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Health System Predictors of Access to Maternal Health Medicines In Low and Middle Income Countries

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This is to certify that the doctoral study by

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Abstract

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MPH, University of Ibadan, 2013

BSc., Nnamdi Azikiwe University, 2005

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

The strength of health systems predict access to medicines that prevent death from pregnancy related complications (essential maternal health medicines). But little is known about the relative impact of each health system building block on access. This quantitative cross-sectional study applied Ishikawa model to examine the relative effect of health systems governance, facilities, service delivery, financing and medicine procurement and distribution (independent variables), on availability, affordability and accessibility (dependent variables) of maternal health medicines in resource poor settings. Data analyzed was pulled from 37 WHO pharmaceutical country profiles and USAID MCHIP survey that assessed national programs for the prevention and management of Postpartum hemorrhage and Pre-Eclampsia/Eclampsia. Data analysis included bivariate and multivariate logistic regressions. All independent variables, except for quality of health services showed statistically significant association with access to maternal health medicines and achieved a p-value < .05 in bivariate analysis. Only three predictors however explained 27% of the variance ($R2 = .266$, $F(5,162)=13.12$, $p<.01$). The strength of medicine procurement and distribution systems significantly predicted access to essential maternal health medicines ($\beta= -.41$, $p<.001$), as did robustness of health system financing ($\beta= -.51$, $p<.001$), and quality of health facilities ($\beta= -.34$, $p<.05$). Authorities may prioritize investments in quality improvement, supply chain strengthening programs, and incentives for private sector financing and public-private partnerships for health system strengthening. This study contributes to positive social change by identifying key health system considerations that can inform future efforts to close geographical gaps in MCH outcomes.

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Dedication

To God Almighty. The Father of all flesh. YOU'VE MADE ALL THINGS BEAUTIFUL, and have again affirmed that I am loved by God - the KING OF THE UNIVERSE. This achievement and all the many blessings that will come from it, I dedicate to You, and to advancing the Kingdom of your Dear Son - Jesus Christ. THANK YOU!

To the best husband in the whole world, Engr. Chibike .N. Nnorom. My Dike! Your great support and encouragement made this journey easy. You are simply the best, and I love you loads. You constantly reminded me of Who and Whose I am. Yes, we did have our struggles along the way, but one thing was constant, you needed me to go through with this. This kept me going – even in the fiercest of opposition. Thank you so much. We can now rock the proceeds of this achievement together!

And to my yummy 5 and 3 -year old cuties, my precious gifts from above – Sharon and Uchechukwu. You were so little, yet so wise and full of understanding. Though babies, you were accommodating. This achievement belongs to all three of us. You both worked hard on it with me. I hope it inspires you to achieve even greater heights when you become adults.

To my Dad and Mum, you are surely the best parents any child can wish for. Your constant reminder: *'Education for an African Girl child is invaluable; hence You must strive to get educated to the highest level possible. We will support you as long as we live"* – have inspired me through the years. You transcended all the hardships of raising my siblings and I in Ajaokuta and here I am – evidencing your tenacity and good work. I can't appreciate God enough for the privilege of starting and travelling far in this life's journey with you both. I trust God to help me transcend the standards you've set for us in my children. God bless you!

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I would like to express my sincere gratitude to my committee members, Dr. Patrick Tschida (chair), Dr. Vibha Kumar (member), and Dr. Simone Salandy (University Research Reviewer) for their immense contributions in knowledge, patience, and motivation, as well as for the hard and stimulating questions that helped me refine my research to the point it has reached. I could not have wished to have a better committee.

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Finally, my gratitude goes to my fellow doctoral students for the stimulating discussions and exchanges over the last 3 years, and the fun we enjoyed during group work and residencies.

It's been such a pleasure knowing and working with you all to advance the mission of bringing positive change to the world we live in. Thank you.

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Section 1: Foundation of Study and Literature Review

Introduction to the Study

Postpartum hemorrhage (PPH), pre-eclampsia and eclampsia are three leading causes of death for women giving birth around the world. These conditions together account for nearly half (41%) of the 289,000 pregnancy-related deaths worldwide (WHO, et al., 2014). They also disproportionately affect women in developing countries (Say et al., 2014; WHO, 2014b).

Oxytocin, misoprostol and magnesium sulfate (herein referred to as essential maternal health medicines) are three medicines that prevent and treat these pregnancy-related complications. (Fujioka, & Smith, 2011). Yet, they are not readily available to women at urban and rural hospitals or clinics in many locations where women give birth (USAID, Landscape Analysis: Postpartum Hemorrhage Solutions, unpublished data, 2012).

Expanding access to essential maternal health medicines would lower maternal death rates and improve maternal health (Wagstaff, 2004). In one study, USAID anticipated that if oxytocin and misoprostol were available to all women giving birth, they would prevent 41 million postpartum hemorrhage cases and saved 1.4 million lives annually (USAID, Landscape Analysis: Postpartum Hemorrhage Solutions, unpublished data, 2012).

In recognizing these realities, governments of many nations with support from multilateral, bilateral and international non-governmental organization have developed and implemented programs to improve access to essential maternal health medicines. But despites these efforts, women in resource poor settings still lack adequate access to these medicines (Spector, Reisman, Lipsitz, Desai, Gawande, 2013; Hill, 2012).

Researchers attribute this to the vertical structure of these programs, and the shrinking funding for public health witnessed in recent years (Paina and Peters, 2011). In other words, components of the health system that affects access to essential maternal health medicines are not adequately accounted for in programs to promote access to these medicines. This is either because practitioners perceive medicines as a standalone component of a health system or funding to promote access are not able to support implementation of multiple and competing programs that facilitate access to these medicines (Paina and Peters, 2011).

To address these gaps, some studies have attempted to determine health system facilitators and barriers to access to essential maternal health medicines. But these studies were limited to single geographies, medicines or health system factor (Smith, 2011; Trans and Bero, 2015; Bigdeli et al., 2013). Therefore, little is known about the relative impact of each health system factor on access to essential maternal health medicines, more so comparatively across geographies in resources poor settings. There is a paucity of evidence on the factors that facilitate or impede access to essential maternal health medicines in low and middle-income countries. Health systems determinant of global access to essential maternal health medicines have not sufficiently studies using nationally representative data.

In this study, I examined the relationship between health systems factors and access to essential maternal health medicines to understand the relative impact of select health systems factors on women's access to these medicines in developing countries. This study is unique in that it will focus on an under researched area of access to essential maternal health medicines.

Findings from this study will make an original contribution to understanding how pregnant women's interactions with the health system affect the use of maternal health medicines

in low and middle-income countries. For the first time, there will be empirical evidence on the determinants of women's access to essential maternal health medicines from a holistic perspective.

Evidence generated through this research can contribute to efforts that aim to expand access to essential maternal health medicines. New knowledge generated can be used to sensitize policy makers and maternal health practitioners, regarding the potential effects of their decisions and interventions respectively on various aspects of the health systems with regards to access to maternal health medicines. The evidence can help policy makers and health managers in international agencies and national governments to design relevant, timely and evidence informed policies and programs to improve pregnant women's access to maternal health life-saving medicines and reduce the number of women dying from pregnancy related causes.

Finally, with multiple intervention options for improving women's access to maternal health medicines, and shrinking funding for public health programs, the information from this study could guide selection of investment priorities and pint to areas of work that foster changes in policy and practice and inform maternal health research and program priorities. These could contribute to a reduction in global and national maternal mortality ratio – a positive social change.

Main aspects of this section include a background that briefly summarizes the knowledge gaps the study will attempt to fill, and why the study is important. This section also presents the problem statement and purpose of the study. The nature of the study, research questions and hypotheses are included alongside the theoretical framework to guide the study. I also present an overview of recent literature related to the scope of the study including a review of the theories

that form the basis of this study, and the methodological approaches explored in previous related studies. I conclude this section with an explanation of what is known and controversial about the variables of interest in this study, and what remains to be studied. Finally, assumptions, scope, delimitations, limitations and significance of the study are highlighted

Problem Statement

Despite recent decrease in global maternal mortality ratio, approximately 830 women still die every day because of complications during pregnancy or childbirth (WHO, 2015). The World Health organization (WHO) estimated that by the end of 2015, roughly 303,000 women will have died during and following pregnancy and childbirth (WHO, 2015). Postpartum hemorrhage (PPH), pre-eclampsia and eclampsia are three leading causes of these deaths. In 2014, these conditions, together accounted for nearly half (41 % of the 289,000 pregnancy related deaths that occurred worldwide (WHO, et al., 2014). While postpartum hemorrhage (PPH) accounted for more than two thirds of cases), hypertensive disorders (pre–eclampsia and eclampsia), sepsis, and unsafe abortion accounted for the rest (Say et al., 2014).

