives Statute (1996), the Pharmacy and Drug Act (1971), and the Allied Health Professionals Statute (1996) guide these councils in regulating and licensing private healthcare providers (Uganda Legal Information Institute (ULII) 1996).

The four councils are primarily responsible for ensuring that private healthcare providers provide quality healthcare services by enforcing licensing and registration standards, validating continuing medical educational requirements, and taking action against those who fail to maintain their licences (Uganda MoH 2013; O'Hanlon *et al*. 2017). Through the district health

management teams, which consist of District Health Officers, health councils inspect sites of private providers and ensure that facilities comply with medical treatment guidelines and offer quality healthcare (Uganda MoH 2013; O'Hanlon *et al*. 2017).

The regulatory structure of drug shops

The NDA (1993) defines a drug shop as a retail outlet, usually operated by an enrolled nurse or midwife, that offers drugs over the counter. Drug shops mainly specialise in selling medicines, and have a storefront, product displays, and a counter. Some may have a small room in the back, separated by a curtain or door, for examination and treatment of patients (O'Hanlon *et al*. 2017).

The NDA is the central statutory body of drug shops in Uganda (Uganda MoH 2013; O'Hanlon *et al*. 2017). Other regulatory organisations, such as the Pharmacy Council and Allied Health Professionals Council, oversee specific aspects of drug shops (O'Hanlon *et al*. 2017). The Pharmacy and Drug Act (Uganda 1971, 1993) of parliament established the NDA as an autonomous entity under the Uganda MoH, to ensure the supply of high-quality, essential, safe, efficacious, and cost-effective medicines in Uganda (NDA 1993).

The NDA monitors and controls the quality of drugs from storage to retail sales in drug shops. As part of its routine operations, the NDA is mandated to conduct site inspections of drug shops, to ensure high-quality medicines. For instance, it is the responsibility of the NDA to ensure that drug shops that diagnose malaria, subject to performing RDTs, only offer antimalarials classified as Class C[12] (NDA 1993). The NDA also licenses all drug shops, while the Pharmacy Council oversees registration, and disciplines drug-shop owners who do not comply with the law (NDA 1993). A recent survey showed that the NDA is too understaffed to effectively monitor and supervise drug shops at national level (O'Hanlon *et al*. 2017).

Through the Allied Health Professional Act Cap. 268, the parliament of Uganda established the Allied Health Professional Council in 1996, to regulate, supervise, and control the training and practice of health professionals in Uganda (NDA 1993). The Council licenses nurses, midwives, storekeepers, and store assistants who operate drug shops (see Figure 4.2).

[12] Class C includes all artemisinin-based combination therapies; for example, Lonart, Coartem, Artefan, Co-Mether, Co-Artesian and Lumether.

Therefore, the Uganda MoH collaborates with the Allied Health Professional Council to enforce rules and regulations in drug shops (ULII 1996).

Unlicensed drug shops

Unlicensed retail drug shops are defined as mobile or stationary commercial settings, such as markets and shops, staffed with individuals without formal training in healthcare. Unlicensed retail drug shops sell antimalarial treatment, but are not registered with any government regulatory body (Albertini *et al.* 2012). Informal private for-profit facilities include unlicensed for-profit facilities such as stand-alone drug shops, general retail shops, kiosks, and mobile vendors. Despite functioning outside the law, unlicensed drug shops remain popular in rural areas, where they fill an essential service delivery gap created by staff shortages and regular drug stock-outs at public health facilities (Uganda MoH Health System 20/20 and Makerere University School of Public Health, 2012; Nabyonga-Orem *et al.* 2013).

4.4 Methods

The section that follows presents the study area, the research design, and the data collection and analysis methods that were used to examine malaria diagnosis and treatment practices of private healthcare providers in Uganda. The section also discusses the ethical clearance obtained from three committees to conduct the study.

4.4.1 Study area

The study was conducted from August to October 2018 in Iganga district, located in eastern Uganda. Five districts border Iganga district: Kaliro district to the north, Namutumba district to the northeast, Bugiri district to the east, Mayuge district to the south, Jinja district to the southwest, and Luuka district to the west (see Figure 4.3).

Iganga district headquarters is located approximately 44 km northeast of Jinja and 125 km from Kampala, the capital city of Uganda (Globefeed 2019). Iganga district has a population of 504 197 people, with 86% living in rural areas, and 60% under the age of 18 years (UBOS 2009, 2014). Iganga consists of three counties and 13 sub-counties, with subsistence farming as the main occupation of the population (UBOS 2009) (see Figure 4.3).

Choice of the study area

Iganga district was selected for this study because it is predominantly rural, with peri-urban regions mainly in the trading centres, and because 60% of the population is under the age of

18 years (UBOS 2009; Census 2014). Iganga has a high prevalence of malaria in children (53.1%) and a high entomological inoculation rate[13] of 100 persons per year (UBOS and ICF International 2017). Iganga district has a high malaria incidence, with 300 cases per 1 000 people reported in 2017/2018 (Uganda MoH 2017a). Areas with a higher incidence of malaria, especially the northern region of Uganda, often have few private healthcare facilities.

Kampala district, on the other hand, has the highest number of private facilities, while it has a low incidence of malaria (Uganda MoH 2017a). Iganga is among districts located in the Health and Demographic Surveillance Site.

Sample selection and size

The study was conducted in 10 of the 13 sub-counties in Iganga. Due to limited resources, the other three sub-counties were not included in the study (see Figure 4.4). The study included both facility surveys and patient exit surveys for all functioning private facilities[14] in the 10 selected sub-counties. Lists of private healthcare facilities (private hospitals, clinics and pharmacies) were obtained from the District Health Officer of Iganga district. The lists contained the following information: (i) name of the private healthcare facility, (ii) physical address, (iii) name of the person in charge, and (iv) geographical location (urban or rural). The lists did not contain updated details on facilities, and a concerted effort was made to scan neighbourhoods for new private facilities and add these to the lists.

The lists of licensed drug shops in Iganga were obtained from the NDA (2016). The lists contained names of drug shops offering healthcare to both people and animals. Research assistants physically searched for drug shops from the 10 selected sub-counties to compile a sample frame for drug shops. Most locations of the drug shops in the 10 sub-counties were identified with the help of local leaders.

This study was designed to consider both licensed and unlicensed drug shops in Iganga district. However, differentiation between licensed and unlicensed drug shops was not possible. Hence, the study looked at drug shops in general, without this differentiation.

The sample of private healthcare facilities consisted of 101 such facilities from the ten selected sub-counties. Details regarding determination of the size of the sample of exiting patients per

[13] The number of infective bites received per person over a specified period
[14] Private facilities included other private healthcare facilities (private hospitals and clinics) and drug shops.

facility are included in Appendix A to Chapter 4. A total of 22 private facilities were not included in the final sample, because research assistants were unable to identify at least five exiting patients from these facilities. The final sample consisted of 79 facilities (33 other private facilities and 46 drug shops). Specifics of the distribution of the private healthcare facilities included in the sample are discussed in Section 4.5.1. The next section presents particulars of the research design adopted for the study.

4.4.2 Research design

A quantitative methodology was utilised, and data were collected through the facility surveys and exit interviews to examine differences in malaria diagnosis and drug-dispensing practices across facilities, as done in other studies (Matovu *et al.* 2014; Bamiselu *et al.* 2016; Mayora *et al.* 2018; Wang *et al.* 2018). Bamiselu *et al*.'s (2016) study in Nigeria (Ogun state) and Wang *et al*.'s (2018) survey in Uganda (Kasese district) utilised cross-sectional surveys to examine differences between public and private facilities' adherence to national guidelines on malaria diagnosis and treatment.

Matovu *et al.*'s (2014) study in Uganda (Iganga and Mayuge districts) and Mayora *et al.* (2018) used exit interviews with patients to examine the quality of healthcare provided by facilities. The use of exit interviews with patients enabled the study to assess the quality of malaria treatment offered by private healthcare providers, whilst avoiding the potential bias that might result from patient satisfaction questionnaires, which request them to either agree or disagree (Dunsch *et al*. 2018). Therefore, the investigation followed previous studies in which healthcare facility surveys and exit interviews were used to explore differences in malaria diagnosis and drug-dispensing practices.

4.4.3 Data collection

Four research assistants conducted the healthcare facility survey and exit interviews with patients over a period of eight weeks (August to October 2018). The research assistants received training on the data collection process before the start of the study, and were supervised by the principal investigator. In each instance, the healthcare facility survey was completed first, followed by the exit interviews. The research assistants spent a full workday at each private healthcare facility.

Design of the facility survey and data collection

The Uganda Clinical Guideline 2016 was used to design the healthcare facility research instrument (Uganda MoH 2016b). Section 2.5.2 (page 191) of the Uganda Clinical Guideline 2016 describes malaria case management in terms of examination, diagnosis, and treatment (Uganda MoH 2016b). The questionnaire was pre-tested in a pilot study, and appropriate adjustments to the instrument were made before undertaking the primary research. Research assistants proficient in English and Lusoga (the local language) administered the questionnaire.[15]

The survey questionnaire had four sections. Research assistants completed Section I, which covered the name and location of the facility. Part II gathered details on the health facility's operations. The research assistants approached decision-makers at the healthcare facilities, such as the owner, director, or manager, to respond to this section. In cases where they were not available at the facility, a telephonic interview was arranged.

The research assistants shared an information sheet (synopsis of the study) and proof of ethical clearance with the prospective survey respondent, and then asked the health facility's staff members if they were willing to participate in the study. All survey respondents provided written consent to participate in the study. The facility personnel provided information on ownership and operations of the facility, record-keeping practices, staff reimbursement, and patients' payment methods.

Part III contained questions that dealt with malaria diagnosis and treatment procedures followed by the health workers. The research assistants identified the staff members who dealt with patients, as well as ones that made clinical decisions on the diagnosis and treatment of health conditions, to provide answers to this section. In more informal settings (such as unlicensed drug shops), this person may not have had a medical background. Clinical staff members providing diagnosis and treatment of malaria also provided signed consent to participate in the study. During the interviews with clinical staff members, the research assistants captured information on the diagnosis and treatment of malaria, referral procedures, as well as information on previous training, supervision received, and access to clinical guidelines and job aids.

Section IV consisted of questions regarding drug availability in the different health facilities. The staff members who dispensed medicines and managed drug supplies in various health

[15] All data-gathering instruments are attached in Appendix B to Chapter 4.

facilities responded to this section. Healthcare workers signed consent letters before participating in the survey. Healthcare workers provided information on the anti-malaria drugs stocked, drug sales, and other relevant factors to the research assistants.

