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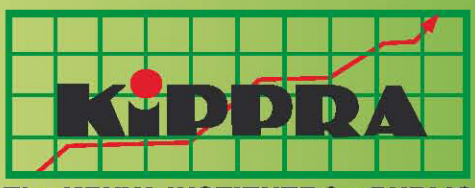

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Predictors of Availability of Maternal Health Medicines in Kenya's Health Facilities

Grace Njeri Muriithi

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YOUNG PROFESSIONALS (YPs) TRAINING
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Predictors of Availability of Maternal Health Medicines in Kenya's Health Facilities

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Social Sector Division
Kenya Institute for Public Policy
Research and Analysis

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Abstract

This study examines the state of and factors that influence the availability of two maternal health medicines–oxytocin and misoprostol–in Kenya's health facilities that offer basic emergency obstetric care (BEmOC). These medicines are used to prevent and treat post-partum haemorrhage, which (at 25%) is the leading cause of maternal mortality in Kenya.

The study made use of the Kenya Public Expenditure Tracking and Service Delivery Indicators Survey (PETS+) data collected by KIPPRA in 2012 for the Ministry of Health. Using a survey logit model, the study found that the availability of oxytocin and misoprostol in BEmOC facilities is significantly determined by: the location of the facility, the type of health facility, the owner of facility (government or private not-for-profit organizations), availability of maternity waiting room in facilities, the type of procurement system used, the number of deliveries, delivery charges, amount of funds received by facilities for medical drugs, prompt procurement of out-of-stock medicines, and the number of health workers involved in the management of essential medicines and medical supplies.

Based on the findings, this study recommends: development of a scale-up strategy for misoprostol in BEmOC facilities; enhancing the distribution of maternal health medicines to all BEmOC facilities so that they meet the WHO standards of a BEmOC facility; establishment of maternity waiting rooms in or near BEmOC facilities; increasing the budgetary allocations to essential medicines; encouraging the utilization of maternal health medicines through awareness creation programmes; strengthening the procurement function of health facilities; and intensifying the training of health workers on administration of maternal health medicines.

Abbreviations and Acronyms

AMTSL	Active Management of the Third Stage of Labour
BEmOC	Basic Emergency Obstetric Care
EML	Essential Medicines List
EMMS	Essential Medicines and Medical Supplies
H(F)MC	Hospital (Health Facility) Management Committee
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immuno-Deficiency Syndrome
KEMSA	Kenya Medical Supplies Agency
KHSSP	Kenya Health Sector Strategic and Investment Plan
KIPPRA	Kenya Institute for Public Policy Research and Analysis
MDGs	Millennium Development Goals
MEDS	Mission for Essential Drugs and Supplies
MLE	Maximum Likelihood Estimation
MMR	Maternal Mortality Ratio
MOH	Ministry of Health
MTP	Medium Term Plan
NEML	National Essential Medicines List
PETS+	Public Expenditure Tracking Survey
PHFs	Public Health Facilities
PPH	Post Partum Haemorrhage
RDF	Revolving Drug Fund
RHFs	Rural Health Facilities
SDI	Service Delivery Indicators
SSA	Sub-Saharan Africa
STI	Sexually Transmitted Infections
TB	Tuberculosis
THE	Total Health Expenditures
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

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1. Introduction

1.1. Background

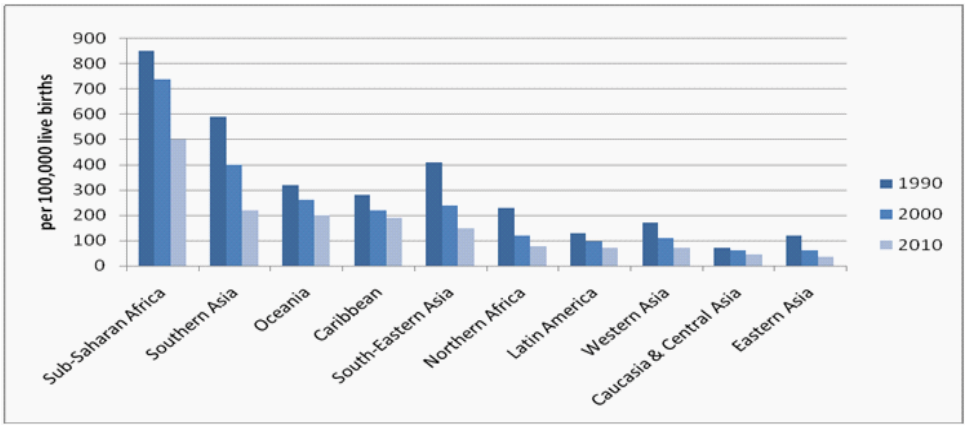
Improving maternal health is a priority in the global health agenda. This is explicit in the Millennium Development Goals (MDGs), whose base and target years are 1990 and 2015, respectively. Specifically, Goal 5 of the MDGs seeks to improve maternal health, with one of its targets being to reduce maternal mortality ratio (MMR) by 75 per cent (United Nations, 2013). Whereas there are many ways of improving maternal health, the issue of essential medicines has largely been under-investigated in Sub-Saharan Africa (Madsen, Bergeson-Lockwood and Bernstein, 2010). WHO defines essential medicines as "those drugs that satisfy the healthcare needs of the majority of the population and therefore should be available at all times in adequate amounts and dosage at an affordable price." Target E of MDG 8 calls for developing countries to provide access to affordable essential drugs, in cooperation with pharmaceutical companies (United Nations, 2013). Essential medicines are critical in saving the lives of those affected, hence their availability is a critical component of any healthcare system that is set to reduce the mortality and morbidity caused by various illnesses (Madsen, Bergeson-Lockwood and Bernstein, 2010).

In 1977, WHO came up with the first list of essential medicines, known as the WHO Model Essential Medicines List (EML), which has since undergone numerous revisions. The WHO member countries are mandated to use the EML model to create their own national lists. Included in the EML is a subset of medicines (essential for mothers) that are critical for saving mothers who are either pregnant, giving birth, or in their first six weeks after delivery. Specifically, the medicines (Appendix 1) are used to treat and manage the major causes of maternal mortality, namely: postpartum haemorrhage (PPH), severe pre-eclampsia and eclampsia, maternal sepsis, sexually transmitted infections, pre-term birth, maternal HIV/AIDS, and malaria (Hill, Yang and Bero, 2012).

Maternal mortality in developing countries

The 2013 MDGs progress report (United Nations, 2013) shows that all the developing regions have made significant achievements in reducing their MMR (Figure 1.1). Such achievements, however, vary from one region to another and from one country to another within the same regions.

Figure 1.1: Maternal mortality ratio by region, 1990-2010



Source: United Nations (2013)

Figure 1.1 shows the trend of MMR in developing regions. There is a steady decline in MMR in all the regions between 1990 and 2010. Nevertheless, the rate of decline differs from one region to another, with Asian regions of Eastern, Southern, South-Eastern, Western and Caucasia and Central Asia as well as Northern Africa recording the most substantial declines (greater than 50%) in their MMR. Latin America, SSA, Caribbean and Oceanic regions had a slower reduction pace in their MMR between 1990 and 2010. Whereas Eastern Asian and Southern Asian countries reduced their MMR by an average of 67 per cent and 62.7 per cent, respectively, between 1990 and 2010, SSA reduced its MMR by an average of 41 per cent, which is below the average of what other regions achieved.

The success of individual countries in reducing their MMR largely points to efforts by their governments and other partners, such as international non-governmental organizations, to increase accessibility of pregnant mothers to essential health services, including emergency obstetric care. A World Bank report stated that up to 74 per cent of maternal deaths could be prevented if all women had access to the interventions for managing complications that occur during pregnancy and childbirth (Wagstaff and Claeson, 2004). Among the notable success stories include: Afghanistan, which reduced its MMR from 1,600 in 2003 to 327 by the year 2010; Honduras, which reduced its MMR by 40 per cent between 1990 and early 2000; Nepal, which has reduced its MMR by 50 per cent since 2002; Sri Lanka, whose MMR has reduced by 87 per cent in a span of 40 years; and Bangladesh, in which women had 53 per cent less probability of dying from pregnancy and childbirth-related complications in 2010 than they were in 1990. In all these countries, emergency obstetric care services, which include the use of essential medicines, have taken a centre stage in their maternal health efforts and programmes (Women Deliver, nd).