These pregnancy-related complications and resulting maternal deaths are not distributed evenly across the globe. Rather, an overwhelming 99% of maternal deaths occur in low income countries, with over 50% reported in sub-Saharan Africa and almost one third in South Asia. In 2015 alone, the maternal mortality ratio in developing countries was 239 per 100 000 live births versus 12 per 100 000 live births in developed countries (WHO, 2015). Also, the probability that a 15–year–old woman will eventually die from a cause related to Postpartum hemorrhage (PPH), pre-eclampsia and eclampsia is much higher for women living in low income countries than for those who live in high income countries (1:180 vs 1: 4900). Furthermore, more than half of

maternal deaths in Africa and Asia occur in fragile and humanitarian settings (WHO, 2015). In countries designated as fragile states, the risk of dying from a cause related to Postpartum hemorrhage (PPH), pre-eclampsia and eclampsia is 1 in 54; a consequence of breakdowns in health systems (WHO, 2015).

The need for oxytocin, misoprostol, and magnesium sulfate (discussed in earlier section) is therefore imminent. It is universal and present wherever deliveries occur: from urban hospitals to rural clinics and homes where more than 50 percent of women in developing countries deliver their babies (Montagu, Yamey, Visconti, Harding, & Yoong, 2011).

In other to make medicines universally available and accessible, the World Health Assembly sanctioned the notion of essential medicines in 1975, and this has been followed by (1) highlight in 2012 by the "United Nations Commission on Life-Saving Commodities for Women and Children on the need to improve women's and children's health by increasing access to 13 high-quality, essential health supplies, including oxytocin, misoprostol, and magnesium sulfate" - (Kade, & Moore, 2012; p.5). (2). Evidence– informed recommendations by the WHO that highlight necessary interventions and medicines needed to improve the health of pregnant women and prevent complications that occur during pregnancy and childbirth (WHO, 2011b; WHO, 2012; WHO, 2013; WHO, 2012c).

Despite these high level championed efforts, recent data suggest that poor and vulnerable women in Africa and Asia still lack adequate access essential maternal health medicines (Spector, Reisman, Lipsitz, Desai, Gawande, 2013; Hill, 2012). Researchers attribute this to gaps in the approach that characterize programs that aim to promote access to essential maternal health medicines at country levels. According to the literature, the role of medicines is often

narrowed down to a health system input, so that approaches to improving access to medicines are vertical and isolated rather than all-inclusive - considering other health system constraints that hamper access to medicines (Paina and Peters, 2011; Bigdeli et al., 2013; p.2).

Access to maternal health services (such as essential maternal health medicines) has important implications on maternal health and mortality. In other to improve access to essential maternal health medicines, there is need to understand and incorporate the full spectrum of the health system in research and practice regarding access to maternal health medicines (Paina and Peters, 2011; Bigdeli et al., 2013; p.2; (Adam, Ahmad, Bigdeli, Ghaffar, & Røttingen, 2011).

Some studies have explored access to medicines, but not many consider component of the health system in ways that are relevant to the unique characteristics of access to essential maternal health medicines (Bigdeli et al., 2012). Many limit health system considerations to the health sector. For instance, a recent survey of peer-reviewed publications on access to medicines in low and middle-income countries demonstrated that only 27 out of 648 between 2003 and 2009 reported on broader pharmaceutical policies and reforms in low and middle-income countries (Adam, Ahmad, Bigdeli, Ghaffar, & Røttingen, 2011).

These gaps in empirical evidence demonstrate the need for additional research on access to maternal health medicines from a health systems perspective.

Purpose of Study

The purpose of the study was to determine the relative impact of health system factors on access to essential maternal health medicines in low and middle-income countries. The study measured the strength of association between each select health system factor and maternal health medicines in low and middle-income countries. Health System factors prioritized in this

study were identified based on finding from the literature and the knowledge gap on health systems and access to maternal health medicines research.

Knowledge gained through this study could inform national and subnational level maternal health policies and programs that have goals to make better the health of women in low and middle-income countries. Finally, the study could inform the design of appropriate policies that address specific health system factors that constrain women from accessing and using essential maternal health medicines. In this era of declining resources for public health, National and local level maternal health programs could use the evidence generated in this study to identify health system factors limiting access to and use of maternal health medicines, and prioritize programs based on their relative potentials to maximize impact.

Research Questions and Hypotheses

The Study had six research questions and corresponding hypotheses:

Is there a significant association between governance and access to essential maternal health medicines in low and middle-income countries?

Ho1: there is no significant association between governance and access to essential maternal health medicines in low and middle-income countries?

Ha1: there is a significant association between the governance and access to essential maternal health medicines in low and middle-income countries?

Is there a significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Ho2: there is no significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Ha2: there is a significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Is there a significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Ho3: there is no significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Ha3: there is a significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Is there a significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Ho4: there is no significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Ha4: there is a significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Is there a significant relationship between health financing and access to essential maternal health medicines in low and middle-income countries?

Ho5: there is no significant association between health financing and access to essential maternal health medicines in low and middle-income countries?

Ha5: there is a significant association between health financing and access to essential maternal health medicines in low and middle-income countries?

Theoretical Foundation of Study

Choice of theory. The Ishikawa diagram – an application theory of the complex adaptive

system concept guided implementation of this study. Ishikawa diagram - also known as the "fishbone" or "cause and effect" diagram was first developed by Kaoru Ishikawa in 1968 and has been vastly utilized in the field of public health as well as the manufacturing industry (Ishikawa, 1968). The main goal of the Fishbone diagram is to illustrate in a graphical way, the relationship between a given outcome and all the factors that influence this outcome, and provide additional insight into the behavior of processes (Ishikawa, 1960).

In the 1960's and 70s, the Ishikawa diagram was commonly used in the manufacturing industry to design products, prevent quality defects, and identify potential factors causing an effect or outcome. However, because of its characteristic flexibility and potential for wide application, the fishbone diagram has been adapted to consider a variety of outcomes or effect scenarios across multiple professions.

Recently, the diagram has been used extensively as theoretical framework for analysis in the health care field – mostly as a continuous quality improvement tool to examine the causes of a problem within a healthcare setting. For example, Hartwell and colleagues (2006) used the fishbone diagram as an analytic approach to identify sources of medication errors in hospitals.

Maternal health researchers have also applied the Ishikawa framework to studies related to access to essential maternal health medicines – the focus of this study. For example, in 2010, Ridge et al. developed, used and proposed the use of this diagram to determine facilitators to the availability and rational use of MgSO4 in Zambia. In 2013, Bigdeli et al. also used this diagram in their study to highlight health system deterrents to access and use of MgSO4 in Pakistan. In 2015, Tran and Bero used the fishbone Ishikawa diagram that Ridge et al. developed to assess

the barriers and facilitators to quality use of three essential medicines – oxytocin, ergometrine, and MgSO4 in seven countries.

Rationale for choice of framework. It was anticipated that firstly, the Ishikawa diagram would allow accounting for various factors that potentially predict access since this study aims to predict patterns of access from various sources. The supply chain for pharmaceutical products, especially in developing countries, are comprised of highly heterogeneous groups of actors (e.g. many types of health care providers, managers, policy-makers, patients, regulators, private sector, public sector etc.) intervening at multiple levels through a variety of services and functions (Holland, 1992; Anderson and McDaniel, 2000; Plsek, and Wilson, 2001; Tan et al., 2005; Rickles et al., 2007; Saadah & Knowles, 2000).; (de Savigny & Adam 2009); Keshavarz et al., 2010). In other words, the medicine supply chain is woven and nested within the health system and interacts with the peculiar behavior of different components of the health system at any given time (de Savigny & Adam 2009). Medicines concern systems outside of the health system and at international level.

Secondly, scaling up access to essential medicines for maternal health is more than the expansion of coverage of health services. Rather, it can be defined as a set of processes that lead to expanded and sustainable coverage of services, and should reflect the open and dynamic relationship that exist in a health system (Anderson and McDaniel, 2000; Plsek, & Wilson, 2001). Scale up should also involve strengthening the capacity of delivery organizations, increasing diversity and robustness of funding and management arrangements, and growing the system's overall capabilities to add more services or to integrate services (Uvin 1995, Subramanian et al., 2010; Tan et al., 2005; Leischow, & Milstein, 2006: Van Wave et al.,

2010),). The Ishikawa diagram is structured to help explain processes that lead to a given outcome and potential factors to promote scale up and improvement – hence it is suitable to this study.

Logical Connection

In using the Ishikawa diagram to determine predictors of access to essential medicines for maternal health, Tran and Bero (2015) proposed that facilitators and barriers to quality use of oxytocin, ergometrine, and MgSO4 occur in four levels of a health system: (1). Government/Regulatory level (2). Pharmaceutical Level (3). Health Facility Level (4) Health professional Level.