Exit interview instrument

The exit interview questionnaire (instrument) for other private healthcare facilities had seven sections, while the one for drug shops consisted of four parts. Both instruments were pre-tested in a pilot study, and appropriate adjustments were made before undertaking the primary research. Part I included questions that dealt with necessary information about the health facility in both instruments. The research assistants completed Section I, and the patient/adult caretaker responded to all the other sections' questions.

The research assistants requested the healthcare providers to, upon completion of consultation with and treatment of malaria patients, refer all patients for an interview. The research assistants gave the consulted patients information forms that contained a synopsis of the study and explained the study objectives. The research assistants then asked the patients if they were willing to participate in the survey. Patients who chose to participate in the study provided written consent before commencing with the exit interview.

Exit interview instrument for other private facilities

For Section II to VI, the research assistants recorded responses from referred patients or adult caretakers (where patients were younger than 18 years). Section II contained introductory questions that captured information on the age and gender of the patient and the patient's reasons for the patient's preference of healthcare facility. Section III gathered specifics on the malaria-related health history of the patient, including whether the healthcare provider had asked the patient about any current symptoms. Physical examinations (weight and temperature measurement) performed on the patient by the healthcare provider were recorded in Section IV. Complementary examinations (diagnostic tests) were noted in Section V. Sections VI and VII captured treatment prescribed and received, as well as the patient's satisfaction in this regard.

Exit interview instrument for drug shops

Section II covered introductory questions related to the patient's health history and complementary examinations (diagnostic tests). The research assistants recorded treatment

prescribed and received in Section III, and the patient's satisfaction with the care received from drug shops in Section IV.

The research assistants were not given access to drug shops' licensing certificates for verification, and most drug shops did not display the certificates as required by the regulations (NDA 1993). It was therefore, unfortunately, not possible to differentiate between licensed and unlicensed drug shops.

Data quality monitoring

To ensure data quality, the principal researcher and the research assistants implemented several quality control mechanisms. The research assistants asked for permission to view any available patient cards, prescriptions, and drugs dispensed (if provided at the private health facility) from the patient/adult caretaker for verification of data on testing and treatment. The research assistants also requested patients to share their contact number with the researchers, for data quality verification. Random telephone calls were made to exit interview participants who had agreed to provide their contact numbers for verification purposes.

Daily data entry enabled the principal investigator to monitor fieldwork on a regular basis and track and address any inconsistencies in data collection. The research assistants had regular meetings in the mornings to talk through problems experienced the previous day and to provide feedback on progress.

4.4.4 Data analysis

Data were entered into EpiData software and analysed with Stata 14.2 software. Data from the facility surveys and exit interviews were matched in Stata 14.2. Each healthcare facility survey was matched with the corresponding survey of each exiting patient who had received both malaria diagnosis and treatment.

Outcome variable

Questions in the provider instrument about malaria case management were based on clinical vignettes.[16] The study had one key outcome variable for appropriate malaria diagnosis and treatment, namely a malaria blood test.

Malaria blood test protocol

For other private healthcare facilities, the study tracked whether patients who had requested malaria drugs were tested for malaria before being given the drugs. For drug shops, the study followed whether drug shop attendants requested malaria blood test results for patients from other facilities, or tested the patients for malaria before dispensing antimalarials.

Malaria blood test protocol (MB test) was defined as:

Test protocol followed (1== blood test performed and protocol followed[17]); and Test protocol not followed (0= either they were not tested or not asked for test results and antimalarials given.)

Table 4.1 Descriptions of independent variables

Variable	Description
1. Staff reimbursement	*Staff reimbursement* was categorised into (0) Fixed salary (1) Drug/Patient volume-based payment
2. Staff professional qualifications	*Staff professional qualifications* was categorised into (0) Nurse/Midwife and (1) Doctor/Clinical officer.
3. Place of facility	*Place of facility* was categorised into (0) Rural and (1) Urban.
4. Diagnostic tests offered	Any diagnostic testing offered or not offered by the facility was categorised accordingly: (0) No diagnostic tests offered and (1) Yes, offered diagnostic tests.
5. Facility type	Facility type was categorised into (0) Other private healthcare facility and (1) Drug shop.
6. RDT training	*RDT training* was categorised into (0) No RDT training received by health worker and (1) RDT training received.

[16] Clinical vignettes are illustrations of patient-related cases for educational purposes and are appropriate for a wider audience.

[17] Protocol followed means Patient tested positive for malaria; healthcare provider received results and dispensed antimalarials/Patient tested negative for malaria; healthcare provider received results and did not dispense antimalarials

Descriptive analyses

As private healthcare facilities are preferred to public healthcare facilities for the provision of early malaria diagnosis and treatment, there is a need to assess differences in the quality of malaria diagnosis, treatment, and dispensing practices of private healthcare providers (Goodman 2004; Rutebemberwa *et al.* 2009; Konde-Lule *et al.* 2010). Descriptive analyses were performed to assess the differences in proportions for characteristics of private healthcare facilities, knowledge of malaria diagnosis, and drug dispensing practices of private healthcare providers. Differences in proportions for other private healthcare practices and drug shop attendants with regard to malaria diagnosis, dispensing practices, and protocol compliance were also calculated.

Multivariate analysis

Choice of model

As stated in Section 2.3.4, logit or probit models are recommended for binary outcome variables. As the outcome variable in the present study was binary (MB test = 1 or 0), logit models were estimated. In setting up the model, we followed previous work such as Das *et al*. (2016) and Fitzpatrick (2020), in controlling for relevant differences in the demand and supply side, but responding to the context and research question of this study. For Model 1, the association between *MB test* and Staff Reimbursement was tested, controlling for *Staff professional qualifications*, *Place of facility*, and *Type of Facility*. For Model 2, the association between *MB test* and *Staff reimbursement* was tested, controlling for *Staff professional qualifications*, *Place of facility* but only for drug shops. Model 3 examined the association between *MB test* and *Staff reimbursement*, controlling for *Staff professional qualifications*, *Place of facility* but only for drug shops who did not have testing facilities available on site.

Model specification

Before running the logit model, Wald tests were performed to test for joint significance of all the coefficients in the model. The variance inflation factor (VIF) was used to quantify the extent of correlation between one predictor and the other predictors in a model. The VIF was used to diagnose multicollinearity; a VIF above 10 indicates high correlation.

In the final step, bivariate statistics were used to identify potential covariates that were worth testing in the multivariate model. The assumption was that, if the independent variable was

associated with the outcome variable (MB test), it might continue to explain the outcome once other covariates are included in the model.

Clustering

Model 1 consisted of variables for patients and healthcare workers from the two types of facilities. To account for the correlation of errors within facility types, clustering was performed at the *facility level* (Cameron and Trivedi 2010; Wooldridge 2013). To obtain heteroskedasticity-robust and cluster-robust standard errors, the commands *vce (cluster facility type)* for Model 1 and *vce (robust)* for Model 2 were used (Cameron and Trivedi 2010; Wooldridge 2013).

4.4.5 Ethical clearance

The investigation entailed obtaining information from human beings; hence, the privacy of respondents and ethical use of their data were of utmost importance. Ethical clearance[18] to conduct the study was obtained from the Health Research Committee II of Stellenbosch University, Makerere School of Social Sciences Research Ethics Committee, and the Uganda National Council of Science and Technology.

Information sheets and consent letters

In acknowledging the importance of autonomy of the respondents, the research assistants provided information sheets and discussed the contents with the facility personnel and exiting patients. The information sheet included detailed information about the purpose of the study, approximate duration of the study, the specific information that was to be kept confidential, the voluntary nature of participation in the study, the direct benefits to the respondents, and any foreseeable risks or discomfort (Hade and Lemeshow 2011). The research assistants interviewed only facility personnel and exiting patients who agreed to participate in the study and who provided written consent. The principal interviewer composed both the information sheet and the consent letter in English and Lusoga. Information sheets and consent letters for facility and exiting patient interviews are included in Appendix B to Chapter 4.

[18] Ethical clearance documents are attached in Appendix B to Chapter 4.

4.5 Results

4.5.1 Sample Description

The study's sample of 101 private healthcare facilities consisted of 43 other private healthcare facilities and 58 drug shops (see Table 4.2). A total of 22 private healthcare facilities were excluded because no malaria patients from these facilities were interviewed. The final sample of 79 matched facilities consisted of 33 other private healthcare facilities and 46 drug shops. The study considered a facility as matched to the study if the research team was able to interview at least one patient who had received a malaria diagnosis or antimalarial drugs. The research assistants interviewed 421 exiting patients (219 patients from other private healthcare facilities and 202 patients from drug shops) from 79 matched facilities. On average, six patients were interviewed from each other private healthcare facility and four patients from each drug shop (see Table 4.2).

Table 4.2 Facility and patient sample description

Description	OPHF[1] (*N* = 43)	Drug shops (*N* = 58)
Facilities selected	43	58
Matched facilities[2]	33	46
Patients[3]	219	202
Patients from rural (%)	14.6	38.1
Patients from urban (%)	85.4	61.9
Average number of patients interviewed per facility via exit interviews	6.63	4.39

Data source: Facility and exit Instruments

Notes

1. Other private healthcare facilities included private hospitals and clinics.
2. Facilities were considered matched to the study if the researchers were able to interview at least one patient who had received either a malaria diagnosis or an antimalarial drug.
3. Patients interviewed at the different private healthcare facilities

4.5.2 Characteristics of private healthcare facilities

Differences in proportions for private healthcare providers are presented in Table 4.3. The results indicated significant differences in proportions between other private healthcare facilities and drug shops for: *Staff professional qualifications*, *Staff reimbursement*, and *Any diagnostic test*.

Table 4.3 Differences in proportions between private healthcare facilities by characteristics of healthcare providers, matched providers

	Drug shops (*N* = 46) (%)	OPHF (*N* = 33) (%)	*Differences in Proportion*
Staff professional qualifications			
Doctors/Clinical officers (vs. Nurse/Midwife)	6.5	71.0	**64.5*** **
Staff reimbursement			
Fixed salary vs. Drug/Patient volume-based payment	51.1	93.8	**42.7*** **
Healthcare providers that received training			
RDT training	48.9	53.1	4.2
Type of Malaria Diagnostic Tests offered			
Microscopy	0	61.3	**61.3*** **
RDT Test	48.9	53.1	4.2

Data source: Facility Instrument
Note: *p*-values *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Other private healthcare facilities have significantly more doctors/clinical officers who offer malaria diagnosis and treatment to patients than drug shops (71.0% vs 6.50%). Patients are significantly more likely to find nurses/midwives (93.5% vs 29.0%) who offer malaria diagnosis and treatment in drug shops than in other private healthcare facilities (See Table 4.3).