Table 1.1: Trends in maternal mortality ratio in Kenya, 1998-2008

Year	Maternal mortality ratio	2015 MDG Target
1998	590 per 100,000 live births	
2003	414 per 100,000 live births	147 per 100, 000 live births
2008	488 per 100, 000 live births	

Source: KNBS and ICF Macro (2009)

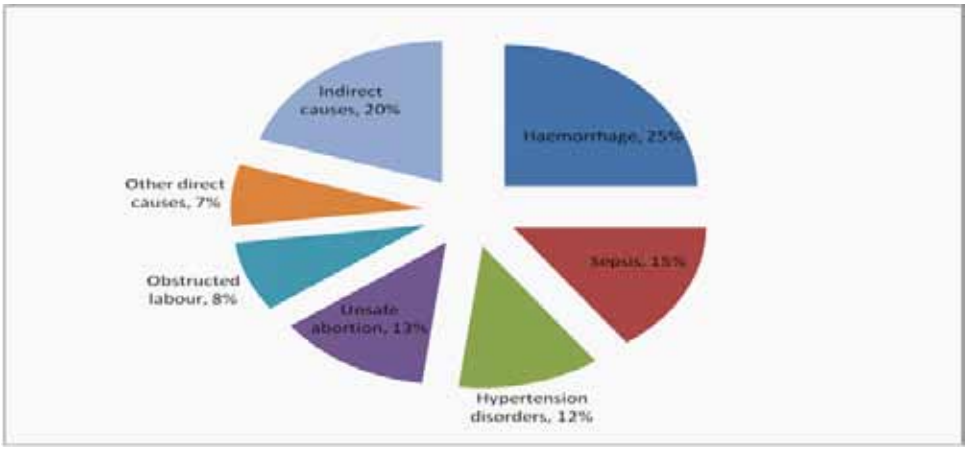
Maternal mortality in Kenya

Government efforts towards reducing maternal mortality ratio in Kenya are evident in various policy documents such as the Kenya National Drug Policy 1994; the Kenya Health Policy Framework 1994-2010; the Kenya National Reproductive Health Strategy 2009-2015; the Kenya National Roadmap for Maternal and Newborn Health (2010); Kenya Vision 2030; the Kenya Health Policy 2012-2030; and the Kenya Health Sector Strategic and Investment Plan (KHSSP) 2013-2017 (Ministry of Health, 2013). These policy documents highlight the persistently high MMR (Table 1.1) and point to the efforts made by the government to address it, for instance by increasing the uptake of family planning services, increasing the uptake of antenatal care, prevention of malaria in pregnant mothers, and provision of care to HIV+ pregnant mothers.

Unlike many developing countries that have managed to reduce MMR by as much as 50 per cent since 1990, Kenya's progress towards meeting the fifth MDG has been slow. The current MMR (488 per 100,000 live births) is high compared to the MDG and the Ministry of Health's (MOH) second Medium Term Plan (MTP) targets of 147 (in 2015) and 100 (in 2017) per 100,000 live births, respectively. Table 1.1 shows that although Kenya was on the right track to reducing its MMR between the 1990s and early 2000s, there has been a reversal of this trend, as indicated by the rise in MMR between 2003 and 2008 (KNBS and ICF Macro, 2009).

The high MMR is worrying, given that majority of the causes of these deaths are preventable with adequate care during pregnancy and birth, as well as after delivery (Wilson *et al.*, 2012). The National Coordinating Agency for Population and Development - NCAPD (2010) report on maternal deaths in Kenya showed that 80 per cent of maternal mortality in Kenya is caused by direct factors such as postpartum haemorrhage (excessive bleeding), sepsis (bacterial infection), hypertensive disorders, unsafe abortion and obstructed labour, while only 20 per cent is caused by indirect factors (Figure 1.2) such as malaria, hepatitis, cardiovascular diseases, psychiatric illnesses, tuberculosis, epilepsy and diabetes (NCAPD, 2010).

Figure 1.2: Causes of maternal mortality in Kenya, 2010



Source: National Coordinating Agency for Population & Development (2010)

Figure 1.2 shows that the leading direct cause of maternal deaths in Kenya is haemorrhage, which contributes up to 25 per cent of maternal mortality in the country. This is followed by sepsis, whose contribution to maternal deaths is 15 per cent. However, these conditions can easily be managed and treated using medicine. Therefore, the persistently high MMR in Kenya begs the question as to whether maternal health medicines are readily available in health facilities.

State of availability of maternal health medicines in Kenya's health facilities

The Kenya Service Provision Assessment Survey of 2010 (KNBS and ICF Macro, 2011) revealed that only 51 per cent of the health facilities that offered delivery services had the essential medicines and supplies for managing common complications that occur during delivery. Worse still, only 40 per cent of government facilities, non-governmental facilities (51%), and private for-profit and faith-based facilities (68%) had these essential medicines and supplies (KNBS and ICF Macro, 2011). Inadequate medicines in facilities has been cited as one of the reasons many pregnant mothers in Kenya do not visit health facilities for delivery (KNBS and ICF Macro, 2011).

Maternal health medicines follow a similar distribution pattern as other essential medicines and medical supplies. Although these medicines are largely distributed to public facilities by the government through Kenya Medical Supplies Agency (KEMSA), development partners also play a key role. For instance, the Ventures Strategies Innovations (VSI) has been actively involved in the distribution of misoprostol. Procurement of the medicines for private not-for-profit facilities

is done by Mission for Essential Drugs and Supplies (MEDS), Prompt, and the Procurement and Supply Chain Management Consortium (Muga, 2008). KEMSA uses a combination of two supply systems, "Push" and "Pull", but the Ministry of Health started replacing the push system with the pull system in all public facilities beginning 2010.[1] The cycle of distribution by KEMSA depends on the level of facility: for level 2 (dispensaries) and level 3 (health centres), the cycle is on a quarterly basis whereas for higher-level facilities, it is on a bi-monthly basis. The national referral hospitals receive their medical supplies on a need basis (Muga, 2008; USAID, 2008).

Inadequacy of maternal health medicines in facilities is linked to a number of factors, including budgetary allocations to the health sector, which affects the allocations to the pharmaceuticals in general, and specifically, to the essential medicines and medical supplies (EMMS). Table 1.2 shows that the proportion of the national budget allocated to the health sector has been steadily declining in the last decade from 8.0 per cent in 2001/02 to 3.0 per cent in 2013/14, despite Kenya being a signatory to the Abuja Declaration, which requires countries to allocate at least 15 per cent of national budget to health. During the same period, allocations to the pharmaceuticals declined from 7.4 per cent in 2001/02 to 2.8 per cent in 2009/10. This has in turn negatively affected the government's investment in EMMS. Whereas the WHO recommends that approximately US$ 1.5-2 per capita

Table 1.2: Total health expenditures indicators: 2001-2010

Indicators	2001/02	2005/06	2009/10	2013/14
Total Health Expenditure (THE) (Ksh)	82,232,016,764	101,977,620,711	122,853,559,803	n.a
THE per capita (Ksh)	2,636	2 861	3 203	n.a
Government health expenditure as a % of total government expenditure	8.0	5.2	4.6	3*
Function distribution as a % of THE	n.a			
Inpatient care	32.1	29.8	21.9	n.a
Outpatient care	45.2	39.6	39.1	n.a
Pharmaceuticals	7.4	2.6	2.8	n.a
Prevention and public health programmes	9.1	11.8	22.8	n.a
Health administration	5.0	14.5	9.0	n.a
Capital formation			3.6	n.a
Others	1.3	1.7	0.8	n.a

*Source: Government of Kenya (2011); *2013/2014 National Budget*

[1]The pull system was found to be more efficient in that it reduced the rate of expiry and wastage of drugs because facilities only demand for the drugs they need.

is required to provide EMMS in a basic health package, the Ministry invested only US$ 1.1 per capita in these commodities by 2013 (Ministry of Health, 2013).

1.2 Research Problem

The Government of Kenya has in the past developed various policies to reduce the country's MMR to a level that is no longer a public health problem. The goals of these policies are clear, but achieving them is elusive because they have overlooked the role played by maternal health medicines in averting maternal mortality by preventing and treating its major causes (Kade and Moore, 2012; Mobeen *et al.*, 2010; Nasreen *et al.*, 2011; Sanghvi *et al.*, 2010; Prata *et al.*, 2009). As a result, these medicines remain largely unavailable in Kenya's BEmOC facilities.Without adequate supply of maternal health medicines in health facilities, the recently launched "free delivery" policy and the "Beyond Zero" Campaign may not achieve the intended objectives. Whereas unavailability of maternal health medicines in Kenya is known, little research has been done to examine the factors that influence their availability in health facilities. This study will investigate the facility-specific essential medicines' management and human resource factors that influence availability of maternal health medicines in Kenya's health facilities.

Box 1: Oxytocin and misoprostol

Oxytocin and misoprostol belong to a group of medicine called *uterotonic* medicines, which increases the frequency and strength of the contractions of the uterine muscles thereby causing the blood vessels to compress so as to reduce the incidence and severity of post-partum haemorrhage.

Globally, oxytocin is the first-line choice of medicines for preventing and treating postpartum haemorrhage (PPH). Nevertheless, it has a number of disadvantages which make misoprostol a better alternative, particularly in resource-poor settings. Oxytocin comes in the form of an injection, requires cold storage, as well as health workers with skills and equipment for administering intravenous therapy.

Misoprostol, on the other hand, comes in the form of a tablet, does not require cold storage, and is easy to administer. Due to its advantages, misoprostol can be used even in home-based deliveries and can easily be distributed by community health workers directly to pregnant women, unlike oxytocin. The main downside to misoprostol is that it can also be used to induce abortion, which is illegal in many developing countries.