In this cross-sectional study, I built on previous studies, like those of Tran and Bero (2015). That applied the Ishikawa framework in maternal health medicines research. This framework provided a solid platform for understanding relationship between the independent and dependent variables for this study. I advanced this diagram through an iterative process that was based on data gotten from each country's report.

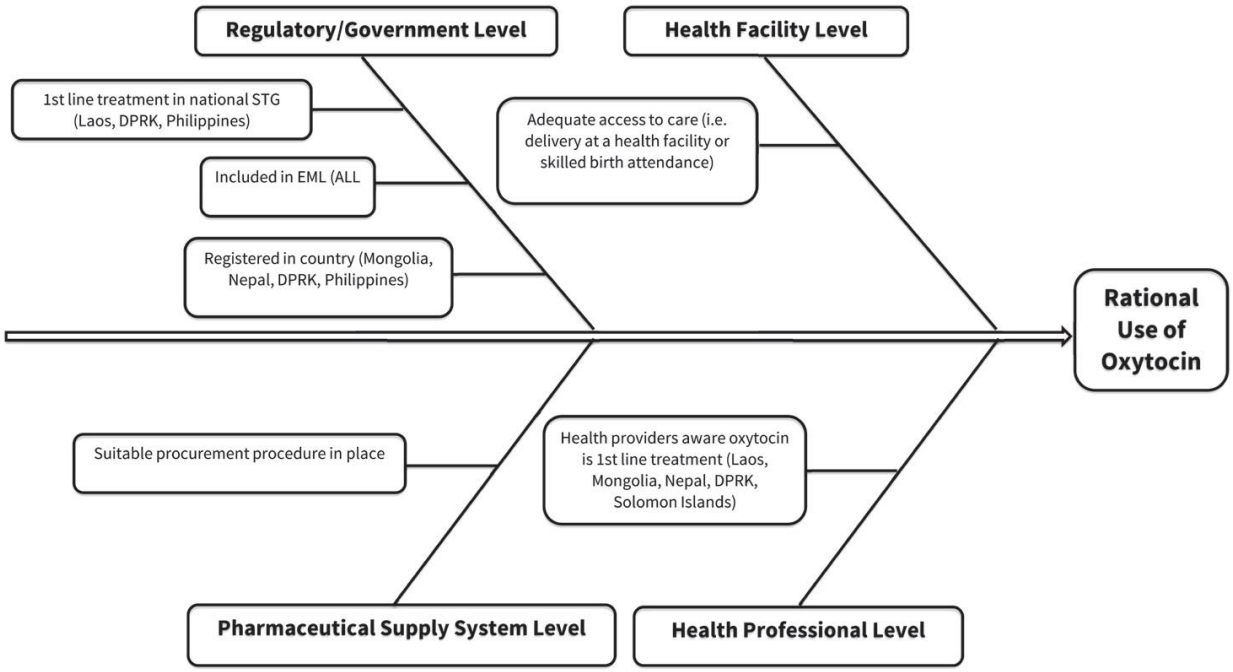

Figure 1. Ishikawa diagram showing the multi-dimensional predictors of rational use of oxytocin. Source: Tran and Bero, (2015)

Nature of the Study

A quantitative cross-sectional approach was used to answer the research questions. This approach is based on post positivist philosophical assumptions that propose: 1). examining the relationships between and among variables is central to answering questions and hypotheses through surveys and experiments; 2). reducing concepts to a parsimonious set of variables, tightly controlled through design and statistical analysis, provides measures or observations for testing a theory (Creswell, 2008). The research questions required quantitative analysis for measuring access to maternal health medicines, and the associations between health systems factors and access to maternal health services.

I carried out a secondary analysis of archived data from a sample of Low and Middle-income Countries (LMIC). Key inclusion criteria were countries that participated in the second USAID Bureau for Global Health's flagship Maternal and Child Health Integrated Program (USAID/MCHIP) annual global survey between March to June 2012. These surveys assessed progress of national programs in the prevention and management of PPH and PE/E (USAID, MCHIP (2011, 2012).

The independent variables for this study were health-system characteristics that influence women's access to essential maternal health medicines. In this regard, five health system domains was assessed: government and regulatory, pharmaceutical supply system, health facility, and health service delivery, and data collection/information reporting. For each domain, at least two health system characteristics or measures that best represent a domain were analyzed (table 1.1).The outcome variable for this study was 'access to essential maternal health medicines', defined as the availability, affordability and accessibility of Oxytocin, Magnesium Sulfate and Misoprostol or Egometrin combined.

Table 1

Health System Determinants of Access to Maternal Health Medicines

Variable Dimension	Measures
Government/regulation	Medicines approved at national level; Availability of Standard Treatment Guidelines; Policy provision for AMTSL present.
Pharmaceutical Supply and Distribution	Written public sector procurement policy available; Public sector procurement is Centralized and decentralized? The government supply system department has a Central Medical Store at National Level; There are national guidelines on Good Distribution Practices (GDP)
Health Facilities and Infrastructures	Number of hospital beds per 10,000 Number of Physicians per 000 pop.
Service Delivery	Pre-service education curricula include AMTSL Current global management principles for PE/E included in in-service training courses AMTSL included in in-service training curricula Pre-service education curricula include current global management principles for PE/E Students assessed for competency in performance of AMTSL Health providers aware medicine is first–line treatment Midwife/skilled birth attendants scope of practice
Health Financing	Private health expenditure as % of total health expenditure (% of total expenditure on health) Pharmaceutical expenditure as a % of Health Expenditure (% of total health expenditure) Total health expenditure as % of Gross Domestic Product

Note: *These are the 6 health system characteristics identified as independent variables for the study.*

Literature Search Strategy

Search Strategy

The literature review for this study was executed by searching for and reviewing peer-reviewed and academic literature from computerized databases and resources available at Walden Library: ABI/INFORM Global, Academic Search Premier, Encyclopedias from Sage, eBrary e-book collections, Education Research Complete, Expanded Academic ASAP, General Science Collection, Health and Medical Complete (ProQuest), Health Sciences: a Sage Full-Text Collection, IEEE Xplore Digital Library, InfoSci Journals, Cumulative Index to Nursing and

Allied Health Literature (CINAHL), MEDLINE with Full Text ProQuest Central, ResearchNow, Science Direct, SocINDEX with Full Text, and applicable academic textbooks.

Additional search focused on online databases like google scholar, WHO website, UNICEF website, and those of other international non-governmental organizations that work on access to medicines and health systems in developing countries. These organizations included Management Sciences for Health (MSH), PATH, Population Service International (PSI), etc. Reference lists of some retrieved articles were also reviewed.

Search Terms

The following keywords were used alone and in combination as search terms: *health systems, health care access, live-saving maternal health medicines, oxytocin, misoprostol, magnesium sulfate, post-partum hemorrhage, eclampsia, pre-eclampsia, access, medicines, pharmaceutical, essential medicines list*. Only texts in English were reviewed, with most literature published between 2003 and 2016.

Scope of Literature Review

The literature review included (a) peer-reviewed studies, including systematic reviews and meta-analysis; (b) studies that examined the association between maternal health medicines or access to medicines more broadly with one or more health system determinants; (c) studies published between 2005 and 2016; (d) studies published in English, and (e) studies published in all regions.

Literature Related to Key Variables and/or Concepts

Global statistics on maternal health: Every day, approximately 830 women die because of complications during pregnancy or childbirth (WHO, 2015). The WHO also estimated that by the end of 2015, roughly 303 000 women will have died during and following pregnancy and childbirth (WHO, 2015). An overwhelming 99% of these maternal deaths occur in low–resource settings. For instance, in 2015 alone, the maternal mortality ratio in developing countries was 239 per 100 000 live births versus 12 per 100 000 live births in developed countries (WHO, 2015). Over 50% of deaths in developing countries occur in sub-Saharan Africa and almost one third occur in South Asia. More than half of maternal deaths occur in fragile and humanitarian settings (WHO, 2015).

Women in developing countries have on average, many more pregnancies than women in developed countries. Consequently, their lifetime risk of death due to pregnancy and related causes is higher (World Bank, 2012). For instance, the probability that a 15–year–old woman will eventually die from a cause related to maternal health is much higher for women living in low income countries than for those who live in high income countries (1:180 vs 1: 4900). In

countries designated as fragile states, the risk is 1 in 54; a consequence of breakdowns in health systems (WHO, 2015).