Other private healthcare providers are significantly more likely than drug shop attendants to be paid on a fixed-salary basis (93.8% vs 51.1%). Drug shop attendants are significantly more likely to be paid on a drug/patient volume basis than other private healthcare facilities (48.9% vs 6.3%).

Other private healthcare facilities are significantly more likely to offer Microscopy tests (0 % vs 61.3%) than drug shops.

There were no significant differences in proportions between other private healthcare facilities and drug shop attendants with regard to RDT training received. Patients are significantly more

likely to find doctors/clinical officers in other private healthcare facilities and nurses/midwives in drug shops that offer malaria diagnosis and treatment.

4.5.3 Knowledge of malaria diagnosis and drug dispensing

Differences in the knowledge of malaria diagnosis and dispensing practices between other private healthcare providers and drug shop attendants are reported in Table 4.4. Results indicate significant differences in proportions between other private healthcare facilities and drug shops in terms of knowledge of malaria diagnosis (history of antimalaria, physical examination, MB tests) and knowledge of malaria dispensing (second-line treatment of uncomplicated malaria, first-line treatment of uncomplicated malaria in pregnant women, first-line treatment of severe malaria).

Other private healthcare providers are significantly better informed than drug shop attendants regarding the history of antimalarial[19] procedures (96.87% vs 76.6%). Other private healthcare providers are more conversant in physical examination processes than drug shop attendants (90.63% vs 42.55%). Concerning malaria blood test[20] procedures, other private healthcare providers are more knowledgeable than drug shop attendants (96.75% vs 72.34%). Overall, other private healthcare providers are more knowledgeable than drug shop attendants regarding malaria diagnosis processes. This difference may be attributable to superior medical training that other private healthcare providers (doctors/clinical officers) receive, compared to drug shop attendants (nurses/midwives).

Other private healthcare providers are more familiar than drug shop attendants with the second-line treatment of uncomplicated malaria (dihydroartemisinin, piperaquine, and quinine tablets) (46.86% vs 14.89%).

Concerning the first-line treatment of uncomplicated malaria in pregnant women in the first, second, and third trimester (quinine/artemisinin-based combination therapy (ACT))[21], other private healthcare providers are better informed than drug shop attendants (50% vs 27.66%).

[19] History of antimalaria: whether the healthcare provider asked the antimalarial history of the patient before dispensing antimalarials.
[20] MB test refers to whether patients were tested for malaria before receiving antimalarial drugs.
[21] ACT is the first-line treatment for pregnant women in the second and third trimester. Quinine is the first-line treatment for pregnant women in the first trimester. However, the guidelines state that, in the absence of quinine, ACT may be used for pregnant women in the first trimester (Uganda MoH 2016b).

Table 4.4 Differences in proportions between private healthcare facilities by knowledge of malaria diagnosis and dispensing

Description	Facility Survey		
	OPHF (*N* = 33) %	Drug shops (*N* = 46) %	Differences in proportions
Knowledge of malaria diagnosis Private healthcare providers who knew of guidelines re:			
History of antimalarial	96.87	76.60	**20.27****
Physical examination	90.63	42.55	**48.08*****
Malaria blood test	96.75	72.34	**24.41*****
Knowledge of malaria dispensing Proportion of health providers who knew of:			
First-line treatment of uncomplicated malaria	90.63	93.62	-2.99
First-line alternative of uncomplicated malaria	18.75	12.77	5.98
Second-line treatment of uncomplicated malaria	46.86	14.89	**31.97*****
First-line treatment of uncomplicated malaria in pregnant women	50.00	27.66	**22.34****
First-line treatment of severe malaria	53.13	29.79	**22.34****
Malaria preventive treatment offered to pregnant women	84.38	76.60	7.78

Note: *p*-values *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Data source: Facility Instrument

Other private healthcare providers were more knowledgeable about first-line treatment of severe malaria (IV artesunate) than drug shop attendants (53.13% vs 29.79%). There were no significant differences in proportions between other private healthcare providers and drug shop attendants with regard to knowledge of the first-line treatment for uncomplicated malaria (artemether-lumefantrine), the first-line alternative for uncomplicated malaria

(artesunate/amodiaquine), and malaria preventive treatment offered to pregnant women (sulfadoxine/pyrimethamine).

4.5.4 Malaria case management of patients by facility type

There were significant differences in proportions between other private healthcare providers and drug shop attendants with regard to malaria diagnosis, dispensing practices, and protocol compliance (see Table 4.5).

Malaria diagnosis

Patients who visit other private healthcare facilities are more likely to be tested for malaria than those who visit drug shops (98.6% vs 34.7%). Patients who visit other private healthcare facilities are more likely to be asked by healthcare providers whether they have taken any antimalarials before being offered malaria treatment than those who visit drug shops (91.1% vs 40.7%).

Malaria dispensing

Drug shop attendants are significantly more likely than other private healthcare providers to dispense ACTs[22] to patients with malaria (84.7% vs 20.5%). Other private healthcare providers are more likely than drug shop attendants to dispense IVs[23] to patients with malaria (83.6% vs 5.8%). Other private healthcare providers are more likely than drug shop attendants to dispense antibiotics to patients (87.2% vs 81.2%). Overall, there are variations in malaria dispensing practices between private healthcare providers.

Compliance with malaria treatment protocol

There were significant differences in proportions between other private healthcare providers and drug shop attendants with regard to complying with the MB test protocol (Table 4.5). Other private healthcare providers are significantly more likely than drug shop attendants to follow the protocol (98.1% vs 37.1%). Antibiotic dispensing to malaria patients who tested negative was found to exceed 80% in all private healthcare facilities.

22 ACT = First-line alternative for uncomplicated malaria; the second-line treatment for uncomplicated malaria is dihydroartemisin/piperaquine/quinine tablets (Ministry of Health (MoH) 2016b).

[23] IVs are injectable drugs. These include first-line treatment for severe malaria include (IV artesunate)/First-line alternative for severe malaria (IV quinine and artemether injection) (Ministry of Health (MoH) 2016b).

Table 4.5 Differences in proportions between private healthcare facilities in malaria diagnosis and dispensing received by patients

	OPHF (*N* = 219) (%)	Drug shops (*N* = 202) (%)	Differences in proportions
Malaria diagnosis			
Patients who were tested for malaria[1]	98.6	34.7	**63.9*** **
Patients who were asked their history	91.1	40.7	**50.4*** **
Malaria dispensing: patients who received			
Any antimalarials	89.0	94.1	**- 5.1***
ACT	20.5	84.7	**- 64.2*** **
IV[2]	83.6	5.80	**77.8*** **
Antibiotics	87.2	81.2	**6.0***
Malaria treatment protocol compliance			
MB test	98.1	37.1	**61*** **
Antibiotics[3]	93.2	89.8	3.4

Note: *p*-values *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

1. For drug shops, *malaria testing* refers to whether drug-shop attendants requested malaria blood-test results for patients from other facilities, or tested the patients for malaria before dispensing antimalarials
2. IV = First-line treatment for severe malaria (IV artesunate)/First-line alternative for severe malaria (IV quinine and artemether injection).
3. Dispensing antibiotics to patients with negative malaria tests
4. Data source: Exit interview instrument.

4.5.5 Multivariate regression results of malaria diagnosis, dispensing, and economic incentives

Model 1

The following variables were significantly associated with following the MB test protocol: *Staff reimbursement*, *Place of facility* and *Type of facility* (see Table 4.6). The probability that healthcare providers who are paid fixed salaries adhere to the MB test protocol reduced by 11.6 percentage points as compared to their counterparts who are paid on drug/patient volumes. The probability that other private healthcare providers complied with the MB test protocol increased by 52.3 percentage points compared to drug shop attendants.

The probability that health providers from the urban complied with the MB test protocol reduced by 7.4 percentage points compared to their counterparts in the rural.

Model 2

The following variables were significantly associated with *MB test protocol*: *Staff reimbursement and place of residence* (see Table 4.6). The probability that drug shop attendants who are paid fixed salaries adhere to the MB test protocol reduced by 21.5 percentage points as compared to their counterparts who are paid according to drug/patient volumes. The probability that drug shop attendants from the urban complied with the MB test protocol reduced by 14.2 percentage points compared to their counterparts in the rural.

Model 3

The following variables were significantly associated with *MB test protocol*: *Staff reimbursement,* and *Place of facility* (see Table 4.6). Drug shop attendants without testing facilities who are paid fixed salaries are is 23.3 percentage points significantly less likely to adhere to the MB test protocol lower compared to their counterpart who are paid according to drug/patient volumes. The probability that drug shops without testing facilities located in urban areas comply with the MB test protocol reduced by 20.6 percentage points compared to those in rural areas.

Table 4.6 Regression results for malaria diagnosis, dispensing, and economic incentives

VARIABLES	Model 1	Model 2	Model 3
Staff reimbursement			
0. Drug/patient payment			
1. Fixed payment	-0.116***	-0.215***	-0.233***
	(0.037)	(0.067)	(0.068)
Staff professional qualifications			
0. Nurse/Midwife			
1. Doctor/Clinical officer	0.040	0.256	0.274
	(0.101)	(0.181)	(0.179)
Place of facility			
0. Rural			
1. Urban	-0.074*	-0.142*	-0.206***
	(0.042)	(0.080)	(0.065)
Facility type			
0. Drug shop			
1. OPHF	0.523***		
	(0.045)		
Observations	418	200	138

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes

1. Model 1 for OPHF and Drug shops
2. Model 2 for Drug shops
3. Model 3 for Drug shops that do not offer testing facilities.