In Kenya, both oxytocin and misoprostol are imported and are distributed like other essential medicines to public facilities through KEMSA. However, some development agencies such as Ventures Strategies Innovations (VSI) are involved in the distribution of these medicines, particularly misoprostol. The use of these medicines is however restricted and regulated by the MOH and as such, are not sold over-the-counter but require a prescription from a clinician.

Source: Cody and Goltz (2012)

The scope of this study is limited to two maternal health medicines that are used for preventing or treating postpartum haemorrhage, which is the leading cause of maternal deaths in Kenya. These medicines, oxytocin and misoprostol (Box 1), are part of the 13 life-saving commodities for which the UN Commission on Life-Saving Commodities for Women and Children recommends rapid increase in access and usage (United Nations, 2012).

1.3 Research Questions

(i) Which facility-specific factors influence the availability of oxytocin and misoprostol in Kenya's BEmOC facilities?

(ii) How is the availability of oxytocin and misoprostol influenced by management of essential medicines in Kenya's BEmOC facilities?

(iii) Do human resource factors affect the availability of oxytocin and misoprostol in Kenya's BEmOC facilities?

1.4 Research Objectives

The general objective of the study is to assess the factors that influence availability of two maternal health medicines– oxytocin and misoprostol – in Kenya's health facilities. The specific objectives are to:

(i) Analyze the effect of facility-specific factors and availability of oxytocin and misoprostol in Kenya's BEmOC facilities;

(ii) Analyze how the availability of oxytocin and misoprostol in Kenya's BEmOC facilities is influenced by management of essential medicines in facilities; and

(iii) Examine the effect of human resource factors on the availability of oxytocin and misoprostol in Kenya's BEmOC facilities.

1.5 Justification and Policy Relevance

Every Kenyan has a right to the highest attainable standard of health, including reproductive health. The Ministry of Health targets to reduce Kenya's MMR to 100 per 100,000 live births by year 2017, equivalent to 75 per cent reduction. This is in line with the MDG target for maternal health. As the government launches more policies and programmes to meet the country's MMR target, there is need to generate as much information as possible to inform future policies and prescribe clear and specific evidence-based strategies.

2. Literature Review

2.1 Theoretical Literature

The theoretical framework for the study is adapted from the utility-maximizing model of not-for-profit and public hospital behaviour (Feldstein, 2012; Henderson, 2012). According to this model, decision makers (administrators) of these health facilities have the objective of maximizing their own utility, which may be monetary or non-monetary benefits such as prestige and reputation. The administrators will therefore run the facilities in a manner that will maximize these benefits, including uptake of new technologies and health products and provision of a wide range of services.

The earliest proponent of the utility-maximizing model (Newhouse in 1970) asserted that the main elements of the utility for not-for-profit health facilities are the output and quality of care provided, or a combination of the two. As such, administrators will strive to be in charge of either the largest facility or the facility that offers services of the highest quality, given the available resources. Quality is measured by the level of technology, the type of facility and services, the quality of staff, and the number of specialists (Feldstein, 2012). Therefore, the reputation of a health facility is gauged by the range of services and facilities it has.

2.2 Empirical Literature

Availability of essential medicines has been studied empirically in various countries, and these studies highlight various factors that affect the availability of these medicines, besides those mentioned in the previous section. These factors can be categorized into four broad themes: a) Inclusion of the essential medicines in the National Essential Medicines List (NEML); b) policy-related factors touching on production, procurement and distribution of the medicines; c) factors related to human resources for health; and d) factors related to health facilities and their management of essential medicines.

Inclusion of essential medicines in the National Essential Medicines List (NEML)

Each member country of the WHO is required to develop its own NEML, guided by the WHO EML. A medicine that is included in the NEML has a higher probability of availability in public health facilities compared to those that are excluded from the list. In Bangladesh, Bergeson-Lockwood *et al.* (2010) found that it was only after the inclusion of misoprostol in the country's EML in 2008 that the

government began procuring and distributing the medicine for PPH use in public health facilities. Nevertheless, having an essential medicine included in the NEML does not necessarily mean that physicians will prescribe them, and this may limit their availability (Twagirumukiza *et al.*, 2010). In China, Chen *et al.* (2010) discovered that the country's NEML is given little attention by the manufacturers, and retail and hospital pharmacies. Chen *et al.* found that "manufacturers produced only 62 per cent and 50 per cent of essential medicines in Shandong and Gansu, respectively. They also found that between 64 per cent and 86 per cent of prescriptions contained an essential medicine. Outdated NEMLs can also hinder availability and standardization of the medicines as was discovered by Twagirumukiza *et al.* (2010).

Policy-related factors

Government policies on production, procurement and distribution of medicines can either enhance or hinder availability of essential medicines in public health facilities. Such policies include promotion of generic versus branded medicines. The generic medicines are cheaper than the branded ones, and therefore if the government encourages their production, for instance through tax exemptions, it would increase their affordability, and consequently their availability in public health facilities as was established by Mendis *et al.* (2007) in their study of Bangladesh, Brazil, Malawi, Nepal, Pakistan and Sri Lanka.

The mode of procurement and distribution of the medicines plays a critical role in ensuring availability of essential medicines. If the Ministry of Health fails to procure the essential medicines, their availability (through mandatory distribution) and affordability (achieved through bulk procurement) in public health facilities will be low (Hamidi *et al.*, 2008). Privatization of distribution of medicine has been tried and tested in a number of countries, including Malaysia and South Africa. Such a policy has been found to have mixed results on medicine availability. On one hand, it increases the availability of the medicines in the public health facilities. For instance, in South Africa, one public-private partnership led to a 93 per cent availability level while another partnership achieved a 77 per cent availability level (Summers *et al.*, 1998). On the other hand, privatization considerably increases the prices paid by consumers. In the Malaysian study, there was a hike of 74 per cent of medicine prices following privatization of distribution (Babar *et al.*, 2007).

Madsen *et al.* (2010), in their study of four essential commodities for mothers (oxytocin, misoprostol, magnesium sulphate, and manual vacuum aspirators) in Uganda, found that all these medicines are not locally manufactured, hence

the government must procure them from abroad. This same study found low availability of these four medicines in Uganda's health facilities. Policies to encourage local manufacturers of essential medicines would increase their supply, and consequently their availability in facilities. This is also supported by Mendis *et al.* (2007), who found that locally manufactured medicines were more available than the imported medicines.

Health facilities and management of essential medicines-related factors

Much of the evidence on availability of essential medicines points to wide disparities with the characteristics of the health facilities (Kotwani, 2013; Zaidi *et al.*, 2013; Robertson *et al.*, 2009; Carasso *et al.*, 2009; Mendis *et al.*, 2007; Kotwani, 2013; Bergeson-Lockwood *et al.*, 2010). The type of health facility, that is whether a health centre, dispensary, clinic or hospital, has been found to greatly affect availability of these medicines (Kotwani, 2013). In a study of 14 countries of Central Africa, Robertson *et al.* (2009) found that there was higher availability of essential medicines in the stores of NGOs and district hospitals compared to teaching hospitals. Retail pharmacies were also found to have higher medicine availability, whereas primary healthcare clinics had the poorest rate of availability. Similarly, in the Pakistan study by Zaidi *et al.* (2013), frequent stock-outs of essential medicines were witnessed in primary, secondary and district hospitals, but the level of the stock-outs varied.

Besides the type of facility, ownership of the facility also has an important correlation with availability of essential medicines. Some of the studies reviewed (Carasso *et al.*, 2009; Mendis *et al.*, 2007; Kotwani, 2013) showed wide disparities in medicine availability between public and private facilities, with the private sector facilities faring much better than public facilities. In Ethiopia, for instance, all the medicines that were not available in public facilities were available in drug vendors (Carasso *et al.*, 2009). Similarly, in Mendis *et al.*'s (2007) study, availability of the essential medicines was substantially higher in the private sector than in the public facilities in all the six countries of study, namely: Bangladesh, Brazil, Malawi, Nepal, Pakistan and Sri Lanka. Bergeson-Lockwood *et al.*'s (2010) study of Bangladesh also found poor availability of essential medicines for mothers in public facilities, but constant supply of the same in faith-based facilities; "only 55 per cent of District Hospitals and 38 per cent of Upazila Health Centres reported having oxytocin."

The amount of user fees charged by health facilities also has an effect on availability of essential medicines. User fees increase the availability of medicines

as the revenue is used by the health facilities to purchase the medicines, particularly in cases where the allocations to EMMS by the ministry are insufficient to meet the facility's needs (Nunan and Duke, 2011).

The availability of maternity waiting rooms in or near health facilities has positive outcomes for maternal health. A study by Kelly *et al.* (2010) found that women who delivered after being admitted in a maternity waiting room had 14.8 times lower MMR compared to those who delivered after being taken to a health facility directly, with the difference resulting from better obstetric management of the women who use the waiting facility.