Advances on Maternal Health: In 2000, 189 member states of the United Nations adopted eight Millennium Development Goals (MDG) (United Nations, 2000). The fifth MDG aimed to reduce maternal mortality worldwide by 75% between 1990 and 2015 with an annual average of 5% (United Nations, 2000, United Nations, 2013). In sub-Saharan Africa, a number of countries halved their levels of maternal mortality since 1990. In other regions, including Asia and North Africa, even greater headway was made. Also, between 1990 and 2015, the global maternal mortality ratio (i.e. the number of maternal deaths per 100 000 live births) declined by only 2.3% per year. However, increased rates of accelerated decline in maternal mortality were observed from 2000 onwards. In some countries, annual declines in maternal mortality between 2000-2010 were above 5.5%, the rate needed to achieve the MDGs. Despite a 43% decrease in maternal mortality from 1990 - 2014, the annual rate of decline has been far below the MDG 5 target (WHO, 2014; UN, 2013, 2015; Lozano et al., 2011).

However, seeing that it is possible to accelerate the decline, countries have now united behind a new target to reduce maternal mortality even further. One target under Sustainable Development Goal 3 is to reduce the global maternal mortality ratio to less than 70 per 100 000 births, with no country having a maternal mortality rate of more than twice the global average (WHO, 2015)**.**

The case for maternal health medicines: Most maternal deaths are preventable because health-care solutions to prevent or manage complications are well known: access to antenatal care in pregnancy, skilled care during childbirth, and care and support in the weeks after

childbirth. It is particularly important that all births are attended by skilled health professionals, because timely management and treatment can make the difference between life and death for both the mother and the baby (WHO, 2015).

Based on these evidence, WHO provided recommendations for the essential interventions and medicines needed to improve maternal health and prevent these maternal complications [WHO, 2011b; WHO, 2012; WHO, 2013; WHO, 2012c). Oxytocin, misoprostol, and magnesium sulfate—are medicines that prevent and treat these two leading causes of maternal death worldwide: excessive bleeding after childbirth and high blood pressure during pregnancy.

Oxytocin is recommended to prevent and treat excessive bleeding (post-partum hemorrhage) after childbirth. It is delivered through an injection. Misoprostol is recommended to prevent and treat excessive bleeding after childbirth when oxytocin is not available. It comes in tablets that are taken orally (Carroli, Cuesta, Abalos, & Gulmezoglu, (2008). Magnesium sulfate is recommended for treating high-blood pressure (pre-eclampsia and eclampsia). It is administered by an injection and needed at all levels of the health system where women seek care (WHO, 2012).

The need for these three medicines are universal and present wherever deliveries occur: from urban hospitals to rural clinics and homes, where more than 50 percent of women in developing countries deliver their babies (Montagu, Yamey, Visconti, Harding, & Yoong, 2011). But women who do not receive the necessary antenatal care miss the opportunity to detect problems and receive appropriate care and treatment in the event of the pregnancy related complications (WHO, 2015).

While levels of antenatal care have increased in many parts of the world during the past decade, poor women in remote areas are the least likely to receive adequate health care during pregnancy and childbirth (WHO, 2015). This is especially true for regions with low numbers of skilled health workers, such as sub-Saharan Africa and South Asia. For instance, only 51% of women in low-income countries benefit from skilled care during childbirth and only 40% of all pregnant women have the recommended antenatal care visits. This means that millions of births are not assisted by a midwife, a doctor or a trained nurse. The high number of maternal deaths in some areas of the world therefore reflects these inequities in access to health services, and highlights the gap in the health system (WHO 2014). Expanding access to essential maternal health medicines would lower maternal death rates and improve maternal health (Wagstaff, 2004).

Studies Related to Key Constructs and Methods

Oliveira et al (2002) carried out an implementation analysis to assess the success and quality of implementation of programs on access to pharmaceutical care by people living with HIV/AIDS in Brazil. Their approach focused on the process of producing outcomes and held relationships as a central tenant of how a program interacts within their organizational context. This approach allowed for continuous quality improvement because it takes into account the dynamic nature of the system and considers relationships and linkages across several components of the health system (Oliveira et al., 2002)

Logie and Harding (2005) used a multi-method approach to evaluate Uganda's morphine access program which handles chronic pain for cancer, HIV/AIDS and pain from sickle cell crisis. The program was evaluated from three perspectives – legislative, clinical, and community.

They used structured interviews, direct observation, and two sets of audits to capture the complexity of pain care delivery system in Uganda. This three-pronged approach combined with their consideration of the various aspects of the health system allowed Logie and colleagues to explore the unintended outcomes of the drug policy in Uganda as well as process barriers faced by various actors. It also allowed the authors to better predict the how the drug supply chain could affect end users and how to improve on it (Logie &Harding, 2005).

Windisch et al (2011) used a mixed methods approach to explore the interaction within and across various components of Uganda's drug supply management systems. WHO's health systems framework for action that outlined seven health systems building blocks guided this systematic study. The study applied the principle of 'path dependence' to consider initiating conditions and the history of supply chain management in the country. Windisch et al (2011) captured perspectives through key informant interviews, and laid out how the different pieces of the system fits together, and how one part of the system affects the other. The authors also showed feedback loops that pointed out unintended effects.

In 2012 also, Xiao, Zhao, Bishai, & Peters carried out a qualitative study in rural China. Their study evaluated a national drug policy's implementation for its intended outcomes and unintended consequences. Xiao, et al., (2012) identified policy implementation actor involved and their roles. In depth key informant interviews were used to understand the motivations of the actors. They also considered the relationships and feedback loops created by the action and responses of these actors to the policy and system. This study accounted for the systemic changes caused by emerging patterns and activities by actors in a policy. A key finding from the study was that policy and behavior of certain actors give rise to behavior patterns by other actors which

in-turn give rise to self-organization, and a system that this is greater than the sum of its paths Xiao, et al., (2012).

Another study in Iran looked at National Drug Authorities. In this study, Abdollahiasl et al., (2014) built a system dynamics model to visualize the effects of market variables involving the 5 P's (Product, Price, Promotion, Place, People) on access, availability, affordability, quality and rationality (Abdollahiasl et al., 2014). The authors also created a stock flow diagram that allowed them to explore processes and evaluate policy approaches used to facilitate decision making. Their model simulated what the system flow and outcome would be - including positive and negative effects, with changes made at various levels of the system. Abdollahiasl and colleagues also suggested that their model can be manipulated depending on what researchers and policy makers would like to focus on as central concepts. For example, in this study, while affordability and availability were the core of the model, quality and rationality were also tested in terms of how they affect the system.

Camaroon et al., (2009) did an analysis of secondary data on medicine prices, availability and affordability for 30 WHO essential medicines in 36 LMIC including some uteronics – which was only reported for a handful of countries.

In 2010, Ridge et al. proposed the development and use of a fishbone diagram to rapidly assess the barriers and facilitators to the availability and use of MgSO4 in Zambia. They used this diagram as a conceptual framework to identify barriers and facilitators to the availability and use of magnesium sulfate. However, this was a smaller scale case study at the facility level and therefore did not explore factors across the health system based on interviews and focus groups. It did however provide a strong basis for demonstrating complexity in translating research to

practice, and it provided an effective way to understand barriers at the regulatory/government, supply, procurement, distribution, health facility and health professional levels. Sevene, et al (2005) did similar study in Mozambique and Zimbabwe where they reported on barriers to the use of MgSO4 in these countries.

In their study to examine the inclusion of the priority medicines for maternal and child health on national essential medicines lists, Hill, Yang and Bero, (2012) examined publically available collection of the national essential medicines lists that have been submitted to WHO by member states in the last 10 years (WHO, 2016). Only countries that had the most-up-to date list in this time-frame were included in the study. Each EML was then evaluated for congruence with WHO "list of priority medicines for Mothers and Children 2011(Hill, et al., 2012). HIV medicines were excluded from the list because most countries have separate platforms for purchasing HIV medicines. 'Missing' were also excluded because these formulations either do not exist, or have not yet been fully commercialized. The authors compared specification of the drug as the International Nonproprietary Name (INN), dosage form, and strength dose combination of TB medicines is not available.

Smit et al. (2014) carried out a key informant survey in 37 LMIC to identify both national and global gaps in PPH and PE/E program priorities and to highlight focus areas for future national and global programming. The survey looked at the three essential maternal health medicines of interest in this study, and consisted of a 44-item questionnaire that addressed 6 core programmatic areas: policy, training, medication distribution and logistics, national reporting of key maternal health indicators, programming, and challenges to and opportunities for scale up.

An interesting aspect of Smit et al. (2014) study is the inclusion of certain programming indicators that could serve as objective pointers to access and use of these medicines in LMIC.

Bigdeli et al (2013) used mixed methods including policy document review, key informant interviews, focus group discussions and direct observation at health facility to explore use of magnesium sulfate for sever pre-eclampsia and eclampsia in Pakistan. They used a fish diagram to identify causal pathways and in the process highlighted barriers and enablers of access to magnesium sulfate. Their study considered the following levels of health system - individual, households and communities; health service delivery; health sector; national level beyond the health sector and international level. They conducted interviews and focus groups to capture the multitude of factors and actors at play in preventing or facilitating access to and appropriate use of magnesium sulfate; and to provide further interpretation of the fish diagrams nodes. Context specific health system barriers and enablers were identified and their capacity to affect access and use of magnesium sulfate was used to make policy recommendation.