Table 4.7 Differences in proportions and bivariate statistics of potential predictors for Model 1

	Model 1			
	$\overline{P_0}$	$\overline{P_1}$	$\overline{P_0} - \overline{P_1}$	χ2 (*p*-values)
Staff reimbursement				**0.045**
0. Drug/Patient payments	26.5	18.0	8.5**	
1. Fixed payment	73.5	82.0	-8.5**	
Staff professional qualifications				**0.000**
0. Nurse/Midwife	92.3	53.8	38.5***	
1. Doctor/Clinical officer	7.7	46.2	-38.5***	
Place of facility				0.644
0. Rural	31.8	23.2	8.6*	
1. Urban	68.2	76.8	-8.6*	
Type of Facility				**0.000**
0. Drug shop	95.5	26.3	69.2***	
1. OPHF	4.5	73.7	-69.2***	

Table 4.7 Differences in proportions and bivariate statistics of potential predictors for Model 2

	Model 2			
	$\overline{P_0}$	$\overline{P_1}$	$\overline{P_0} - \overline{P_1}$	χ2 (*p*-values)
Staff reimbursement				**0.001**
0. Drug/Patient payments	27.8	50.0	-22.2***	
1. Fixed payment	72.2	50.0	22.2***	
Staff professional qualifications				0.370
0. Nurse/Midwife	96.0	92.1	3.9	
1. Doctor/Clinical officer	4.0	7.9	-3.9	
Place of facility				**0.004**
0. Rural	33.3	46.1	-12.8	
1. Urban	66.7	53.9	12.8	

Table 4.7 Differences in proportions and bivariate statistics of potential predictors for Model 3

	Model 3			
	$\overline{P_0}$	$\overline{P_1}$	$\overline{P_0} - \overline{P_1}$	χ2 (*p*-values)
Staff reimbursement				**0.001**
0. Drug/Patient payments	31.0	60.4	-29.4***	
1. Fixed payment	69.0	39.6	29.4***	
Staff professional qualifications				0.414
0. Nurse/Midwife	94.1	88.7	5.4	
1. Doctor/Clinical officer	5.9	11.3	-5.4	
Place of facility				**0.006**
0. Rural	18.4	39.6	-21.2***	
1. Urban	81.6	60.4	21.2***	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes

1. $\overline{P_0}$ = MB test was not followed by healthcare providers (MB test = 0)
2. $\overline{P_1}$ = MB test was followed by healthcare providers (MB test = 1)

The results in Table 4.7 indicate differences in proportions for all the three models. For Model 1, significant differences in proportions were found for *Staff reimbursement*, *Staff professional qualifications*, and *Type of facility*. For Model 2 and Model 3 mean significant differences in proportions were found for *Staff reimbursement*, and *Type of facility*.

Wald test results in Table 4.8 (in Appendix A to Chapter 4) (at a threshold of $p > 0.05$) show that the coefficients for all the regressors were non-zero for Model 1, Model 2, and Model 3. Results in Table 4.9 indicate that all VIF estimates for the predictors were less than 10, indicating that there were no multicollinearity issues for all models 1(see Appendix A to Chapter 4 for all models).

Chi squared results of the bivariate analyses in Table 4.6 show that (at a threshold of $p < 0.05$), *Staff reimbursement*, *Staff professional qualifications*, and *Type of facility* for Model 1 were significantly associated with *MB test protocol*. For Model 2 and Model 3, *Place of facility* and *Staff reimbursement* were significantly associated with *MB test protocol*.

All the models passed the goodness-of-fit test and correctly classified an acceptable percentage of observations (Table 4.8 in Appendix A to Chapter 4). Robustness checks indicate that the coefficients across the models (logit, probit, and linear probability model (LPM)) for Model 1, Model 2 and Model 3 told a qualitatively similar story about the relationship between the predictors on the *MB test protocol* variable (see Tables 4.10, 4.11 and 4.12).

4.6 Discussion

The main objective of this study was to examine the relationship between the payment modes (of private healthcare providers) and malaria diagnosis and treatment. This section presents a discussion of the results.

4.6.1 Malaria Diagnosis

We found that drug shop attendants, compared to other private healthcare providers, are relatively uninformed regarding the appropriate malaria diagnosis procedures (malaria blood testing, physical examination, and taking a history of antimalarials). Likewise, malaria diagnosis procedures (malaria blood testing and history of antimalarials) were found to vary significantly between other private healthcare providers and drug shop attendants. The results suggest that patients that visit other private healthcare providers are more likely to be tested for malaria and asked about antimalarials they have taken. However, drug shop attendants are less likely to carry out malaria diagnosis procedures (asking about a previous positive malaria test or administering a test). Not all drug shops can test for malaria, but guidelines dictate that they enquire about a diagnosis prior to dispensing medicine. These results are not entirely surprising, and there are several explanations, including the role and function of drug shops vs. those of other private healthcare providers (often not including diagnosis), the higher clinical training received by other private healthcare providers (doctors/clinical officers) when compared to drug shop attendants (nurses/midwives/lay workers), and variations in diagnostic facilities. The AMFm Independent Evaluation Team (2012) reported similar significant differences in diagnostic facilities of health facilities/pharmacies and drug shops.

4.6.2 Malaria Dispensing

With regard to variations in knowledge of dispensing antimalarials (Class A and B[24] category), other private healthcare providers are significantly better informed than drug shop attendants. A plausible explanation for this result is that drug shop attendants are only permitted to dispense Class C[25] antimalarial drugs, while other private healthcare providers are allowed to administer all categories (NDA 1993). As other private healthcare providers administer a wider range of antimalarial treatments, they are more likely to be knowledgeable about dispensing Classes A and B than drug shop attendants.

[24] Class A and B antimalarials include IV = First-line treatment for severe malaria (IV artesunate)/First-line alternative for severe malaria (IV quinine and artemether injection).
[25] Class C includes all ACTs.

A major concern arising from the study is the high dispensing rate of IV treatment (83.59%) and the low dispensing of ACT (20.51%) by other private healthcare providers, despite increased availability of quality-assured ACTs (QAACT), a decrease in QAACTs' prices, and an increase in the QAACTs market share in Uganda (AMFm Independent Evaluation Team 2012).

It was found that more than 80% of patients who visit either other private healthcare facilities or drug shops receive antibiotics, despite having tested negative for malaria. This result implies that patients with negative malaria results are most likely to receive antibiotics without the full blood count as recommended by the clinical guidelines (Uganda MoH 2016b). Prescription of antibiotics despite a negative test result is over-prescription and misuse of antibiotics, which may lead to resistance to antibiotics. Other researchers (Cohen *et al.* 2012; Mbonye *et al.* 2015; Das *et al*. 2016) have reported similar results regarding unnecessary dispensing. Das *et al.* (2016) reported that the likely reason for the unnecessary dispensing and treatment is that private healthcare providers who are paid on a fee-for-service basis, compared to those paid a fixed salary, are more likely to dispense medication. Further research is needed to establish the behaviour of private healthcare providers with regard to over-dispensing of IVs, lower dispensing of ACTs to malaria patients, and prescription of antibiotics to patients who tested negative for malaria.

4.6.3 Malaria case management

Adherence to malaria treatment protocols was also found to vary significantly between other private healthcare providers and drug shop attendants. Descriptive analyses and multivariate results suggested that other private healthcare providers are significantly more likely to adhere to the MB test protocol than drug shop attendants. Other studies (Mbonye *et al.* 2013; Awor *et al.* 2014; Mayora *et al.* 2018) have shown that most drug shop attendants rely on presumptive malaria diagnoses, and do not comply with malaria treatment protocols. For example, Mayora *et al.*'s (2018) study in western Uganda found that only 21% of patients who visited drug shops received an appropriate malaria diagnosis — with the use of thermometers and RDTs.

Overall, results from the multivariate analysis suggest that private healthcare providers (especially from drug shops) who are paid based on drug/patient volumes are more likely to comply with the MB test protocol than those paid a fixed salary. This result is contrary to the

initial hypothesis, but consistent with that of other studies that found a positive relationship between the fees charged by private facilities and the quality of healthcare received by patients (Das and Hammer 2007; Das *et al*. 2016; Fitzpatrick 2020). A possible explanation is that private healthcare providers who are paid on a fee-for-service basis are more likely to exert more effort in treating patients, in hopes of attracting more patients in the future (Das *et al.* 2007; Das *et al.* 2016).

Study limitations

Directly observing providers (through exiting patients) may have resulted in them changing their behaviour to what they thought would impress or please the investigators, known as the Hawthorne effect (Leonard and Masatu 2006; Fitzpatrick and Tumlinson 2017). In this regard, Leonard and Masatu (2006) found that, when doctors are being observed, the quality of their care increased by 26% (off the base rate of 50% compliance). Das and Hammer (2014) showed that only standardised patient and patient file audit methods of data collection are not affected by the Hawthorne effect. In addition, most facilities in low-income countries, especially in rural areas, do not keep thorough and detailed notes on interactions with patients.

In view of the above, results from this study's exit interview data may have been different if a mystery patient study had been conducted, rather than directly observing private health providers. The original proposal of conducting a mystery patient study was rejected in favour of interviewing exiting patients, on ethical grounds. Such a study would have provided more credible information on the relationship between malaria case management and payment methods of private healthcare providers.

The study could not differentiate between licensed and unlicensed drug outlets, as the lists received from NDA had not been updated to include registered drug shops, and most drug shops do not display their licences.

4.7 Conclusion and recommendations

In summary, there are significant variations between other private healthcare providers and drug shop attendants concerning malaria diagnosis and antimalarial dispensing practices. Other private healthcare providers are significantly more conversant than drug shop attendants in malaria diagnosis and dispensing of antimalarials. Other private healthcare providers are significantly more likely than drug shop attendants to adhere to the MB test protocol. The

results of the present study suggest that the financial incentives given to private healthcare (especially drug shop attendants) providers are associated with adherence to malaria treatment protocols.

The over-prescription of IV treatment by other private health facilities despite the availability and affordability of QAACT is noted with concern. The prescription of antibiotics to patients with negative malaria test results in both private healthcare facilities requires attention by regulatory bodies, as this will ultimately increase antimicrobial resistance. It is also recommended that further investigations be conducted into the over-prescription of IV treatment by private healthcare facilities and the prescription of antibiotics to patients with negative malaria test results.

Appendix A to Chapter 4

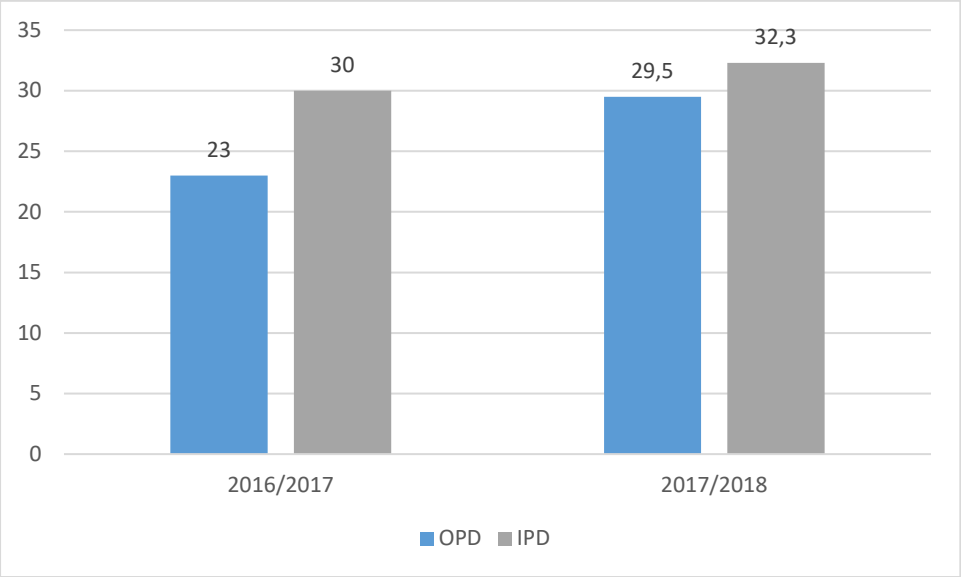


Figure 4.1 Malaria as a share of the Outpatient Department and Inpatient Department in Uganda 2016/2017 and 2017/2018