Other critical factors for increasing availability of essential medicines focus on how essential medicines are managed in facilities, for instance, supervision of health facilities by pharmacy staff. Nunan and Duke (2011) argue that such visits could help improve management of medicine stock, provide support to training on select drug-related issues such as prescription, implementation of national standards, and identification of needs in health facilities. In Zimbabwe, for instance, structured supervisory tours by pharmacist staff increased stock management skills by 14 per cent (Nunan and Duke, 2011).

Human resource factors

Availability of essential medicine is also influenced by human resource factors. The skill mix of healthcare professionals in a health facility will determine whether or not certain medicine will be procured. For instance, availability of pharmacists in health facilities increases the likelihood of procurement and prescription of essential medicines, which would enhance their availability. However, in many cases, such cadres of health workers are lacking in public facilities. Zaidi *et al.* (2013) found very low availability of pharmacists in Pakistan's health facilities, with only 0.06 pharmacists per 10,000 population. Moreover, majority of the pharmacists (70%) were employed in the pharmaceutical industry, with the remaining ones distributed across hospital and community pharmacies as well as academia. The Pakistani study also revealed frequent stock-outs of essential medicines in the country's health facilities, thereby supporting the importance of having pharmacists in facilities.

Training of health workers on essential medicine and accurate prescription plays a major role in their uptake and availability. Such training is also helpful in resource-poor settings in which use of health facilities is low. Nunan and Duke (2011) revealed that staff training was used as an intervention to increase the use of essential medicines in Nepal, and the results showed a significant decline of stock-outs for children's medicine by 22.9 per cent and for family planning medicines

by 4.1 per cent. The role of training in maternal health has also been emphasized in Madsen *et al.*'s (2010) study of Uganda, which found that misoprostol can be distributed by any cadre of health workers – doctors, nurses, nurse aides and Village Health Teams – provided they have been trained. Trainings on Active Management of the Third Stage of Labour (AMTSL) through the USAID-funded prevention of Postpartum Haemorrhage Initiative also increased health workers' knowledge on oxytocin (Madsen *et al.*, 2010). The same case applies to Bangladesh in which oxytocin and misoprostol can be administered even at community level by community-based skilled birth attendants as well as community health volunteers provided they are trained (Bergeson-Lockwood *et al.*, 2010).

2.3 Critic of the Literature

With the exception of two studies (Madsen *et al.*, 2010; and Bergeson-Lockwood *et al.*, 2010), which looked specifically at maternal health medicines, the other studies reviewed focused on essential medicine for various types of illnesses, and not necessarily for maternal health. Mendis *et al.* (2007), for instance, looked at medicines for chronic illnesses; Chen *et al.* (2010) and Carasso *et al.* (2009) focused on general essential medicines; and Robertson *et al.* (2009) focused on essential medicine for children. This brings to light the limited empirical studies on the factors that influence availability of maternal health medicine, specifically in Kenya, hence this study will narrow this literature gap.

The methodology used in the reviewed studies focused mainly on descriptive statistics to explain variation in availability of surveyed medicines. These statistics included percentages, mean, median and ratios. This study will differ from the reviewed studies by using empirical model, the logit model, to analyze the factors influencing the availability of maternal health medicines.

There was variation in the facilities surveyed by the studies. Chen *et al.* (2010) included primary, secondary and tertiary care hospitals drawn from both rural and urban areas. Carasso *et al.* (2009) included four rural primary health facilities and one semi-rural primary health facility. The main limitations of Carasso *et al.* (2009) are: it failed to include higher level facilities; it failed to survey urban-based facilities; and it only surveyed five facilities in one region (Amhara), hence the results of this study could not be generalized to Ethiopia. Mendis *et al.* (2007) surveyed public and private for profit facilities drawn from urban centres and administrative regions. Robertson *et al.* (2009) surveyed public and private facilities as well as central medical stores, NGO stores, one teaching hospital, one district hospital, three PHC clinics, and five private or retail pharmacies. Babar *et al.* (2009) also included public and private retail pharmacy sectors and

dispensing doctors' clinics. This study will only analyze public and private not for profit facilities of different levels (dispensaries, health centres and hospitals), due to data limitations.

There was also tendency to analyze the different types of drugs; that is, innovator drugs versus generics (Mendis *et al.*, 2007; Babar *et al.*, 2007; Kotwani, 2013). This analysis provided additional knowledge on variations of availability and affordability of medicine. In terms of availability and affordability, generics was higher than branded ones. This study does not analyze different types of drugs due to limitations of data.

In summary, this study focuses on the factors that are directly related to the facilities due to the nature of the data used. There is paucity of information to show that the issue of maternal health medicines and the factors that influence their availability has been analyzed empirically in Kenya. This study attempts to fill this gap by analyzing the facility-specific management of essential medicines, and human resource factors that influence the availability of maternal health medicine in Kenya's health facilities.

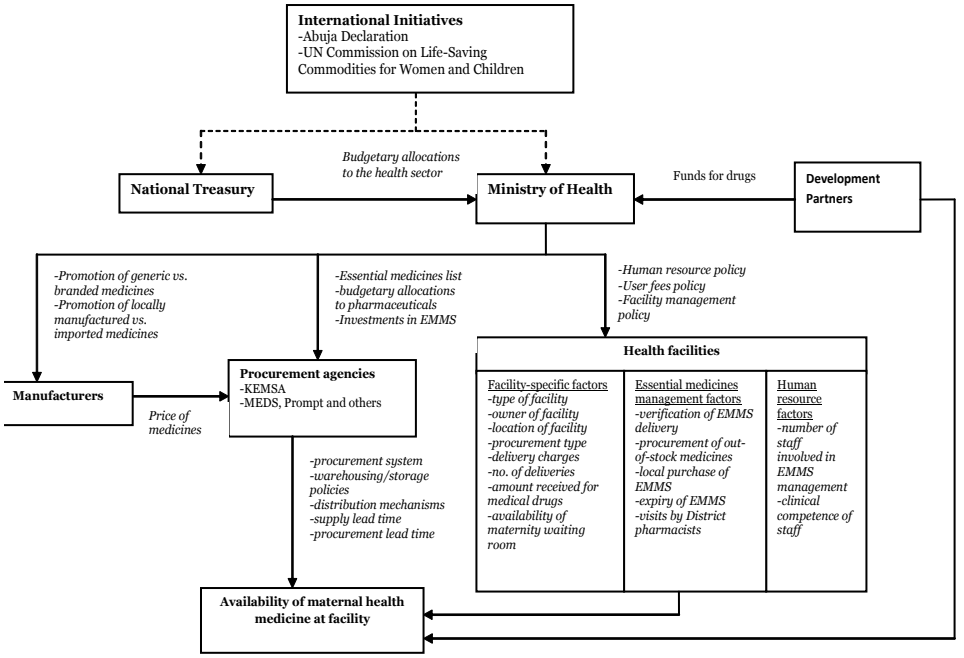
3. Methodology

3.1 Institutional and Conceptual Framework

The existing literature and the background information on essential medicines indicate that availability of medicine is determined by many factors and institutions (Figure 3.1). The figure shows that initiatives at the international level have an impact on the health status at the national level, although such an impact could be weak. The budget allocated by the National Treasury to the Ministry of Health (MoH) in Kenya impacts indirectly on availability of maternal health medicine through the proportion allocated by the Ministry to pharmaceuticals in general, and essential medicines and medical supplies in particular. Other policies by the Ministry, such as hiring, deployment, and training of health workers will impact indirectly on availability of medicine. Besides the National Treasury and the Ministry of Health, development partners could also impact on availability of essential medicines by allocating funds to the Ministry and/or distributing the medicine directly to the health facilities.

Other stakeholders involved include manufacturers, either local or foreign, and procurement agencies in the country. In Kenya, there are different procurement agencies depending on the ownership of the facility: KEMSA for public facilities, and MEDS and Prompt for the private not-for-profit facilities. The procurement agencies may have different effects on availability of the medicines, depending on the efficiency (or lack thereof) of their procurement systems. Lastly, at the facility level, the characteristics of the facilities, their management of essential medicines, and their human resource factors determine whether or not the medicines will be available at the facility. This study empirically analyzed the last group of factors. Whereas majority of the variables for the analysis have been discussed in the literature review, the study introduced some variables that have not been discussed in previous studies, which the author felt might explain availability of the medicine in the Kenyan context.

Figure 3.1: Institutional and conceptual framework for availability of maternal health medicines in Kenya's health facilities



Source: Author's conceptualization

3.2 Analytical Framework

The application of the utility-maximizing theory discussed in section 2.1 on availability of maternal health medicines in public and not-for-profit health facilities is illustrated in this section. We assume that the administrators of a health facility want to maximize their utility, U_i, which in this case results from the availability of maternal health medicine in their facilities. However, this utility is a function of available resources, including a vector of human, institutional and managerial resources, as shown in equation 1:

$$U_i=f(F_i,M_i,HRH_i,\theta_i) \quad \text{.....(1)}$$

where:

U_i represents the availability of oxytocin and misoprostol in health facility;

F_i is a vector of facility-specific factors;

M_i is a vector of factors relating to the management of essential medicines in facilities;

HRH_i is a vector of human resources for health in a facility and includes both the number and competence of the health workers; and

θ_i is a vector of other unknown factors that affect the utility of administrators.