A major strength of their study was the triangulation of data sources and methods of collection – as it allowed for more comprehensive exploration of the different levels of the health systems as well as the various building blocks of the health system. Context specificity is also an important strength of this study in improving availability and use of medicines within the service delivery system used to map determinants of access to and use of life saving maternal health medicines at all five levels: health sector and health service delivery levels.

Tran and Bero (2015) analyzed seven UNFPA/WHO reports published in 2008–2010. These reports summarized country–wide rapid assessments of access to and use of essential medicines for maternal health in Mongolia, Nepal, Laos, the Democratic People’s Republic of

Korea (DPRK), the Philippines, Vanuatu, and the Solomon Islands. Tans and Bero used a “fishbone” (Ishikawa) diagram as the analytic framework to identify facilitators and barriers at four health–system levels: government/regulatory, pharmaceutical supply, health facility, and health professional.

Something of note is that the majority of these studies that explore access to uteronics used similar methodology, constructs and variables in their research. For instance, Smith et al., (2011) administered a 44-item survey addressing 6 core programmatic areas: policy, training, medication distribution and logistics, national reporting of key indicators, programming, and challenges to and opportunities for scale-up. Trans and Baro (2015) explored the following measures for oxytocin, Ergometrine and magnesium sulfate in their study: (1) need and demand, (2) availability, (3) presence on essential medicine lists, (4) inclusion in standard treatment guide lines and protocols, (5) rational use, (6) licensing and areas of quality assurance, (7) storage, (8) procurement and supply chain, (9) costs, and (10) coordination and integration between public and private collaboration efforts. A couple other studies (Tran and Bero, 2015, Ridge et al., (2010). Bigdeli et al., 2009; SeveneSevene, et al., 2005) considered health systems barriers and facilitators to access to one or a combination of maternal health medicines in LMIC.

Health Systems and Access to Medicines

Defining health systems: The WHO defines a health system as a system "whose primary purpose is to promote, restore, or maintain health" (WHO, 2000). According to WHO (2000), health system activities range from direct service provision through clinics and hospitals to community level prevention strategies and health education.

In other to ensure stakeholders have a shared understanding of what health systems are and actionable points for strengthening health systems, WHO developed a framework comprised of six building blocks of a health system: 1) health service coverage, 2) human health resources, 3) health information systems, 4) medical products, vaccines and technology, 5) health financing, and 6) leadership and governance (WHO, 2007). These building blocks are expected to support a "health system that can prevent, treat and manage illness and to preserve mental and physical well-being for all individuals equitably and efficiently, within a specified geographic area" (WHO, 2007, p. 2).

Defining and Measuring Access: Although the concept of access - broadly is commonly thought to be quite complex, researchers have explored the concept in health care since the 1970's, and have put forward a myriad of definitions (Srivastava, 2011; Donabedian 1972; Aday & Andersen, 1974; Penchansky, 1977; Gulliford, Figueroa-Munoz, et al. 2002; Oliver & Mossialos, 2004). In terms of measuring access, the literature does not present a clearly defined pattern for measuring access since multiple factors affect access to medicines including health facilities, service providers, money, knowledge and beliefs (Hausmann-Muela, 2003). However, it is common to find access being measured based on dimensions suggested in 'access' definitions and according to the particular access topic being investigated e.g. health care, medicines, etc.

Service utilization - Donabedian (1972) defined proof of access to be the use of service rather than whether the facility exists – as suggested by other researchers. He also proposed that access should be distinguished between two components: initiation and continuation

(Donabedian 1972) Aday and Anderson's (1974) point that the potential to utilize was distinct from utilizing a service or gaining access appear to align with Donabedian's (1972) assertion.

Similarly, Wagstaff & van Doorslaer, (2000) defined access as the utilization of health services or treatment. According to them, utilization of health services did not depend on the availability of treatment opportunities alone, but includes the extent to which individuals avail themselves of the opportunities (Wagstaff & van Doorslaer, 2000a).

Interaction between individuals and a health system - Other researchers like Penchansky (1977), Mooney (1983), Oliver and Mossialos (2004) thought that access should not be only construed as utilization of health services, but should include the interaction between an individual and the health system. Access should also demonstrate a sync between demand and supply related factors (Donabedian 1972; Penchansky 1977; Gulliford et el., 2002; Oliver and Mossialos, 2004). It should relate to factors beyond time and monetary cost of seeking care (Le & 1982; Mooney,1983), but extends to include income (Olsen, & Rogers, 1991), services, quality, personal inconvenience, cost and information (Goddard & Smith, 2001).

Accordingly, in 2002, Gulliford et al proposed the following dimensions as measures of access: Availability of Health service - which focuses on the supply and utilization of health services; Health service outcomes which depicts how relevant, effective and quality services are; Equity of access - which relates to the extent to which people access services in proportion to their needs.

Some researchers like Palmer (2008) have also proposed simpler measures like equality of expenditure (the extent to which monies spent on people are the same) or equality of utilization (the extent to which people equally use a health facility).

Similarly, Thiede et al. (2007) defined access more broadly as "freedom to use health services" (Thiede et al., 2007, p. 105). Their definition considered three dimensions: availability; affordability, and acceptability of health services. In their view, availability refers to the extent to which needed services are available, within geographical reach and equitably distributed across different population groups. Affordability refers to the financial access in the broadest sense (e.g. direct costs, indirect costs, household financial wealth). In this regard, other researchers have advocated for measures like use of health care, Out- of-Pocket (OOP) payments for health services, health status, mortality, or funding allocated from governments (Brockerhoff and Hewett, 2000; Dayton et al. 2000; Makinen, Waters, et al. 2000; Wagstaff, 2000b). Acceptability refers to how patients perceive health services including health worker attitude to patients, cultural attitudes of patients towards health care services, condition of premises, waiting times, duration of consultations, and quality of care in public versus private facilities.

Access to Pharmaceuticals: Some researchers have used models of health services utilization to define access to pharmaceutical products because access to medicines is considered to be a subset of health services utilization (e.g., Kloos et al., 1986; Miralles and Kimberlin, 1998). However, a couple of disadvantages exist with strictly using "utilization" to describe access (Aday & Andersen, 1981). Firstly, utilization does not capture all aspects of access. For instance, the difference between health service utilization and access to medicines is quite distinct: unlike health service utilization, both pharmaceutical products and pharmaceutical services impacts access to medicines. So defining access strictly by service utilization leaves out the opportunity to understand the role of pharmaceutical product characteristics in determining

access. It also does not reflect individuals who need health care but do not receive it (Aday & Andersen, 1981).

Furthermore, utilizations may identify equity challenges in the distribution of health care services but it may not fully capture the appropriate level of quantity or quality of care (Thiede et al. 2007). For instance, the utilization pattern may be skewed towards lower income groups but this may be because the alternatives for the poorer segments of the population are unaffordable (Thiede et al. 2007). Consequently, access to medicines needs to be considered in terms of the service as well as the goods that are delivered by the service.

In addition, Kloos et al., (1986) noted that when defining access to pharmaceutical products and services, it is important that definitions of access to pharmaceutical commodities extend beyond explaining utilization by "entry use" through a prescription from a health care professional to incorporate utilization patterns in the informal sector and in self-medication (Miralles and Kimberlin, 1998). This is because many drugs are available to the general public in a relatively uncontrolled environment. For most medicines, consumers are allowed greater leeway in personal decision making about drug use than are patients seeking care in treatment facilities (Kloos et al., 1986).

Furthermore, the issue of 'pharmaceutical integrity and bioequivalence of the product as well as the quality of the services that affect the appropriate use of the product' comes to play in defining access to pharmaceuticals. In this regard, Miralles and Kimberlin, (1998) suggested that considerations for access to pharmaceutical products should incorporate access to information needed to make appropriate decisions regarding availability and use of the product. Information in this context include all aspects of drug supply chain including selection, procurement,

distribution and use. They should also address concern regarding the continuity or sustainability of access to pharmaceutical products and services, especially for use in chronic or endemic situations.

Determinants of Access to Medicines

In this section, we discuss the literature regarding determinants of access to medicines from two dimensions that appear to be common themes - theoretical propositions and empirical research findings. These represent rationale for selection of variables proposed for this study. Multiple Conceptual Propositions that attempt to explain factors that determine access to medicines are discussed in following paragraphs.