Source: Uganda MoH (2016a, 2017a)

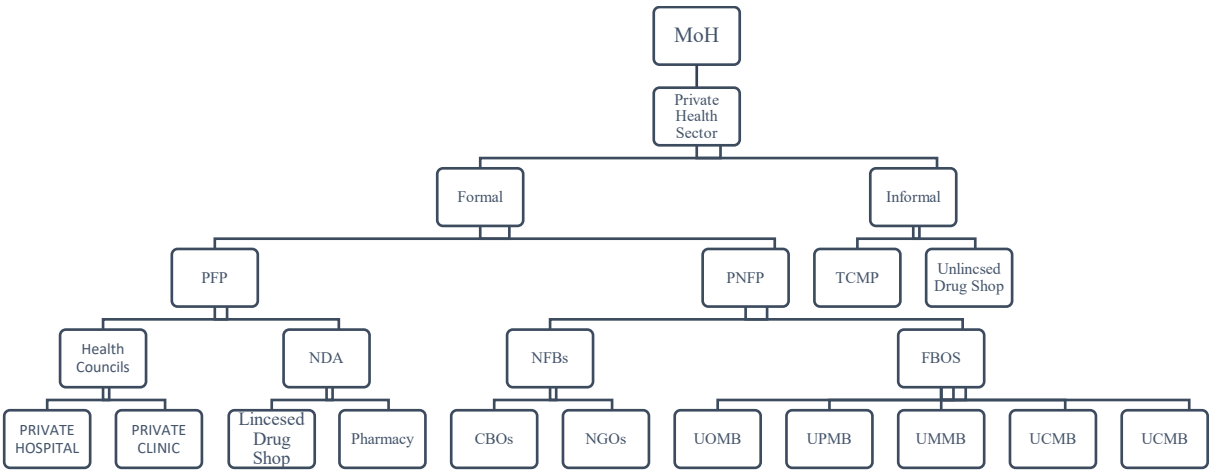


Figure 4.2 Structure of the private healthcare system in Uganda

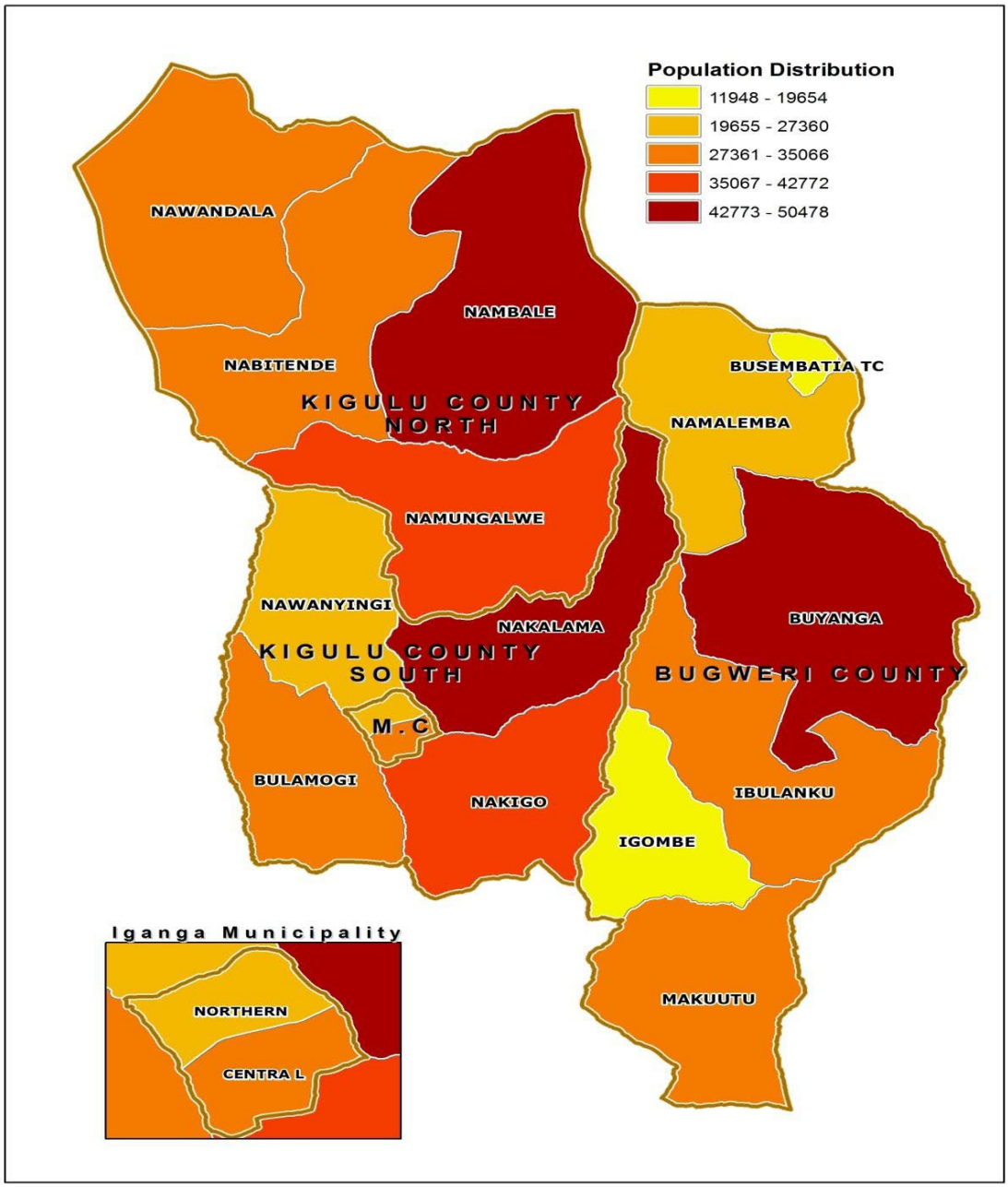


Figure 4.3 Map of Iganga

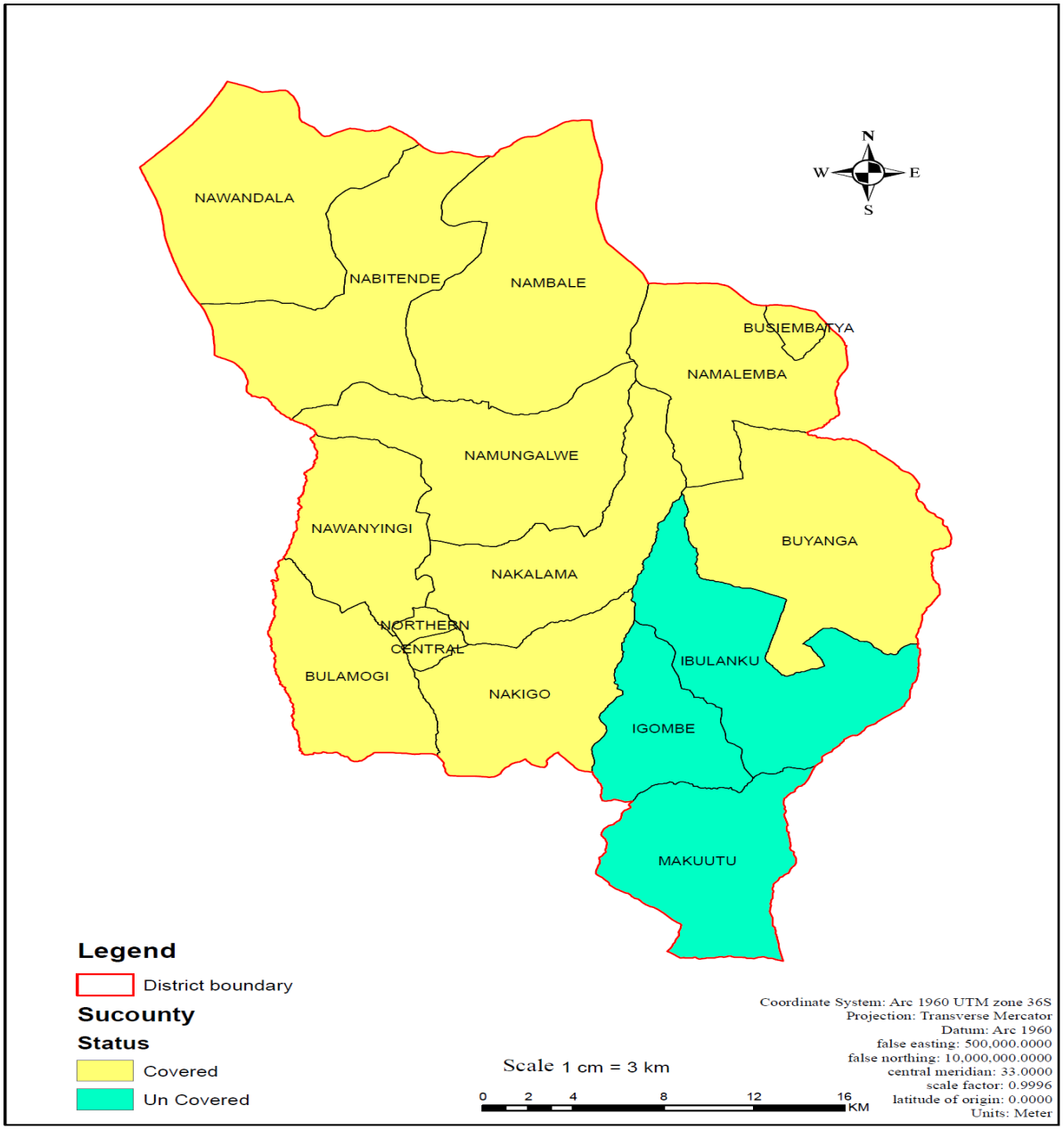


Figure 4.4 Map of Iganga showing sub-counties that were covered and uncovered

Table 4.8 Hosmer and Lemeshow goodness-of-fit test for Model 1, Model 2 and Model 3

	Model 1	Model 2	Model 3
Number of observations	418	200	138
Wald test			
Pearson chi squared	97.95	88.15	78.16
Prob > chi squared	0.000	0.000	0.000
Goodness-of-fit test			
Pearson chi squared	10.80	5.44	3.81
Prob > chi squared	0.094	0.066	0.149
Correctly classified	83.01%	67.50%	68.12

Notes

1. Model 1 for OPHF and Drug shops
2. Model 2 for Drug shops
3. Model 3 for Drug shops that do not offer testing facilities.
4. **Wald test**
   H0: The coefficients are jointly zero
   H1: At least one of the coefficients is different from zero
   Hence we reject the null hypothesis (at a threshold of p > 0.05) for all the three models
5. **Goodness-of-fit test**
   H0: Model does not indicate misspecification
   H1: Model indicates misspecification
   The null hypothesis was not rejected for all three models at a threshold of $p < 0.001$
   Correctly classified = The percentage of correctly specified values for the models (using the *estat classification* command)

;[

Table 4.9 Test for multicollinearity Model 1, Model 2 and Model 3

Variable	VIF Model 1	VIF Model 2	VIF Model 3
Mode of payment			
Fixed payments	1.17	1.03	1.06
Drug/Patient payment			
Staff professional qualifications	1.79	1.06	1.06
Nurse/Midwife			
Doctor/Clinical officer			
Place of facility	1.11	1.04	1.08
Rural			
Urban			
Facility type	1.24		
Drug shop			
OPHF			

Notes

1. Model 1 for OPHF and Drug shops
2. Model 2 for Drug shops
3. Model 3 for Drug shops that do not offer testing facilities.
4. All VIF estimates for the predictors were less than 10 in all the 3 models, indicating that there were no multicollinearity issues.