The utility in equation 1 is subject to a number of constraints over which the administrators of the facility have no control. These constraints include: budgetary allocations to the health sector by the National Treasury (BA), budgetary allocations by the Ministry of Health to essential medicines and medical supplies (EMA), human resource policy (HRP), user fees policy (UFP), manufacturing policy (MFP), and policies touching on procurement agencies (PRCP).

Therefore, we maximize the utility in equation 1 subject to the constraints:

max:

$$U_i=f(F_i,M_i,HRH_i,\theta_i) \quad (2)$$

subject to:

$$C=f(BA,EMA,HRP,UFP,MFP,PRCP) \quad (3)$$

where *C* represents the constraint function.

We assume that the facility administrators have no control over the constraints, therefore the constraints are equated to zero, leaving the availability of maternal health medicines to be determined by the vector of facility-specific, management and human resource factors.

F_i includes the location of the facility (LOC), type of health facility (THF), ownership of health facility (OHF), availability of maternity waiting room (MWR), type of procurement system (PRS), number of deliveries (NDLV) in the previous 3 months, charges for normal (vaginal) delivery (DLC), and amount of money received for medical drugs (TMD).

M_i includes verification of EMMS delivery by health facility management committee (VEMMS), procurement of out-of-stock essential medicines (POOSM) in the previous quarter, local purchase of EMMS (LPEMMS), expiry of essential medicines (EXEMMS) during previous quarter, and supervisory visits by district pharmacists (DVISITS).

HRH_i includes the number of staff involved in the management of EMMS (SEMMS) and the clinical competence of clinicians (CCSTAFF) measured by their ability to accurately diagnoze and treat postpartum haemorrhage.

Solving equation 2 based on the constant constraints gives the equation:

$$Y_i= \beta_o+\beta_1 F_i+\beta_2 M_i+\beta_3 HRH_i+\varepsilon_i \quad (4)$$

replacing equation 4 with the actual variables gives the final model for the study (equation 5). Two models were run, one for oxytocin, the other for misoprostol.

$$Y_i=\beta_0+\beta_1 THF_i+\beta_2 OHF_i+\beta_3 LOC_i+\beta_4 PRS_i+\beta_5 TMD_i+\beta_6 NDLV_i+\beta_7 DLC_i+\beta_8 MWR_i+\beta_9 VEMMS_i+\beta_{10} POOSM_i+\beta_{11} LPEMMS_i+\beta_{12} EXEMMS_i+\beta_{13} DVISITS_i+\beta 14 SEMMS_i+\beta_{15} CCSTAFF_i+\varepsilon_i \quad (5)$$

where ε_i is the error term.

The variables used in the model are presented in Table 3.2, along with their measurement and a priori expectation.

Table 3.2: Measurement of variables

Variable	Description of variable	Measurement of variable	A priori expectation
Outcome variable			
AEM	Availability of oxytocin and misoprostol in facility	Dummy variable (1 if oxytocin/misoprostol is available, 0 otherwise)	_
Explanatory variables			
LOC	Location of facility	Categorical variable (rural or urban)	AEM odds expected to be higher in urban than rural facilities
OHF	Ownership of health facility	Categorical variable (government or private not-for-profit)	AEM odds expected to be higher in FBO and NGO facilities and lower in public facilities
THF	Type of health facility	Categorical variable (dispensary, health centre or hospital)	AEM odds expected to be highest in hospitals and lowest in dispensaries
MWR	Availability of maternity waiting room	Dummy variable (1 if available, 0 otherwise)	Indeterminate
PRS	Type of procurement system	Categorical variable (pull or push system)	Indeterminate
NDLV	Number of deliveries in the last 3 months	Continuous variable	Indeterminate
TMD	Total amount received from medical drugs	Continuous variable	Positive relationship: AEM odds expected to be higher with an increase in TMD
DLC	Charges for normal (vaginal) delivery	Continuous variable	Positive relationship: AEM odds expected to be higher with an increase in delivery charges

VEMMS	Verification of EMMS delivery by H(F)MC	Dummy variable (1 if EMMS delivery is verified, 0 otherwise)	Indeterminate
POOSM	Procurement of any out-of-stock essential medicines in last quarter	Dummy variable (1 if procured, 0 otherwise)	Indeterminate
LPEMMS	Local purchase of EMMS	Dummy variable (1 if EMMS purchased locally, 0 otherwise)	Indeterminate
EXEMMS	Expiry of EMMS during the last quarter	Dummy variable (1 if EMMS expired, 0 otherwise)	Indeterminate
DVISITS	Facility visited by district pharmacists last year	Dummy variable (1 if facility was visited once or more times, 0 otherwise)	AEM odds expected to be higher in facilities that were visited by District pharmacists
SEMMS	Number of staff involved in EMMS management	Continuous variable	Positive relationship: AEM odds expected to be higher with an increase in staff involved in EMMS management
CCSTAFF	Clinical competence of clinicians: Ability to diagnoze and treat PPH	Dummy variable (1 if staff is clinically competent, 0 otherwise)	Positive relationship: AEM odds expected to be higher in facilities with clinically competent staff

Estimation technique and model

Estimating equation 5 largely depends on the nature of the dependent variable, Y_i, which is availability of maternal health medicine. This variable is binary (takes a value of 1 if the medicine is available and non-expired in facility, and 0 if otherwise) and therefore requires the use of the binary dependent models, which include the linear probability model (LPM), logit, and probit models. The LPM is similar to the ordinary least squares regression applied to a binary dependent variable and, as such, it has a number of disadvantages that make it unsuitable: the error term in LPM is heteroscedastic, leading to biased estimates. Second, the fitted probabilities may lie outside the 0-1 range. The probit model, on the other hand, leads to results that are similar to the logit model, but the inverse linearizing transformation for the probit model does not have a direct interpretation whereas the logit model is interpreted as the log-odds (Gujarati, 2003). It is for these reasons that the logit model was preferred for this study.

The logit model assumes that the error term has a logistic distribution function of the form:

$$\Lambda(z) = \frac{1}{1+e^{-z}} \quad \text{.....(6)}$$

where Λ represents the cumulative distribution function (CDF) and *z* represents a vector of the regressors and their coefficients.

Replacing the *z* with the vector gives the probability function shown in equation 7:

$$p = \frac{1}{1+e^{-(x_i'\beta)}} \quad \text{.....(7)}$$

The probability that the dependent variable is 1 or 0 can be re-written as equations 8 and 9, respectively:

$$p = \Pr[y_i = 1 \mid x_i] = \wedge(x'\beta_i) = \frac{\exp(x_i'\beta)}{1+\exp(x_i'\beta)} \quad \text{.....(8)}$$

$$1-p = \Pr[y_i = 0 \mid x_i] = 1-\wedge(x'\beta_i) = 1-\frac{\exp(x_i'\beta)}{1+\exp(x_i'\beta)} = \frac{1}{1+\exp(x_i'\beta)} \quad \text{.....(9)}$$

$$\frac{p}{1-p} = \frac{\frac{\exp(x_i'\beta)}{1+\exp(x_i'\beta)}}{\frac{1}{1+\exp(x_i'\beta)}} = \exp(x_i'\beta) \quad \text{.....(10)}$$

The ratio of equations 8 and 9 gives the odds ratio; that is, the odds that y_i=1 and is given as:

$$In\left(\frac{p}{1-p}\right) = x_i'\beta \quad \text{.....(11)}$$

Taking the log of the odds ratio in equation 10 gives the logit or log-odds:

$$In\left(\frac{pr[AEM=1]}{\Pr[AEM=0]}\right)$$

Replacing equation 11 with equation 5 gives:

$=\beta_0+\beta_1 THF_i+\beta_2 OHF_i+\beta_3 LOC_i+\beta_4 PRS_i+\beta_5 TMD_i+\beta_6 NDLV_i+\beta_7 DLC_i+\beta_8 MWR_i+\beta_9 VEMMS_i+\beta_{10} POOSM_i+\beta_{11} LPEMMS_i+\beta_{12} EXEMMS_i+\beta_{13} DVISITS_i+\beta_{14} SEMMS_i+\beta_{15} CCSTAFF_i$ .....(12)

The logit is a linear function of the explanatory variables, *x*. A logit model is

estimated using the Maximum Likelihood Estimation (MLE) technique, which fundamentally maximizes the likelihood of an event occurring. From equation 12, the odds ratios were computed, which gave the effect of the explanatory variable on the odds that medicine is available in a facility. However, given that some of the facilities were over-sampled, the study used the survey logit model (which uses weights) in place of the standard logit model (Lee and Forthofer, 2006).

3.3 Data Type and Source

The study made use of cross sectional data obtained from the Public Expenditure Tracking and Service Delivery Indicators (PETS+) survey conducted by KIPPRA in 2012 for the Ministry of Health. The survey covered 294 public and private not-for-profit health facilities; 1,876 non-medical staff; and 629 clinicians in 15 counties selected using a multi-stage, cluster sampling strategy. This study used the facility and clinician datasets.