WHO-MSH 2000 framework: WHO-MSH 2000' ATM framework was the first 'Access to Medicines' (ATM) framework that attempted to define how access to medicine should be measured from a health systems perspective. It was developed in 2000 during a WHO-MSH consultative meeting in Ferney–Voltaire (Centre for Pharmaceutical Management, 2003). This framework was informed at the time by 1) WHO Medicines Strategy: Framework for Action in Essential Drugs and Medicines Policy, 2000–2003 (WHO, 2000), 2) Country experiences with using existing pharmaceutical sector indicators, and 3). Penchansky and Thomas's (1981) 4As of access framework: 'Availability', 'Accessibility(geographical)', 'Acceptability' and 'Affordability', with 'Quality' of products and services as a cross-cutting determinant – which also represents the dimensions for WHO-MSH framework. Also, each of the A's had two demand and supply focused indicators.

The WHO 2004 'Equitable Access Framework: The WHO 2004 'Equitable access to essential medicines' framework was the next major access to medicine model that evolved. This

framework was developed because there was global recognition that in the last two decades prior to this time, tremendous progress had been made in ensuring access to medicines globally, but significant equity gaps remained (WHO, 2004).

Not everyone had benefited equitably from global improvements in the provision of less costly and more effective treatments with essential medicines. The WHO (2004) model proposed that four dimensions of a system predicts access to medicines - 1) Rational selection and use, 'Affordable prices', Sustainable financing, 'Reliable health and supply system.

Rational selection emphasize the need to rationalize medicine choices (WHO, 2004). In other words, countries needed to identify, give preference and promote access to those medicines that will have the greatest impact in a given health care setting – This concept was later referred to as essential medicines list (WHO, 2007). 'Rational use' proposes to improve use of medicines by consumers. That is, to ensure safe and effective treatments, and minimize the risks and waste linked to irrational prescribing and use of medicines through trained medical personnel's and adequate diagnostic equipment's. 'Affordable prices' relates to supply-side aspect of affordability.

'Sustainable financing' is viewed in the context of overall health care financing, and addresses resource mobilization and pooling (public funding, donor assistance and development loans, donor funding for and donations of medicines), and reduction of out-of-pocket and catastrophic expenditures. The 'reliable health and supply system' dimension of the WHO -2004 framework assume that among the many elements of an effective health and supply system, four elements are most important in supporting access to essential medicines are: Health sector development (human resources for health, health equipment's, hospitals, etc.), public-private-

NGO mix, regulatory control, procurement co-operatives, and Traditional and complementary medicines.

Frost and Rich framework: Frost and Reich (2010) examined how poor people in poor countries access health technologies, including medicines. In their model, they adopted a 4A framework for ATM - though different from the WHO-MSH 4A model (Table 1.2): 'Architecture', 'Availability', 'Affordability' and 'Adoption' are the determinants of access. In their framework, 'Availability' represents supply and includes manufacturing, forecasting, procurement, distribution and delivery functions. 'Adoption' represents demand at all levels. 'Affordability' integrates costs, at government, non-government and end-user levels. All three are coordinated by organizational relationships at national and international levels, represented in the pharmaceutical 'Architecture' function.

Table 2

Domains and Determinants Covered in Existing Frameworks for ATM

ATM Framework	Domains	Specific Dimensions	Cross-cutting Determinants
WHO-MSH 2000 (Centre for Pharmaceutical Management, 2003)	Availability	Medicines' supply—type and quantity, Medicines' demand—type and quantity	Quality of products and services
	Affordability	Prices of drug products and services, User's income and ability to pay	
	Acceptability	Prices of drug products and services, User's income and ability to pay, Characteristics of products and services	
		User's attitudes, expectations of products and service	
	Accessibility	Medicines' supply location, User location	
WHO (2004c	Rational Use	Rational therapeutic choices, Improved medicines' use by consumers	Quality of medicines
	Affordable Prices	Medicines' pricing policies,	
	Sustainable Financing	Resource mobilization, Pooling, Reduction of out-of-pocket expenditures, Reliable health and supply systems	
	Reliable Health and Supply Systems	Medicines procurement and supply, Regulation, Human resources	
Frost and Reich (2010)	Availability	Manufacturing, Forecasting, Procurement, Distribution, Delivery	Architecture: organization relationships at national and international level
	Affordability	Government affordability, Non-governmental agency, affordability, End-user affordability	
	Adoption	Global adoption, National adoption, Provider adoption, End-user adoption and appropriate use	
Bigdeli et al' 2013	Individual, household, Community	Perceived quality of medicines and health services, Cost of medicines and services, irrational health-seeking behavior, demand for and use of medicines, Social	

	and cultural barriers (stigma related to poverty, ethnicity, and gender)
Health service delivery	Irregular availability, High medicine prices Irrational prescription and dispensing, Low quality/sub-standard and counterfeit medicines, Low quality of health services, Competition between public and private health service delivery
Health Sector	Pharmaceutical sector governance, Medicines price control,
	Weak health sector governance affecting all health system
	building blocks, Health sector pluralism and stewardship over private sector
Public Policies Cutting Across Sectors	Low public accountability and transparency, Low priority attached to social sectors
	High burden of government bureaucracy
	Conflict between trade and economic goals for pharmaceutical
	markets and public health goals
International and Regional Levels	Unethical use of patents and intellectual property rights, International donors' agenda, Distorted research and development, not targeting disease burden in LMICs

Source : Bigdelo et al., (2013)

Bigdeli framework*:* In 2013, Bigdeli et al developed an 'access to medicines from a health systems perspective' model. This model was proposed as a paradigm shift from traditional access to medicines frameworks (discussed further latter in this chapter) which only partially addressed the full range of 'access to medicines' predictors. It is intended to promote a systems approach to improving access to medicines, to ensure that policies are more effective and generate longer-term equitable and sustainable results.

This 2013 framework proposed that different elements of a health system predict access to medicines: Characteristics of individuals, households and communities; resources, service delivery, and governance (Bigdeli et al., 2013). These elements interact with each other in multiple and dynamic ways, are supply and demand- driven, and occur at different levels: (1) individual, households and community level; (2) health service delivery level; (3) health sector level; (4) national level beyond the health sector (public policies cutting across sectors) and (5) international/regional levels (Bigdeli et al., 2013). Some authors categorize the 'individual, households and communities' elements as demand -side determinants, and resources, service delivery, and governance as supply side determinants (Ensor and Cooper 2004; Peters et al. 2008; Jacobs et al. 2012).

Bigdeli et al (2013) framework was based on recognition that previous models emphasized more of supply-side approaches to address demand-side constraints. Previous models also tended to focus more on products than service delivery. Except for the WHO-MSH (2000) model – which seems to be clearly centered on health service delivery, and the WHO health systems framework – which was more encompassing, all others centered on the medicines/medical products (Bigdeli et al., 2013). Bigdeli and colleagues also noted that governance in all three models focused on the pharmaceutical sector, and there are minimal linkages with national policies beyond the health sector. Their model considers equally, both supply and demand-side approaches, as well as products and services from both pharmaceutical and non-pharmaceutical perspectives. Their model also incorporates ATM predictors from both the health sector and non-health sector and advocates for approaches that weaves ATM into other aspects of a health system.

Findings from Past Research

Socio-economic and demographic determinants: Different measures of equity and economic status have been considered as predictors of access in developing country settings (Wagstaff 2000b), Wagstaff (2000b) and colleagues looked at the population according to subgroups like wealth quintiles (Wagstaff, 2000b), gender and ethnicity (Brockerhooff & Hewett, 2000), health condition (Gakidou, Murray, et al., 2000) geographical location, age, education or occupation (Gwatkin, 2000b). Household consumption, expenditure, or asset ownership, are also common proxies used in the literature, and are considered better measures in these settings. Income data are not considered reliable measures because there can be under-reporting. They can also be seasonally dependent and do not necessarily capture longer-term income or permanent wealth in low -income settings (Makinen et al. 2000; Palmer 2008).

Social status is also commonly considered as predictors of access and education and occupation are more commonly used as proxies for social status. For example, data sets from the Demographic and Health Surveys allow analysis of household assets by creating an asset index and the application of principal component analysis (Filmer, & Pritchett, 2001).

Heller (1982) and Dzator et al. (2004) also looked at distance and time as predictors of access. While distance is typically modelled as distance from health facility, time related information is analyzed as time spent traveling to the health facility, waiting time and treatment time. For example, Heller (1982) found that a 1% increase in waiting time will affect the probability of demand by -0.02% to 0.02%. Dzator et al. (2004) found that a 1% increase in distance will reduce the probability of demand for treatment by -0.36% at a public provider. However, a limitation with findings related to time and distance is that most studies use

aggregate level data rather than household level (Srivastava, 2011). It may be worth noting that the "time' indicator has also been used as indicator for health service delivery.