Table 4.10 Robustness checks for MB test Model 1

VARIABLES	Logit	Probit	LPM
Staff reimbursement			
0. Drug/Patients payment			
1. Fixed Payments volumes	-0.116***	-0.122***	-0.182**
	(0.037)	(0.040)	(0.069)
Staff professional qualifications			
0. Nurse/Midwife			
1. Doctor/Clinical officer	0.040	0.016	0.004
	(0.101)	(0.082)	(0.054)
Place of facility			
0. Rural			
1. Urban	-0.074*	-0.076*	-0.094
	(0.042)	(0.044)	(0.058)
Type of facility			
0. Drug shop			
1. OPHF	0.523***	0.511***	0.667***
	(0.045)	(0.043)	(0.072)
Observations	418	418	418

Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes

The coefficients across the restricted models (logit, probit, and LPM) for Model 1 tell a qualitatively similar story about the relationship between MB test and predictors.

Table 4.11 Robustness checks for MB test Model 2 (Drug shops)

VARIABLES	Logit	Probit	LPM
Staff reimbursement			
0. Drug/Patient payment			
1. Fixed payments	-0.215***	-0.216***	-0.227***
	(0.067)	(0.068)	(0.078)
Staff professional qualifications			
0. Nurse/Midwife			
1. Doctor/Clinical officer	0.256	0.251	0.256
	(0.181)	(0.178)	(0.195)
Place of facility			
0. Rural			
1. Urban	0.256	0.251	0.256
	(0.181)	(0.178)	(0.195)
Observations	200	200	200

Standard errors in parentheses; *** $p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes

The coefficients across the restricted models (logit, probit, and LPM) for Model 2 tell a qualitatively similar story about the relationship between MB test and predictors.

Table 4.12 Robustness checks for MB test Model 3 (Drug shops without testing facilities)

VARIABLES	Logit	Probit	LPM
Staff reimbursement			
0. Drug/Patient payment			
1. Fixed payments	-0.233***	-0.235***	-0.250***
	(0.068)	(0.069)	(0.081)
Staff professional qualifications			
0. Nurse/Midwife			
1. Doctor/Clinical officer	0.274	0.270	0.283
	(0.179)	(0.175)	(0.201)
Place of facility			
0. Rural			
1. Urban	-0.206***	-0.209***	-0.225***
	(0.065)	(0.068)	(0.080)
Observations	138	138	138

Standard errors in parentheses; *** $p < 0.01$, **$p < 0.05$, *$p < 0.1$

Notes

The coefficients across the restricted models (logit, probit, and LPM) for Model 3 tell a qualitatively similar story about the relationship between MB test and predictors.

Chapter 5
Conclusion

Malaria remains the leading cause of mortality and morbidity at all ages in Uganda, despite the substantial investment by government, the private sector, and the development partners in interventions to prevent and treat malaria. Active ownership and utilisation of malaria interventions by the population, and the appropriate provision of malaria diagnosis and treatment services by healthcare providers, are critical in reducing malaria-related mortality and morbidity in Uganda. Therefore, this study utilised different novel data sets to assess the different malaria prevention interventions and the malaria diagnosis- and treatment practices of the private healthcare providers in Uganda.

5.1 What we know

The study investigated whether bed net distribution had improved over time, specifically covering the period before and after a mass distribution campaign. Equity in both household ownership (access to bed nets and universal coverage) and utilisation of bed nets (by population and malaria-vulnerable groups) were examined. Factors associated with bed net utilisation in 2009 and in 2014 were included in the analyses. The results showed that, in 2014, the percentage of households with access to bed nets, the percentage of households attaining universal coverage of bed nets, and the percentage of population and malaria-vulnerable groups who utilised bed nets increased. In 2014, socio-economic inequities in household access to bed nets, universal coverage and utilisation (of bed nets by the population and malaria-vulnerable groups) reduced. In 2014, access to bed nets for household members in poorer households increased, and more people in the population and from malaria-vulnerable groups in poorer households slept under bed nets.

Mother's primary level of education in both years was vital in promoting bed net utilisation by the poor in both years. Hence, providing additional evidence for the importance of the education level of mothers.

In 2014, malaria-vulnerable groups, household members from the northern region, households with more bed nets, household with few members, mothers with a post-secondary education, and household members in the poorest wealth quintile were associated with bed net utilisation.

Overall, access to bed nets, universal coverage, and utilisation by the population and malaria-vulnerable groups increased in 2014.

The study found evidence in support of the hypothesis that economic incentives are associated with adhering to malaria diagnosis and treatment procedures. The results showed that private healthcare providers who are paid based on drug/patient volumes are more likely to comply with the malaria diagnosis and antimalarial drug dispensing protocols than those paid a fixed salary. The descriptive statistics showed significant differences between other private healthcare providers and drug shop attendants with regard to malaria diagnosis, antimalarial dispensing practices, and adhering to malaria treatment procedures. Results suggest over-prescription of IV treatment by other private healthcare providers and the prescription of antibiotics to patients with negative malaria test results in both groups of private healthcare facilities.

5.2 What we do not know

Chapter 2 considers changes over time in access and utilisation of bed nets during a period where there was free mass provision of preventive healthcare increases coverage and utilisation of preventive healthcare, especially in poor households in a low-income country. Studies in low-income countries often assume that financial constraints and access to consultations and treatment are the primary limitation to investment in preventive healthcare. While government and development donor partners should invest in free distribution of preventive healthcare in order to realise increased and sustained coverage and utilisation of preventive healthcare in low-income countries, it is also important to recognise that financial constraints are not the only factors inhibiting uptake and more research is required on this front.

The study considered the uptake of three or more doses of IPT-SP, per the WHO (2013) recommendation of IPT-SP3 as an effective measure against malaria during pregnancy. Awareness of factors associated with uptake of three or more doses of IPT-SP by pregnant women is essential in formulating policies aimed at increasing the proportion of pregnant women who receive the recommended dosage of IPT-SP3. Therefore, this study assessed the factors associated with uptake of IPT-SP3 dosage by pregnant women in 2011 and 2016 (discussed in Essay 2, in Chapter 3). While we saw a large increase in IPT-SP3, the conditional time dummy in the pooled regression with covariates was significant but small. The model with 2016 interaction effects with covariates confirmed that the relationships did not change over time, so changes were driven by shifts in the underlying demand factors themselves.

The over-prescription of IV treatment by other private health facilities despite the availability and affordability of QAACT was noted with concern in chapter four. Given that the clinical guidelines only recommend the use of IV for first-line treatment for severe malaria MoH (2016b), further investigations behind the motive of over-prescription of IV by private healthcare providers is required. The prescription of antibiotics to patients with negative malaria test results without a full blood count, which is recommended by the clinical guidelines by private health facilities also requires further investigations.

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Appendix B to Chapter 4

Facility Questionnaire

FACILITY SURVEY IGANGA 2018
Section I: Basic Information
Interviewer completes this section for all facilities.
Case ID [ ] [ ] [ ]
A1. Today's date(dd/mm/yyyy) [___|___]-[___|___]-[_2_|_0_|_1_|_8]
A2. Interviewer's name [_____]
A3. Name of facility [_____]
A4. Sub county of facility [_____]
A5. Parish of facility [_____]
A6 Residence status of facility *Interviewer should tick appropriately* 1. Urban ☐ 2. Rural ☐
A7. Type of facility *Interviewer should tick appropriately* 1. Private ☐ 2. Pharmacy ☐ 3. Licensed Drug shop ☐ 4. Unlicensed Drug Shop ☐

A8. START TIME		

START OF INTERVIEW

Introduction of field worker

Hello, my name is _____. We are conducting a study on the malaria case management in private facilities. The results will be used to improve the appropriate malaria treatment in Uganda.

As part of this study, I would like to ask a few questions to the facility staff members. This data instrument has four sections. The director, manager or senior staff present on the site will be the preferred member to provide responses to section II. The person dealing with patients as well as one that makes clinical/health decisions on tests and dispensing drugs will be preferred to provide responses to section III and staff members that dispense and manage drug in different health facilities will be preferred to provide responses to section IV.

These questions will take about 20 minutes to complete.

Whatever information you provide will be kept strictly confidential and will not be shared with anyone. Participation in this survey is voluntary, and if we should come to any question you do not want to answer, just let me know and I will go on to the next question; or you can stop the interview at any time. However, we hope you will participate in the survey since your views are important. At this time, do you want to ask me anything about the survey? May I begin the interview now?

Instructions to field worker on how to identify appropriate respondents:

For Section II: We need to identify a staff member at the facility who is in a position to give us reliable information about how the facility operates. If there is an owner and a manager try to speak to both. If the owners are not in Iganga, you can phone him to verify answers or to ask questions that the manager could not answer. Try to speak to the most senior person on site, i.e. manager is responsible for financial accounts and day-to-day managerial decisions.

For Section III: We need to identify a staff member who is the person dealing with clients and will be making clinical/health decisions on diagnostic tests and prescribing drugs. In set-ups that are more informal, this person may not have a medical background (i.e. drug shops) and it may be the same person as for Section I. In larger organisations, it may be different people.

For Section IV: We need to identify a staff member who is dispensing and managing the supply of malaria drugs.

For All Sections:

The interviewer should read the responses for the respondent and tick the options selected by the respondent.

SECTION II: Facility type and operations

These questions should be asked to the person responsible for managing the facility

P1. For how many years has this facility been in operation? ____

P2 Is this facility owned by:

1. Medical practitioners ☐
2. Business persons ☐
3. Other (please specify) ☐

P3 (i). Do the owners take part in the day-to-day running of this facility?