4. Results and Discussion

4.1. Diagnostic Tests

The goodness of fit of the survey logit model was measured by the F-statistics. The F-statistics for the oxytocin and misoprostol models were 4.60 (prob>F=0.0000) and 5.65 (prob>F=0.0000), respectively. They indicate that the main effects models were a significant improvement over the null models (Lee and Forthofer, 2006). The specification of the model was tested using the Adjusted Wald test, whose results were oxytocin model (F=20.05, p>F=0.0000) and misoprostol model (F=14.67, p>F=0.0001), implying that the models were correctly specified. A correlation analysis (Appendix 2) was also carried out, whose results indicate absence of severe multicollinearity problem. Multicollinearity occurs when two or more variables are highly correlated, indicated by a correlation statistic close to one.

4.2 Descriptive Statistics

Table 4.1 summarizes statistics for both the discrete and continuous variables used in the analysis. The original sample size of the clinicians and facilities was 629 and 294, respectively, but maternal health medicines are only required to be available in facilities that offer at least basic emergency obstetric care (BEmOC). Out of the 294 facilities, 234 provided BEmOC, of which 7 were nursing homes excluded from the sample, leaving the final facility sample at 227. The focus was on those facilities that offer BEmOC because they require to be equipped with the medicines used to manage PPH, in case it occurs during child birth. After merging the facility and clinician datasets, the final sample was reduced to 513.

Table 4.1 shows that approximately 73.44 per cent of public and private not-for-profit health facilities in Kenya have oxytocin, while only 5.21 per cent have misoprostol. Misoprostol is generally less available in Kenya's health facilities. This finding supports previous research conducted in Uganda (Madsen, Bergeson-Lockwood and Bernstein, 2010) and Bangladesh (Bergeson-Lockwood, Madsen and Bernstein, 2010), which also found oxytocin to be more available in health facilities than misoprostol. These studies found that health workers are reluctant to administer misoprostol because of its alternative use in abortion, hence the low availability. However, the government in these countries and development partners are providing training on appropriate use of misoprostol for PPH, which is helping to alleviate the negative perceptions about the medicine.

Table 4.1: Summary statistics

Discrete variables	Weighted percentage
Availability of oxytocin	
Available (and non-expired)	73.44
Otherwise	26.56
Availability of misoprostol	
Available (and non-expired)	5.21
Otherwise	94.79
Location of health facility	
Rural	82.02
Urban	17.98
Ownership of health facility	
Government (public)	80.26
Private not-for-profit (NGO/FBO)	19.74
Type of health facility	
Dispensary	56.02
Health centre	26.86
Hospitals	17.11
Availability of maternity waiting room	
Yes	50.36
No	49.64
Type of procurement system	
Push	16.40
Pull	83.60
Expiry of essential medicines in previous quarter	
Yes	33.02
No	66.98
Verification of EMMS delivery by H(F)MC	
Yes	64.64
No	35.36
Procurement of any out-of-stock essential medicine in last quarter	
Yes	79.46
No	20.54
Local purchase of EMMS	
Yes	70.17
No	29.83
Facility visited by District pharmacists during last year	
Once or more	95.96
Never	4.04
Clinical competence of clinicians	

Clinically competent	63.19
Clinically incompetent	36.81
Continuous variables	Weighted Mean
Number of deliveries in the last three months	84.31
Total amount received from various sources for medical drugs	332,182.6
Normal delivery charges	365.2
Number of staff involved in EMMS management	3.5

Source: Author's computation

Table 4.2 shows how the availability of the two medicines varies with the location of facility, ownership, and type. Approximately 60.97 per cent and 2.58 per cent of public health facilities have oxytocin and misoprostol, respectively. On the other hand, 12.47 per cent and 2.64 per cent of private not-for-profit facilities have oxytocin and misoprostol, respectively. This shows that whereas oxytocin is more available in public facilities, misoprostol is slightly more available in private not-for-profit facilities. A higher proportion of dispensaries than health centres and hospitals have oxytocin, but misoprostol is more readily available in hospitals compared to health centres and dispensaries. More rural than urban facilities have oxytocin, but misoprostol is more available in urban facilities compared to rural facilities. These statistics show that oxytocin is more readily available in facilities irrespective of their level, location and ownership, whereas misoprostol is more available in private not-for-profit, higher-level and urban facilities. This essentially implies that the country is yet to take advantage of the desirable properties of misoprostol by ensuring it is available in poor-resource settings.

Table 4.2: Availability of oxytocin and misoprostol by facility owner, facility type and location (weighted percentages)

Variable	Availability of oxytocin		Availability of misoprostol	
	Yes	No	Yes	No
Ownership of health facility				
Government	60.97	19.29	2.58	77.68
Private not-for-profit	12.47	7.27	2.64	17.1
Type of facility				
Dispensary	36.57	19.45	0.17	55.85
Health centre	21.26	5.6	0.89	25.97
Hospital	15.61	1.51	4.15	12.97
Location of facility				
Rural	57.68	24.34	1.93	80.09
Urban	15.76	2.22	3.28	14.7

Source: Author's computation

4.3 Regression Results

The regression results presented in this section emanate from equation 12. Table 4.3 presents the odds ratio results and t-statistics calculated after running the logistic model.

4.4 Discussion of Results

(i) Location of facility

Facilities located in urban areas have higher odds of having misoprostol (OR=4.15, p=0.024) compared to rural-based facilities. Location of facility is, however, not significant for availability of oxytocin, meaning that the odds of having oxytocin did not differ with the location of the facility. The finding that urban facilities have higher levels of availability of essential medicines is supported by previous studies conducted by Chen *et al.* (2010) and Mendis *et al.* (2007).

(ii) Ownership of health facility

Although misoprostol is available in only 5.21 per cent of the BEmOC facilities, its availability is significantly determined by facility ownership. Health facilities run by non-governmental and faith-based organizations have higher odds of having misoprostol (OR=19.24, P=0.002) compared to government-run facilities. This finding supports the studies by Carasso *et al.* (2009), Mendis *et al.* (2007) and Bergeson-Lockwood *et al.* (2010), which also found poorer availability of misoprostol in public health facilities compared to private not-for-profit facilities. On the other hand, facility ownership is not significant for oxytocin.

(iii) Type of health facility

The type of health facility was not significant for the availability of oxytocin, thus the odds of availability of oxytocin did not differ with dispensary, health centres and hospitals. On the other hand, this variable is significant for availability of misoprostol; health centres had higher odds of having misoprostol (OR=11.02, p=0.017) compared to dispensaries. Hospitals also have higher odds of having misoprostol (OR=55.26, p=0.000) than dispensaries. Availability of misoprostol in health facilities follows a hierarchical structure, with higher-level facilities having higher odds of stocking the medicine compared to lower-level facilities, specifically the dispensaries. This finding supports previous studies (Kotwani, 2013; Robertson *et al.*, 2009; Zaidi *et al.*, 2013), which also found variability of availability of essential medicines with the type of facility.

The finding also explains the dysfunctional referral system for delivery services. For normal deliveries, mothers are expected to visit the nearest facility that offers

Table 4.3: Survey logistic regression results (t-statistics in parentheses)

Variables	Availability of oxytocin (Odds Ratio)	Availability of misoprostol (Odds Ratio)
Location of facility (base: rural)		
Urban	1.0090(0.02)	4.1480** (2.26)
Ownership of health facility (base: government)		
Private not-for-profit	0.3612 (-1.52)	19.2371*** (3.04)
Type of health facility (base: dispensary)		
Health centre	2.3344 (1.54)	11.0200** (2.39)
Hospital	0.6875 (-0.33)	55.2577*** (4.04)
Availability of maternity waiting room (base: No)		
Yes	3.7705*** (3.53)	10.0713*** (2.94)
Type of procurement system (base: push)		
Pull	5.2735*** (3.32)	1.8980 (0.81)
Number of deliveries in the last three months	0.8372 (-0.80)	1.3351*** (2.98)
Normal delivery charges	1.1749*** (3.32)	0.9894** (-2.04)
Total amount received from various sources for medical drugs	1.1882** (2.07)	0.9984 (-0.30)
Verification of EMMS delivery by H(F)MC (base: No)		
Yes	1.7142 (0.86)	0.4740 (-1.31)
Procurement of any out-of-stock essential medicines in previous quarter (base: No)		
Yes	4.7151*** (2.64)	6.2528 (1.25)
Local purchase of EMMS (base: No)		
Yes	0.0557*** (-3.42)	0.6853 (-0.46)
Expiry of essential medicines in previous quarter (base: No)		
Yes	9.6484*** (4.10)	2.1778* (1.72)
Facility visited by district pharmacists during previous year (base: never visited)		
Once or more visits	0.1765 (-1.62)	1.2121 (0.31)
Number of staff involved in EMMS management	1.3685*** (2.72)	0.8480 (-1.39)
Clinical competence of clinicians (base: clinically incompetent)		
Clinically competent	0.8056 (-0.56)	0.5368 (-1.65)
Constant	0.6449 (-0.29)	0.0001*** (-2.95)
No. of observations	513	5824.922
Population size	512	4.60
Design df	0.0000	513
F(16, 497)	5824.922	512
Prob>F	5.65	0.0000

***(**)* means statistically significant at 1% (5%) and 10% significance level, respectively

Source: Author's computation

BEmOC services, which would then refer them to a higher-level facility in case a complication occurs and cannot be handled by the facility. However, in most instances, mothers would visit a hospital, preferring to travel longer distances for delivery rather than visit the nearest BEmOC facility (KNBS and ICF Macro, 2011). One of the reasons cited for bypassing health facilities is lack of medicines for mothers in the lower-level facilities (KIPPRA, 2013; KNBS and ICF Macro, 2011), which this study also found.