Health systems determinants: While systemic determinants may include a variety of factors, the literature regarding access to medicines and uteronic appear to be heavy on a few. The robustness of a public health system has been highlighted as a necessary component to achieve the Millennium Development Goals (MDG) (Farahani, Subramanian & Canning, 2009; Freedman et al, 2005). Hoppu, Ranganathan, & Dodoo, 2011; Oshikoya, and Senbanjo, (2010) in summary noted that reasons for the lack of essential medicines include fragile supply systems, out-of-pocket payments which make the medicines unaffordable, and poor quality products.

Additionally, Ridge et al.(2010) identified the following requirements (or critical components) for adequate access to and use of MgSO4 in their Fishbone Diagram: inclusion of MgSO4 in National Essential Medicines List (NEML) and Standard Treatment Guidelines (STG), registration in the country for use in treatment of severe pre-eclampsia and eclampsia, presence of a suitable procurement and distribution system, presence of a suitable local protocol for use by health facilities providing basic and emergency obstetric care, awareness and adequate training of health professionals on the use of MgSO4 as first line treatment for severe pre-eclampsia and eclampsia, availability of supplies and equipment to administer MgSO4 at facility level. These are discussed in greater details in following sections.

Leadership, governance and policies - Muldoon et al (2011) found that the more corrupt a government is perceived to be (i.e. lower CPI score) the stronger the association with increased rates of infant, child and maternal mortality. As health systems are publicly administered and require strong national commitment and resources, a corrupt government runs

the risk of diverting public health resources for private gains (Pinzón-Flórez, et al., 2015). Corruption is also found to be an indication of "The establishment, application, and follow-up of rules for the health system; the extent to which there is equality of conditions for all the agents of the system; and, the definition of the strategic agents for the health system as a whole." (Pinzón-Flórez, et al., 2015).

National policies were also identified as critical predictors of access to uteronics – the most popular being the presence of uteronic in global and national essential medicines list. Smith et al., (2014) found that countries that reported infrequent availability of misoprostol noted a lack of a national policy supporting misoprostol as a principle cause. Similarly, Tran & Bero, (2015) found that the first common facilitator of quality use of oxyttocine egometrin and magnesium sulfate at the government policy level was that all three essential medicines were consistently listed on national EMLs.

Ridge et al. (2010) also identified inclusion of MgSO4 in National Essential Medicines List (NEML) and Standard Treatment Guidelines (STG), as precursor to adequate access to and use of MgSO4. Bigdeli, Zafar, Assad, & Ghaffar, (2013) found that lack of adequate translation of national policies into implementation arrangements was an important determinant of access to and use of MgSO4. They are related to fragmentation of procurement and supply based on demand from practitioners rather than on NEML or national policies Bigdeli, Zafar, Assad, & Ghaffar, (2013).

Pharmaceutical supply system and market dynamics - Reasons for the lack of essential medicines include fragile supply systems (Hoppu, Ranganathan, & Dodoo, 2011; Oshikoya, & Senbanjo, 2010), (Hill, Yang & Bero, 2012) thought that essential medicines should

be manufactured according to quality standards, licensed for use by regulatory authorities, on essential medicines lists, part of national standard treatment guidelines, procured from the supplier of a quality product, in the supply chain, and prescribed by health care professionals who know how to use them (Hill, Yang & Bero, 2012).

In Zambia, the major barrier to availability within the public health system was lack of procurement by the Ministry of Health (Ridge, Bero, & Hill, 2010), (Javadi & Bigdeli, n.d) thought that information systems can also play a critical role in drug supply management and avoidance of stock-Outs - a central tenet to poor access.

Sevene et al., (2005) identified a range of market and system failures that explained the use of MgSO4 in Mozambique and Zimbabwe: these include the low price of generic MgSO4 which is a deterrent to effective marketing practices by pharmaceutical companies and a lack of specific public intervention to correct the situation. Accordingly, Bigdeli, Zafar, Assad, & Ghaffar, (2013) found that De-facto monopoly of a single pharmaceutical company and a small market creates disincentive for marketing MgSO4.

Poor availability of magnesium sulfate may also reflect limitations of procurement systems. In one study, magnesium sulfate was not supplied to the lower levels of care because it was out of stock at the Central Medical Store (Ridge, Bero, & Hill, 2010). Affordable price of MgSO4 was added as a requirement.

Quality of product and services - In 1993, McPake noted that quality is a difficult factor to capture in both cross-section and time series analysis, and this theme seem to be widely allured to in the literature. This is because quality as a variable has multiple dimensions – such as availability, affordability, health human resources, and health service delivery. These dimensions

also happen to be used in other themes regarding access - either as standalone indicators of access and use of medicines or as determinants of access. Quality cuts across multiple levels of the health system including health service delivery, human resources, trainings, and products.

As a result, most quality and access studies are unable to capture some important dimensions of quality such as process and outcome (Sepehri and Chernomas 2001). They are also unable to control for the marginal influence of covariates. For example, drug availability – a widely used measure of quality in access to medicines is an important factor for patients but this measure is influenced by both demand and supply factors (Sepehri and Chernomas 2001).

That said, studies on quality for access have produced mixed results of its effect on utilization. While some studies suggest that perceived quality of care is an important predictor of health care utilization and success of health system financing reforms (Annis 1981; Wouters 1991; Barnum H and Kutzin J 1993; Lavy and Quigley 1993), others suggest otherwise. For instance, Bitran (1989) and Yoder (1989) found that utilization was lower where quality of care was perceived to be lower. Hutton (2004) and James et al. (2006) also had similar findings - utilization in smaller phased-in programs increased when combined with quality improvements.

Chalker (1995) found that an increase in drug availability led to increases in utilization after an initial drop due to the introduction of user fees. However, Deolalikar (1998) noted a couple of years later that even though drug availability provides useful information, it only captures one relevant aspect when used in and of itself, and cannot account for whether it would imply better treatment.

Wouters (1991) report of Denton, et al. (1990) and Akin, et al (1990) findings also indicated that in a region of Nigeria three aspects of quality were significantly associated with

utilization: percentages of years' drugs are available, operational cost per capita, and facility condition.

In contrast, Annis (1981) found that rural health posts had reasonable good quality of services but were not used. Denton, et al. (1990) and Akin, et al (1990) findings also indicated that machinery (x-ray machine and laboratories), number of support personnel, nurses and doctors per capita were not significant as well. In the same studies, investment in quality improvements were not offset by the revenue generation from user fees (Denton et al., 1990).

Service delivery affects how medicines can reach patients and the extent to which rational use of medicines are upheld and promoted (Rouse, 2008; Javadi, and Bigdeli, (n.d). Well- trained human resources are required for improved diagnoses, prescribing and dispensing practices as well as for supporting adherence to drug regimens where home - based care is necessary.

Also, a measure of quality as the probability of being seen by a physician was insignificant (Heller 1982; Mwabu, Ainsworth M et al. 1993). In the same vein, Muldoon et al (2011) used an amalgamated measure (i.e. nurses, doctors, skilled birth attendants) for human health resources and found that physician density, and health financing as measured by less out-of-pocket payments were associated with decreased mortality for infants and children. Ridge, et al., (2010) also found that a lack of in-service training in the use of a specific medication was a barrier to access to that medication.

Ridge et al (2010) identified access to antenatal care services as a requirement for access to and use of MgSO4. They also noted that lack of demand by health professionals at the health center level negatively affected access to MgSO4. Bigdeli, Zafar, Assad, & Ghaffar, (2013)

found that lack of adequate translation of national policies into implementation arrangements was an important determinant of access to and use of MgSO4. They are related to fragmentation of procurement and supply based on demand from practitioners rather than on NEML or national policies.

Ridge, Bero, & Hill, (2010) noted that persisting practices of using diazepam or immediate referral without stabilization also acted as bottlenecks to access of MgSO4. In their study, there were no local protocols nor referral guidelines, and therefore little support for health staff to use MgSO4. However, the fact that drugs are produced locally served as an enabler to access because the country is able to navigate the challenge of international issues, and price is lower, hence affordable.

Another enabler based on finding from Ridge, and colleague's study (2010) is that procurement was based on NEML, and health professionals were trained to administer and diagnose pre-eclampsia, and eclampsia. The fact that Magnesium sulphate was not supplied to the lower levels of care because it was out of stock at the Central Medical Store, served as a deterrent (Ridge, Bero, & Hill, 2010).

Haddad and Fournier (1995) found that in a rural setting in Zaire, a steady supply of drugs did not reverse a reduction in utilization, the competence of health care professionals, and the improvements in infrastructure and machinery. These findings were similar to those of Mwabu (1993) who found that greater availability of medicines had a negative relationship on utilization. But, Ridge et al. identified access to antenatal care services as a requirement for access to and use of maternal health medicines. They also noted that lack of demand by health professionals at the health center level negatively affected access to these medicines.