The interviewer should tick appropriately

1. Yes *(go to P(3ii))* ☐
2. No *(go to P4)* ☐

P3 (ii). How often do the owners get involved in the day-to-day running of this facility?

The interviewer should tick appropriately

1. Never (see owners a few times a year) ☐
2. Seldom (see owners monthly) ☐
3. Often (owners present daily) ☐

P4 Who runs the day-to-day operations of this facility?

The interviewer should tick appropriately

1. Facility Manager ☐
2. Senior Doctor ☐
3. Senior Nurse / Midwife ☐
4. Senior Clinical Officer ☐

P5 (i). How many staff are working at this facility? ____

P5 (ii) Do you have someone responsible for bookkeeping and the financial accounts?

1. Yes *(go to P5 (iii))* ☐
2. No *(go to P6(i))* ☐

P5 (iii) Who is responsible for bookkeeping and the financial accounts?

1. Doctor ☐
2. Accountant ☐
3. Cashier ☐
4. Administrator ☐
5. Other ☐

P6 (i). How do you pay the staff members who work with clients and dispense medicine?

1. Fixed amount (salary) ☐
2. Based on drugs sold ☐
3. Based on the number of patients seen ☐
4. Other (please describe below):----------

P6 (ii). Your role

Please describe your roles and responsibilities.

Role 1_____

Role 2_____

Role 3_____

P7 (i). How many malaria patients on average do health provider(s) attend to in this facility on a daily basis?	

This question completed by the field worker based on how they answered P7. Do not read this aloud.

P7 (ii) Did the respondent check records or just answered the questions without checking records?

1. Did check records ☐
2. Did not check records ☐

P8. Do you offer malaria diagnostic services or sell malaria diagnostic tests?

1. Yes ☐

☐

2. No

P9 How do most patients with malaria cover their medical bills?

1. Fixed fee including medicine, consultation and tests ☐
2. Medicine only – no consultation offered ☐
3. Separate charges for consultation, medicine and tests ☐
4. Other (specify if other) ……...

P10 Are you responsible for tracking money and taking it to the bank?

1. Yes ☐
2. No ☐
3. There is no bank account ☐

P11. How do you ensure that your staff are on time and delivering good service to your customers?

Do not read the answers – just check what he/she answered

1. Check into the facility a few times a week ☐
2. Always at the facility ☐
3. Trust my staff ☐
4. Other answer (specify if other) ……...

Section III: Malaria screening and treatment

These questions should be asked to the person working with clients/patients

C1. A patient walks into your facility complaining of a recurrent high fever, what questions do you ask him?

The interviewer should NOT read these options out, but circle if provider mentions the step and make a cross if provider did not mention the step.

C1 (a) Does the provider mention taking the medical history of the patient?

1. Yes *(go to C1 (b))* ☐
2. No ☐

C1 (b) If he or she does, what symptoms do they mention?

- Headache ☐
- Loss of appetite ☐
- Chills or rigors ☐
- Nausea or vomiting ☐
- Joint weakness or pains ☐
- General malaise ☐
- Enlarged spleen and liver especially in children ☐

C1 (c) Do they mention a physical examination?

1. Yes *(if yes go to C1 (d))* ☐
2. No ☐

C1 (d) What checks do they mention?

- Temperature ☐
- Blood pressure ☐
- Pulse rate ☐

C1 (e) Do they mention a malaria test?

1. Yes *(if yes go to C1 (f))* ☐
2. No *(if no go to C1 (h))* ☐

C1 (f) Is it a blood slide or a RDT test – enquire if they do not volunteer the information

1. Yes ☐
2. No ☐

C1 (h) If they do not mention a malaria test, is malaria drugs provided without the test?

1. Yes ☐
2. No ☐

C1 (i) If the test is positive, do they provide malaria medicine.

1. Yes ☐
2. No ☐

C1 (j) Which of the factors below do they mention in their assessment of the appropriate treatment?

- Severity of case ☐
- Complications ☐
- Pregnancy ☐
- Age ☐
- Weight ☐

C1 (k) Does the provider mention investigating for another cause of fever?

1. Yes *(if yes go to C1 (l))* ☐
2. No ☐

C1 (l) If so does he/she mention any of these below?

- If running nose, sore throat and cough: viral upper respiratory infection ☐
- If swollen tonsils with exudate on it: tonsillitis ☐
- If ear pain and discharge: otitis ☐
- If cough, rapid breathing and difficulty in breathing: pneumonia ☐
- If urinary symptoms: urinary tract infection ☐
- If vomiting, diarrhoea and abdominal pain: gastroenteritis ☐
- If skin rash: measles or other viral rash ☐

C1 (m) When the patient is negative, does the provider mention providing medicine without further examination?

1. Yes *(if yes go to C1 (n))* ☐
2. No ☐

C1 (n) If so, what medicine is provided?

- Malaria medicine ☐
- Antibiotics ☐
- Vitamins ☐

- Painkillers
- Others (specify) ☐

C2. If a patient or client is sure that they have malaria, will you provide malaria medicine?

1. Yes ☐
2. No (they need to have a test or show test results) ☐

C3. Malaria knowledge (Do not read the answers)

C3 (a). Do all malaria cases have symptoms?

1. Yes ☐
2. No ☐

C3b (i). What would you prescribe to a woman less than 3 months pregnant testing positive for malaria?

- Quinine oral treatment
- Other answer (specify)…….

C3b (ii). What would you prescribe to a child of under 4 months testing positive for malaria?

- Artemether/Lumefantrine
- Other answer (specify)…….

C4 (a). What is your first-line treatment for uncomplicated malaria for all patients?

Name

C4 (b). What is your first line alternative treatment for uncomplicated malaria for all patients?

Name

C4 (c). What is your second-line treatment for uncomplicated malaria for all patients?

Name

C4 (d). What is your first- line alternative treatment for uncomplicated malaria for pregnant women in 1st trimester?

Name

C4 (e). What is your first-line treatment for severe malaria?

Name

C4 (g) What type of malaria preventive treatment do you offer to pregnant women and when?

Name

C4 (h) What type of antibiotics would you prescribe to patients with negative malaria results?

Name _____

Name _____

Name _____

C5. What is your priority when you consult a client entering your shop/clinic seeking advice or help?

1. Client is happy and ☐
2. satisfied when they leave ☐
3. Client will be cured and feel better
4. Client feels they are getting value for money ☐
5. Client will return to this facility ☐
6. Follow the medical and protocols ☐
7. Do what my manager requires of me ☐
8. Other (specify)

C6. What is your highest level of education you have obtained?

1. None ☐
2. Primary ☐
3. Secondary ☐
4. University ☐
5. Other tertiary

C7. What type of profession qualification do you hold?

The interviewer should tick appropriately respondents' type of qualification. The interviewer should not read out to the respondent the options of qualifications listed below.

1. Doctor ☐
2. Clinical officer ☐
3. Pharmacist ☐
4. Nurse ☐
5. Midwife ☐
6. Laboratory Technician ☐
7. Shop Assistant ☐
8. Other (specify if other)……...

C8 When did you last receive any malaria case management training?

The interviewer should circle providers response

1 = Never

2 = if less than 2 Years
3 = if more than 2 Years

	Never	Less than 2 Years	More than 2 Years
i. Artemisinin Combination Therapy (ACT)	1	2	3
ii. IMCI Guidelines	1	2	3
iii. Rapid Diagnostic Tests (RDTs)	1	2	3
iv. Microscopy	1	2	3
v. Other (specify if other)	1	2	3

C9 What type of malaria diagnostic tests do you offer?
The interviewer should circle;
1 = If provider mentions the diagnostic test
2 = if provider does not mention the diagnostic test

i. None	1	2
ii. RDT	1	2
iii. Microscopy	1	2
iv. Lumbar Puncture	1	2
v. Random Blood Sugar and HB level	1	2
vi. Thin film for parasite	1	2
vii. Other (specify) ……	1	2

SECTION IV: Drug Availability Questions *(for the staff member who dispense drugs)*

D1. Do you have any antimalarial medicines in stock today?

1. Yes *(go to D2)* ☐
2. No ☐

D2. Which type of antimalarial medicine do you have in stock today?

Ask respondent to show an example of each product if he says is in stock today. Only circle '1' if product type has been observed.

1 = observed the product in stock today 2 = product not in stock today

Artemether/Lumefantrine

	observed the product	*product not in stock*
i. Lonart	1	2
ii. Coartem	1	2
iii. Artefan	1	2
iv. Co Mether	1	2
v. Co Artesian	1	2
vi. Lumether	1	2
vii. Others		

Artesunate + Amodiaquine

	observed the product	*product not in stock*
Apmod	1	2
Artesun Plus	1	2
Falcimon	1	2
Other		

Dihydroartemisin/ Piperaquine

	observed the product	*product not in stock*
Duo-coteexin	1	2
P-Alaxin	1	2
Ridmal	1	2
Duo Quin	1	2

Other	

Quinine

	observed the product	*product not in stock*
Kam Quin Mixtures	1	2
Quinine Tablets	1	2
Swiss Quine	1	2
Others		

Quinine Sulphate

	observed the product	*product not in stock*
Requin	1	2
Ago Quinine	1	2
Quinas	1	2
Others		

Quinine Dihydrochloride

	observed the product	*product not in stock*
Falcimax	1	2
Quinine Dihydrochloride Injection	1	2
Quinine Injection	1	2
Others		

IV

	observed the product	*product not in stock*
IV Artesunate	1	2
IV Quinine	1	2
Artemether Injection	1	2
Rectal Artesunate	1	2
Other		

D3. Are there any medicines that are out of stock today, but that you stocked in the past 3 months?

The interviewer should Only circle '1' if
1 = the product in stock past three months 2 = product not in stock for the past three months
Artemether/Lumefantrine

	Product in stock for past 3 months	*Product not in stock for past 3 Months*
i. Lonart	1	2
ii. Coartem	1	2
iii. Artefan	1	2
iv. Co Mether	1	2
v. Co Artesian	1	2
vi. Lumether	1	2
vii. Others		

Artesunate + Amodiaquine

	Product in stock for past 3 months	*Product not in stock for past 3 Months*

	1	2
	1	2
	1	2

Dihydroartemisin/ Piperaquine

	Product in stock for past 3 months	*Product not in stock for past 3 Months*

i. Duo-connexin	1	2
ii. P-Alaxin	1	2
iii. Ridmal	1	2
iv. Duo Quin	1	2
v. Other		

Quinine

	Product in stock for past 3 months	*Product not in stock for past 3 Months*
i. Kam Quin Mixtures	1	2
ii. Quinine Tablets	1	2
iii. Swiss Quine	1	2
iv. Others		

Quinine Sulphate

	Product in stock for past 3 months	*Product not in stock for past 3 Months*
i. Requin	1	2
ii. Ago Quinine	1	2
iii. Quinas	1	2
iv. Others		

Quinine Dihydrochloride

	Product in stock for past 3 months	*Product not in stock for past 3 Months*

i.	Falcimax	1	2
ii.	Quinine Dihydrochloride Injection	1	2
iii.	Quinine Injection	1	2
iv.	Others		

IV

		Product in stock for past 3 months	*Product not in stock for past 3 Months*
i.	IV Artesunate	1	2
ii.	IV Quinine	1	2
iii.	Artemether Injection	1	2
iv.	Rectal Artesunate	1	2
v.	Other		

D4 What type of antibiotic medicine do you have in stock today?