(iv) Availability of maternity waiting room

Facilities that have a maternity waiting room have higher odds of having oxytocin (OR=3.77, p=0.000) and misoprostol (OR=10.07, p=0.003), compared to facilities that lack a maternity waiting room. Health facilities that have a maternity waiting room, therefore, seem to perform better than their counterparts as far as having maternal health medicines is concerned, which supports the role played by maternity waiting rooms in maternal health (Kelly *et al.*, 2010).

(v) Number of deliveries

The number of deliveries reported by the facilities was positively and significantly related to availability of misoprostol, but not oxytocin. An increase in the number of deliveries by 100 is associated with higher odds of having misoprostol in health facilities (OR=1.34, p=0.003). High numbers of deliveries in a health facility imply high demand for and utilization of the facility's delivery services. This should motivate the facility's administrators to procure and stock more medicine.

(vi) Delivery charges and amount of money received for medical drugs

The charges for normal deliveries had a mixed relationship with availability of oxytocin and misoprostol. An increase in the delivery charges by Ksh 100 is associated with higher odds of having oxytocin (OR=1.17, p=0.001). On the other hand, the odds for stocking misoprostol reduced when delivery charges increased by Ksh 100 (OR=0.99, p=0.042). This difference could be an indication of the facilities' preference for oxytocin, compared to misoprostol, in managing PPH. Delivery charges are part of user fees, which were found in Nunan and Duke (2011) to be positively associated with availability of medicines in facilities, since part of this fees is used to purchase drugs.

Similarly, the total amount of money received by health facilities for medical drugs was significant for availability of oxytocin, but not misoprostol. An increase in the total funds received for medical drugs by Ksh 100,000 is associated with higher odds of availability of oxytocin (OR=1.19, p=0.039). As with the finding on delivery charges, facilities seem to allocate more of their funds for medical drugs to oxytocin and not misoprostol.

(vii) Type of procurement system and procurement of out-of-stock medicine

The procurement system used by health facilities determines the availability of oxytocin. Facilities that use the "pull" system have higher odds of having oxytocin (OR=5.27, p=0.001) compared to those that use the "push" system. Related to this variable is the procurement of out-of-stock medicine. Facilities that procured out-of-stock medicine in the previous quarter prior to the survey have higher odds of having oxytocin (OR=4.72, p=0.009) compared to those that failed to procure out-of-stock medicine. These two variables are, however, not significant for availability of misoprostol.

(viii) Local purchase of EMMS

Local purchase of EMMS was negatively associated with the availability of oxytocin. Specifically, the odds of having oxytocin in facilities that purchased their EMMS locally are lower (OR=0.06, p=0.001) compared to those that did not purchase EMMS locally. This is an indication that relying on local chemists and stores for essential medicine was negatively associated with availability of oxytocin, which is expected because its use and distribution is regulated by the Ministry of Health, hence it is not sold over the counter. In Uganda and Bangladesh, Madsen, Bergeson-Lockwood and Bernstein (2010) and Bergeson-Lockwood, Madsen and Bernstein (2010) also found that distribution of maternal health medicines is only allowed in health facilities, hence cannot be easily found in local drugs' stores.

(ix) Expiry of essential medicines

Facilities that reported expired essential medicines in the previous quarter have higher odds of having oxytocin (OR=9.65, p=0.000) and misoprostol (OR=2.18, p=0.086), compared to those that did not report expired essential medicines. The positive association between expiry of essential medicines in health facilities and availability of oxytocin and misoprostol could be an indication of low demand for medicine, either from users or clinicians, which in turn makes them available at the facility. The role of demand in making the essential medicine available requires further investigation.

(x) Number of staff involved in EMMS management and clinical competence of clinicians

The number of staff involved in the management of EMMS was significant for the availability of oxytocin but not misoprostol. Specifically, an increase in the number of staff involved in EMMS management is associated with 1.37 times higher odds of having oxytocin. An unexpected finding with regard to the role of health workers is that the clinical competence of the clinicians (measured by

ability to accurately diagnoze and prescribe treatment for PPH) had no significant effect on availability of oxytocin or misoprostol in the facilities.

This finding contradicts the studies by Nunan and Duke (2011), Madsen, Bergeson-Lockwood and Bernstein (2010) and Bergeson-Lockwood, Madsen and Bernstein (2010) and raises questions on the extent clinicians in Kenya accurately prescribe and use the medicines required for managing PPH. It also raises concern about the adequacy of the training received by clinicians, as far as managing the major causes of maternal mortality is concerned. A report on service delivery in Kenya by the World Bank (2013) found that only 44.2 per cent of medical staff in Kenya's public health facilities have the clinical knowledge for managing maternal complications. Clinical knowledge was measured by the history questions asked and physical examination undertaken by the medical staff. The level of clinical knowledge declines with the type of health facility. Among hospital medical staff, the level of clinical knowledge is 48.4 per cent, while that of health centres' and dispensaries' medical staff is 45.7 per cent and 43 per cent, respectively. In addition, only 44.6 per cent of all clinicians in Kenya adhere to the clinical guidelines for managing maternal and newborn complications. The rate of adherence was highest among doctors (46.6%), followed by clinical officers (46.4%) and lowest among nurses (44.5%), yet deliveries, in most cases, are carried out by nurses.

4.5 Overview of Results

The study has revealed that, generally, oxytocin is more available in Kenya's health facilities compared to misoprostol. This is despite the fact that misoprostol is more user-friendly to both patients and health workers because it is in tablet form, while oxytocin is administered as an injection (Madsen, Bergeson-Lockwood and Bernstein, 2010). The study found that all the facility-specific factors examined– location, type and ownership of facility, availability of maternity waiting room, type of procurement used, number of deliveries, delivery charges and funds received for medical drugs – were important for availability of maternal health medicines in BEmOC facilities. Two essential medicine management factors examined–procurement of out-of-stock medicines and expiry of medicines–were important for availability of the medicine. Lastly, the only human resource factor that was significant for availability of maternal health medicine was the number of staff involved in the management of essential medicine and medical supplies.

5. Conclusion and Policy Recommendations

5.1. Conclusion

This study examined the factors influencing the availability of maternal health medicines in Kenya's health facilities, with a focus on oxytocin and misoprostol. The two are used for the prevention and treatment of PPH, which is the leading cause of maternal mortality in Kenya. The study used both descriptive statistics and survey logistic regression to examine how availability of the medicine varies with facility-specific, essential medicines' management and human resource factors. The results showed that, in general, oxytocin is more available than misoprostol in Kenya's BEmOC facilities, at 73.44 per cent and 5.21 per cent, respectively. In addition, availability of the medicine in facilities is influenced by: a) facility-specific factors: the location, type and ownership of facility, availability of maternity waiting room, type of procurement system used, number of deliveries, delivery charges and funds received for medical drugs; b) essential medicines' management factors: procurement of out-of-stock medicines and expiry of medicines; and c) human resource factors, specifically the number of staff involved in the management of essential medicines and medical supplies.

5.2 Policy Recommendations

(i) Scale up the supply of misoprostol in BEmOC facilities

The study found misoprostol to be available in only 5.21 per cent of the BEmOC facilities. The low rate of availability of misoprostol in health facilities is not unique to Kenya, but has been seen in many other countries (Bergeson-Lockwood, Madsen and Bernstein, 2010; Madsen, Bergeson-Lockwood and Bernstein, 2010). Although oxytocin is the first-line choice of medicine for preventing or treating PPH, misoprostol is gaining more support on the global health platform because of its desirable properties (Box 1). Ensuring the availability of misoprostol in BEmOC facilities, even when oxytocin is available, would help address some of the challenges facing the use of oxytocin, particularly lack of ideal storage conditions and shortages of authorized staff to administer intravenous drugs. As such, Uganda and Bangladesh have developed protocols for the use of misoprostol for PPH, which include training of health workers to ensure that the medicine is used properly and in the correct dosage. The government of Bangladesh began procuring misoprostol in 2010, and the medicine can now be distributed at the community level by trained health workers (Bergeson-Lockwood, Madsen and Bernstein, 2010). In Uganda, the policy to use misoprostol for PPH was introduced in 2008, and this has received wide support from health workers

(Madsen, Bergeson-Lockwood and Bernstein, 2010). This study recommends a similar strategy for the Ministry of Health to scale up the use of misoprostol as an alternative medicine for PPH, particularly in resource-poor areas where it is difficult to stock and administer oxytocin. However, the scale-up strategy of the use of misoprostol should be accompanied by training of health workers on its correct prescription and dosage.