D4 (i)._____

D4 (ii)._____

D4 (iii)._____

Thank the Provider

END TIME		

Exit Interview Questionnaire (OPHF)

EXIT INTERVIEW GUIDE (OPHF) IGANGA 2018

Section I: Basic information

Enumerator completes this section for each interview. To save time this can be filled out before starting the interview with patients.

Case ID | | | |

A1. Today's date(dd/mm/yyyy)

[___|___]-[___|___]-[_2_|_0_|_1_|_8]

A2. Enumerator's name

[_____]

A3. Name of Facility

[_____]

A4. Sub county of Facility

[_____]

A5. Parish of Facility

[_____]

A6 Residence status of facility

Interviewer should tick appropriately

1. Urban ☐
2. Rural ☐

A7. Type of Facility

1. Private Hospital ☐
2. Licensed Drug shop ☐
3. Unlicensed Drug Shop ☐

START OF EXIT INTERVIEW

Introduction of field worker

Hello, my name is _____. We are conducting a study on the malaria case management in public and private facilities. The results will be used to improve the appropriate malaria treatment in Uganda.

The director/manager of this facility has given me consent to conduct this survey (interviewer presents the consent letter). Thank you for agreeing to participate in this survey as well. As a patient who has been diagnosed with malaria at this facility, I would like to ask you a few questions about the care you received today and the malaria treatment that has been offered to you. However, if you are feeling too unwell to answer the questions, your caretaker can respond to these questions. These questions will take about 20 minutes to complete.

Whatever information you provide will be kept strictly confidential and will not be shared with anyone. Your participation in this survey is voluntary, and if we should come to any question you do not want to answer, just let me know and I will go on to the next question; or you can stop the interview at any time. However, we hope you will participate in the survey since your views are important.

At this time, do you want to ask me anything about the survey?

If not, may I please begin the interview?

START TIME		

Section II Introduction Section		
SN	Introduction	Researcher Ticks appropriately
D1	Why did you come to the facility today? Screening question – only proceed if he/she has received either diagnosis of and treatment for malaria	
D2	Age of the patient Do not proceed with the interview if it is an unaccompanied minor (under 18)	Age of the patient ☐
D4	Interview with adult patient or adult caretaker? Only initiate interview at this point. You can now give the study introduction and request consent	1. Adult patient ☐ 2. Adult caretaker ☐
D3	Sex of the Patient	1. Male ☐ 2. Female ☐
D4	Why did you choose this facility? Please tick all that apply	1. Closest form my home (travelling distance) 2. Most convenient (shortest waiting time) 3. Friendly staff 4. I trust them 5. They have medicine in stock (no stock outs) 6. Most affordable 7. Other

Section III Patient History Section		
SN	Questions	Researcher Ticks appropriately
H5	Has the health provider asked you if you have taken any antimalarial medication for this illness episode?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H6	Has the health provider asked you have a high and recurrent temperature? (coming back every night/ every second night)	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H7	If yes to the above question, has the health provider asked you for how long you been having recurrent temperature?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H8	Has the health provider asked you the time of the day do you feel fever?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H9	Has the health provider asked you if you feel chills?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H10	Has the health provider asked you if have a cough or flu?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H11	Has the health provider asked you if you have episodes of excessive sweats?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H12	Has the health provider asked you if you lose appetite?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H13	Has the health provider asked you the number of times you eat?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H14	Has the health provider asked you if you have started vomiting?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐

H15	Has the health provider asked you when this vomiting started? / was it mild or severe?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H16	Has the health provider asked you if you have diarrhoea?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H17	Has the health provider asked you when the diarrhoea started?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H18	Has the health provider asked you if you have joint and muscle pain?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H19	Has the health provider asked you if you experience a headache when your body temperature rises?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H20	Has the health provider asked you if you have had problems with breathing?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
H21	Has the health provider asked you if you had a convulsion?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐

Section IV Physical examination Section		
SN	Questions	
E1	Has the health provider measured your height	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
E2	Has the health provider measured your weight	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
E3	Has the health provider inspected your mouth for enough saliva?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
E4	Has the health provider examined your eyes for any dark circles underneath the eyes?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
E5	Has the health provider used a thermometer to measure temperature by either placing it under the armpit or in the month?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
E6	Chest and Lung auscultation i. Has the health provider listened to the sounds in the chest by placing a stethoscope on the chest? *ii.* Has the health provider inspected the chest to look for the rate of breathing and effort of breathing (indications of dehydration)?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
E7	Abdominal palpation and spleen inspection Has the health provider examined the abdomen	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐

Section V Complementary Exams		
SN	Questions	Researcher Ticks appropriately
T1	Have you been tested for malaria?	1. Yes *(go to T4)* ☐ 2. No *(go to T6)* ☐ 3. Do not Recall (go to T6) ☐
T2	Has the health provider done a blood slide (microscope) test?	*1.* Yes (*go to T3)* ☐ 2. No (*go to T3)* ☐ 3. Do not Recall ☐
T3	Has the health provider done a Rapid Diagnostic Tests (RDT)?	1. Yes *(go to T4)* ☐ 2. No (*go to T6)* ☐ 3. Do not Recall ☐
T4	Has the health provider shared the results of malaria tests with you?	1. Yes *(go to T5)* ☐ 2. No *(go to T6)* ☐ 3. Do not Recall ☐
T5	What are the results of your malaria test?	1. Positive ☐ *(go to section VI)* 2. Negative go to ☐ *(go to T6)* 3. Do not Recall ☐
T6	Has the health provider suggested for complete blood count?	1. Yes *(go to T7)* ☐ 2. No (go to section VI) ☐ 3. Do not Recall ☐
T7	What are the results of the complete blood count?	1. Positive ☐ *(go to section VI)* 2. Negative ☐ *(go to section VI)* 3. Do not Recall ☐

Section VI Type of Medicine	
What type of antimalarial medicine did the provider prescribe?	
SN	Medicine
M1	
M2	
M3	
What type of antibiotic did the provider prescribe?	
B1	
B2	
B4	
What other medicines did the provider prescribe?	
P1	
P2	
P3	

Section VII Satisfaction			
S1	How satisfied are you with the service you have received during this particular visit?	1. Very dissatisfied ☐ 2. Some how dissatisfied ☐ 3. Neutral ☐ 4. Some how satisfied ☐ 5. Very satisfied ☐	
S2	Would you come back to this facility?	1. Yes ☐ 2. No ☐ 3. Do not know ☐	
S2	Would you recomend this facility to your friends and family?	1. Yes ☐ 2. No ☐ 3. Do not know ☐	
Section IX Finalisation			
End time. ☐☐☐☐		Enumerator name	Signature

Exit Interview Questionnaire (Drug Shop)

DRUG SHOP EXIT INTERVIEW GUIDE IGANGA 2018

Section I: Basic information

Enumerator completes this section for <u>each interview</u>. To save time this can be filled out before starting the interview with patients.

Case ID			

A1. Today's date(dd/mm/yyyy)

[___|___]-[___|___]-[_2_|_0_|_1_|_8]

A2. Enumerator's name

[_____]

A3. Name of Facility

[_____]

A4. Sub county of Facility

[_____]

A5. Parish of Facility

[_____]

A6 Residence status of facility

Interviewer should tick appropriately

3. Urban ☐
4. Rural ☐

A7. Type of Facility

1. Licensed Drug shop ☐
2. Unlicensed Drug Shop ☐

START TIME		

Section II Patient History Section		
SN	**Questions**	**Researcher Ticks appropriately**
DH1	Why did you choose this facility? **Please tick all that apply**	1. Closest form my home (travelling distance) 2. Most convenient (shortest waiting time) 3. Friendly staff 4. I trust them 5. They have medicine in stock (no stock outs) 6. Most affordable 7. Other
DH2	Have you visited any health facility before coming to this drug shop?	*1.* Yes ***(go to DH3)*** ☐ 2. No ***(go to DH6)*** ☐
DH3	Have you been tested for malaria?	***1.*** Yes (***go to DH4)*** ☐ 2. No ***(go to DH6)*** ☐ 3. Do not Recall ☐
DH4	What are the results of your malaria test?	1. Positive ***(go to DH5)*** ☐ 2. Negative ***(go to DH5)*** ☐ 3. Do not Recall ☐
DH5	Has the healthcare provider (Drug shop attendant) asked for these malaria results before dispensing drugs?	1. Yes ***(go to M1)*** ☐ 2. No ***(go to DH6)*** ☐ 3. Do not Recall ☐
DH6	Has the healthcare provider asked you if you have taken any antimalarial medication for this illness episode?	1. Yes ☐ 2. No ☐ 3. Do not Recall ☐
DH7	What malaria symptoms has the healthcare provider asked you? ***The interviewer should NOT read these options out, but circle if provider mentions the step and make a cross if provider did not mention the step.*** 1. Headache ☐ 2. Loss of appetite ☐ 3. Chills or rigors ☐ 4. Nausea or vomiting ☐ 5. Joint weakness or pains ☐ 6. General malaise ☐ 7. Enlarged spleen and liver especially in children ☐ 8. Others (specify)	

Section III Type of Medicine	
What type of antimalarial medicine did the provider prescribe?	
SN	Medicine
M1	
M2	
M3	
What type of antibiotic did the provider prescribe?	
B1	
B2	
B4	

Section IV Satisfaction		
DS1	How satisfied were you with the service you received during this particular visit?	6. Very dissatisfied ☐ 7. Some how dissatisfied ☐ 8. Neutral ☐ 9. Somehow satisfied ☐ 10. Very satisfied ☐
DS2	Would you come back to this facility?	4. Yes ☐ 5. No ☐ 6. Do not know ☐
DS3	Would you recommend this facility to your friends and family?	4. Yes ☐ 5. No ☐ 6. Do not know ☐

Section V Finalisation		
End time. ☐☐☐☐	Enumerator name	Signature