(ii) Enhance the distribution of maternal health medicines to all BEmOC facilities

The study found that lower-level facilities have lower odds of stocking maternal health medicine, despite the fact that dispensaries are closer to the people than health centres and hospitals. This essentially means that even though some health facilities claim to provide BEmOC services, they do not meet the basic requirements of a BEmOC facility as defined by the WHO. In addition, public health facilities and facilities located in rural areas had lower odds of stocking maternal health medicine compared to private and urban-based facilities. The county health departments need to enhance the distribution of maternal health medicine in all BEmOC facilities regardless of the level and location of the facility. This can be done by carrying out regular monitoring of procurement performance of all facilities, as well as annual external audit. This will not only encourage the use of maternity services in all facilities, but also address the challenges facing the referral system for delivery services by minimizing congestion in higher-level health facilities.

(iii) Establish maternity waiting rooms in BEmOC facilities

Having a maternity waiting room is positively associated with availability of maternal health medicines, because it encourages timely management of complications that may arise during or after delivery. The county health departments should embark on establishing maternity waiting rooms in their BEmOC facilities.

iv) Increase budgetary allocations to essential medicines

The study found availability of oxytocin to be positively associated with the amount received for medical drugs by facilities. The county health departments need to increase the budgetary allocations to essential medicine and medical supplies, as this will enhance their availability in facilities. Although the study found positive association between delivery charges and availability of maternal health medicines, it does not recommend increasing delivery charges; rather, it supports the government's "free delivery" policy in public facilities. This will encourage the use of maternal health services. Increasing budgetary allocations to EMMS to meet the WHO-recommended threshold of US$ 1.5-2.0 per capita from

the current US$ 1.1 per capita will also address the loss of revenues incurred by public facilities due to waiver of delivery charges.

(v) Strengthen the procurement function of health facilities

The use of the pull system of procurement had a positive impact on availability of oxytocin and this should be rolled out to all facilities. In addition, prompt procurement of medicine that has run out of stock increases the availability of maternal health medicine in health facilities. Health Facilities Management Committees should strengthen their procurement functions by ensuring that they have a functional procurement committee in place and consider a shift from manual to electronic procurement and stock taking. Staff involved in procurement should also be trained on effective stock management skills to ensure that medicines are replaced before or immediately it runs runs out of stock. This will help to minimize stock-outs and delays in receipt of orders.

(vi) Intensify training of health workers on administration of maternal health medicines

The introduction of the "free delivery" policy has significantly increased the number of delivering mothers visiting health facilities in the country, therefore putting pressure on the already over-stretched health work force. Whereas the Ministry of Health continues to hire more community nurses and community health workers to address the health workers' shortage (Burrows, 2013), there is need to intensify training of health workers working in maternal and reproductive health on the usage, prescription and accurate dosage of the essential medicines used during and after delivery so as to reduce the country's maternal mortality. In addition, the study recommends the distribution and use of information, education and communication (IEC) materials and job aids such as wall charts showing the procedures to be followed in preventing and treating the major causes of maternal mortality, so as to enhance clinical competence of staff.

In order to address the low rate of adherence to clinical guidelines, the Kenya Medical Practitioners and Dentists Board needs to institute tougher penalties such as suspension and withdrawal of licenses for medical staff who fail to adhere to the clinical guidelines for managing excessive bleeding and other complications that arise during childbirth.

5.3 Limitations and Areas for Further Analysis

This study has a number of limitations that can form the basis for future studies. First, the study relied on quantitative analysis but it would benefit more from a mixed-methods research involving both quantitative and qualitative analyses.

This would further explain the state of availability of the two types of medicine. Specifically, the perception of the health workers, mothers and policy makers towards the medicines would help shed more light on the reasons behind the comparatively low availability of misoprostol, as well as reveal physicians' behaviour towards these medicine.

Second, the supply chain is critical in determining the availability of essential medicines. While the study by Chen *et al.* (2010) and Mendis *et al.* (2007) examined the aspect of manufacturing, this study was limited due to lack of such information in the dataset used. A follow-up study investigating the supply chain of maternal health medicine would thus be critical in further explaining the state of availability of the medicine in health facilities.

Lastly, the use of the medicine by mothers was not empirically investigated due to lack of data. Knowledge on the demand for essential medicines as well as their awareness among the population is critical in informing the government of the measures it should take when scaling up the access of medicines. The Kenya Demographic and Health Survey (KDHS), which comprehensively captures the demand for reproductive health services in the country, lacks information on the demand and usage of maternal health medicines. This study recommends incorporating information on the utilization of the medicines in subsequent KDHS.

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Appendix

Appendix 1: Essential medicines for mothers

Indication	Medicine
1. Postpartum haemorrhage:	
Treatment	Oxytocin: 10 IU in 1-ml ampoule
	Sodium chloride: injectable solution 0.9% isotonic or Sodium lactate compound solution – injectable (Ringer's lactate)
Prevention	Misoprostol: tablet 200µg
2. Severe pre-eclampsia and eclampsia	Magnesium sulphate: injection 500 mg/ml in a 2-ml ampoule, 500mg/ml in a 10-ml ampoule
	Calcium gluconate injection (for treatment of magnesium toxicity): 100mg/ml in a 10-ml ampoule
3. Maternal sepsis:	
Treatment of infection due to sepsis	Ampicillin: powder for injection 500mg; 1g (as a sodium salt) in vial
	Gentamicin: injection 10 mg; 40mg/ml in a 2-ml vial
	Metronidazole: injection 500mg in a 100-ml vial
4. Treatment of incomplete miscarriage	Misoprostol: tablet 200µg
5. Chlamydia	Azithromycin: capsule 250mg; 500mg or oral liquid 200mg/5 ml
6. Gonorrhoea	Cefixime: capsule 400mg
7. Syphilis	Benzathine benzylpenicillin: powder for injection 900 mg benzylpenicillin in a 5-ml vial; 1.44g benzylpenicillin in a 5-ml vial
8. Prevention of early labour	Betamethasone: injection 5.7mg/ml as betamethasone sodium phosphate 3.9mg (in solution) or betamethasone acetate 3 mg (in suspension) in an aqueous vehicle or Dexamethasone – injection 4mg dexamethasone phosphate (as disodium salt) in 1-ml ampoule
	Nifedipine: immediate release capsule 10mg

Source: PATH, WHO and UNFP (2006)

Appendix 2: Correlation matrix

	Oxytocin	Misopr.	LOC	OHF	THF	MWR	PRS	NDLV	DLC	TMD	VEMMS	POOSM	LPEMMS	EXEMMS	DVISITS	SEMMS	CCSTAFF
Oxytocin	1																
Misoprostol	0.1623	1															
LOC	0.0819	0.2739	1														
OHF	0.0472	0.2558	0.1581	1													
THF	0.2272	0.3763	0.1191	-0.1702	1												
MWR	0.1105	0.2317	-0.0120	0.0634	0.2888	1											
PRS	0.0625	0.1048	0.1284	0.0402	0.0063	-0.0102	1										
NDLV	0.1323	0.4825	0.3322	-0.0246	0.4061	0.1817	0.0788	1									
DLC	0.1492	0.4020	0.3086	0.2767	0.2973	0.1847	0.0666	0.2741	1								
TMD	0.1052	0.3753	0.1972	0.0791	0.2669	0.1596	0.0047	0.6783	0.2632	1							
VEMMS	-0.0029	-0.0590	0.0938	-0.2740	0.1185	0.0149	-0.182	0.0265	-0.091	0.0227	1						
POOSM	-0.0466	-0.0350	-0.1400	-0.0389	0.0843	0.0165	-0.089	-0.076	-0.086	0.0584	0.0634	1					
LPEMMS	-0.0715	0.0395	-0.0620	0.0918	0.1286	0.1333	-0.070	0.1043	0.0426	0.0692	-0.101	0.5409	1				
EXEMMS	0.1093	0.1660	0.1661	-0.0250	0.1229	-0.0016	0.0737	0.282	0.1371	0.1057	-0.031	0.0424	0.1615	1			
DVISITS	-0.0239	-0.0100	0.0961	-0.1742	-0.004	-0.0051	0.0240	0.0789	0.0179	-0.077	0.1894	-0.018	-0.0613	0.0867	1		
SEMMS	0.2026	-0.0240	0.0848	-0.2263	0.1843	0.0449	-0.068	0.0067	-0.007	0.0119	0.1552	0.0005	-0.1072	0.0438	-0.0275	1	
CCSTAFF	-0.0142	-0.0790	0.0214	0.0423	-0.141	-0.0937	-0.024	-0.026	0.0325	0.0042	0.0357	-0.001	-0.0919	0.0023	0.1026	-0.016	1

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