Health and pharmaceutical financing - Financing systems are a major bottleneck to access due to low affordability of drugs; without national policies to give universal access to essential medicines, those living below the poverty threshold are unlikely to access medicines when necessary (Javadi & Bigdeli, (n.d). Leadership and governance play an important role in preventing corruption and sale of drugs in black markets; regulation also serves to mitigate problems of counterfeits and substandard medicines (Javadi & Bigdeli, (n.d).

A limitation with studies that considered quality is that most of them were small scale, had short time horizons and lacked robust methods and design (e.g. randomized) (Srivastava, 2011). According to Srivastava, (2011) for most studies, findings were based on observation rather than modelling. As a result, it is difficult to properly assess the impact of quality on utilization.

Review and Synthesis of Studies Related to Key Independent and Dependent Variables

Many LMIC have elements in place to ensure access to essential maternal health medicines for addressing PPH and PE/E, but notable gaps remain in both policy and practice (smith et al., 2014). In this section, some of these as featured in the literature are presented. The availability of functional drug registration systems and manufacturing practices, and licensing status are also considered.

Medicines in Essential Medicines List: In 2007, WHO found that 131 of 151 countries surveyed had an essential medicines list (Hill, Yang & Bero, 2012). Twenty-four of the national essential medicine lists were last updated prior to 2007. There was one list from 1999; but all others prior to 2007 were from 2001 to 2007. The four priority medicines most recently added to the WHO Model Essential Medicines List were misoprostol, cefixime, nifedipine, and zinc, all

added in 2006. The more up to date lists were more likely to contain the four medicines added in 2006 than the older lists (Hill, et al., 2012).

Hill, et al., 2012) found considerable global variation in the listing of Priority Medicines for Mothers on national essential medicines list. Their findings demonstrated that for prevention and treatment of postpartum hemorrhage in women, oxytocin was more prevalent on the lists than misoprostol - included on 55 (62%) and 31 (35%) of lists, respectively – although misoprostol was more likely to be listed on country essential medicines lists in the WPRO region than any other region. (Hill, et al., 2012).

The authors (Hill et al., 2012) suggested that one reason for this may be that key opinion leaders in the region argued for the inclusion of misoprostol because, unlike oxytocin, it does not require refrigeration. In their view, the lack of cold storage in the region may have convinced medicines selection committees to add misoprostol. On the other hand, Magnesium sulfate injection for treatment of severe pre-eclampsia and eclampsia was on 50% (45/89) of the lists although they were not included consistently in national documents. Cefixime, for treatment of uncomplicated anogenital gonococcal infection in woman was on 26% (23/89) of lists.

Tran and Bero (2015) also observed that Oxytocin was included in the essential medicine lists (EML) of all seven countries they assessed. However, In Mongolia and the Solomon Islands, ergometrine was not listed on the national EMLs. It was however, licensed for use in three countries (Nepal, DPRK, the Philippines). Ergometrine and Syntometrine were recommended as first–line drugs for PPH in Vanuatu and on the Solomon Islands, respectively. MgSO4 injection - recommended for the prevention and treatment of eclampsia in women with

severe pre-eclampsia was also included as an essential medicine in the national EMLs of all seven countries.

Availability of Guidelines and Indications for Use*:* Tran and Bero (2015) found that Indications for use of Oxytocin were included in the EMLs of six countries, with the exception of the Philippines. A functional drug registration system in compliance with WHO–Good Manufacturing Practices guideline existed in all countries except the Solomon Islands. Data for oxytocin licensing status was not consistently reported across all seven countries. However, none of the oxytocin formulations were licensed in Laos. Standard treatment guidelines recommended oxytocin as a first line medicine for prevention of treatment of PPH in Laos, DPRK, and the Philippines. In contrast, Vanuatu and the Solomon Islands recommended ergometrine or syntometrine (combination of oxytocin and ergometrine) as a first - line drug treatment, which was not consistent with WHO evidence–based recommendations.

Indications for use of MgSO4 injection - recommended for the prevention and treatment of eclampsia in women with severe pre-eclampsia were clearly provided with the exception of the Philippines. In Laos, the recommended formulation (50% solution) was not found to be licensed or available; 20% and 15% formulations were observed in facilities. DPRK was the only country which reported translating and utilizing treatment guidelines for pre–eclampsia and eclampsia in partnership with WHO, UNFPA, and other national professional associations.

Furthermore, across all seven countries assessed in Tran and Bero's (2015) study, standard treatment guidelines were inconsistent, out–of–date, and not widely disseminated. In Vanuatu and on the Solomon Islands, Standard treatment guidelines for prevention and treatment of PPH and the use of ergometrine were unavailable or not updated according to the most current

WHO clinical guidelines. These countries recommended ergometrine or syntometrine (combination of oxytocin and ergometrine) as a first - line drug treatment, which was not consistent with WHO evidence–based recommendations.

In contrast, Laos, DPRK, and the Philippines recommended oxytocin as a first line medicine for prevention of treatment of PPH in line with WHO recommendation, the Standard treatment guidelines. But overall, the use of Egometrine as second-line treatment for prevention and treatment of PPH when oxytocin is unavailable or when bleeding does not respond to oxytocin was limited by its side effects and contraindication in patients who have high blood pressure.

Availability and Demand: Regarding availability of the three essential maternal health medicines, Tran and Bero (2015) found that availability of the three medicines varied by country and medicine. Oxytocin for example had high availability in six out of seven countries studied compared to ergometrine. The two exceptions were the Philippines and the Solomon Islands, where ergometrine was available in a higher percentage of facilities than oxytocin. In the same study, four countries had MgSO4 available in less than 60% of their facilities, with only 18% of health facilities carrying MgSO4 in Laos. According to them, calcium gluconate, a required antidote for MgSO 4 toxicity, was not consistently available when MgSO4 was present.

Similarly, Smit et al (2014) found that the vast majority of countries (34 of 37, or 92%) also reported regular availability of oxytocin in the national medical store or warehouse. Oxytocin and magnesium sulfate were also reported to be regularly available (available ‘more than half the time’’) in facilities in 89% and 76% of countries, respectively. However, only 27% of countries studied, however, noted regular availability of misoprostol in health facilities (smith

et al., 2014). The 4 countries that reported that oxytocin was not regularly available were Bangladesh, Liberia, South Sudan. Smit et al (2014) also noted that evidence collected from maternity units of hospitals with more than 1000 deliveries in Mexico and Thailand shows that MgSO4 is underutilized in women with eclampsia.

Hill, et al., (2012). Found that demand for MgSO4 at the health center level was apparently low, it was not clear however, if the problem of availability was due to lack of demand leading to a lack of supply or vice versa (Ridge, Bero, & Hill, 2010). Where there was demand by obstetricians, magnesium sulfate injection was being procured from the private sector by the hospital pharmacy despite not being registered and licensed for use for the treatment of severe pre-eclampsia and eclampsia by the national Medicines Regulatory Authority. However, as this assessment did not include an audit of clinical data it is not clear if this was because there were in fact few cases or that cases were being misdiagnosed (Ridge, Bero, & Hill, 2010). Cases of pre-eclampsia were infrequent at small hospitals.

Affordability of maternal health medicines: In terms of affordability, these medicines appear to be mostly provided for free. In Smith et al., (2014) study, about 70% of the countries (26 of 37) reported that oxytocin was provided for free to clients at public health facilities. In 9 countries, however, respondents reported that clients sometimes had to pay for oxytocin, even though national policy indicates that it should be provided at no cost. A substantial number of countries (25 of 37), however, also included diazepam for the same indication. Of the 20 SDGs reviewed, 6 showed incomplete or inaccurate instructions for the use of magnesium in severe PE/E, compared with the WHO standard protocol for use of the drugs.

Accessibility of maternal health medicines: Only 51% of women in low-income countries benefit from skilled care during childbirth (WHO, 2015). Most countries (31 of 37, or 84%) reported that midwives/skilled birth attendants (SBAs) were authorized to perform AMTSL, including administration of oxytocin. Fewer (29 of 37, or 78%) reported that midwives/SBAs were authorized to diagnose severe PE/E and to administer magnesium sulfate to treat the condition. Fewer still (26 of 37, or 70%) reported that midwives/SBAs were authorized to perform manual removal of the placenta. Also, sixteen of 37 countries (43%) reported that they were piloting or had piloted misoprostol for prevention of PPH at home birth; only 5 of 37, however, reported efforts to take this program to national scale. In follow-up qualitative responses, 7 countries reported that their governments do not support misoprostol for use at home births.

Operational Definition of Terms

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

Health System: consists of all organizations, people and actions whose primary interest is to promote, restore or maintain health (Zaidi, et al., 2013).

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

Essential Medicines: Medicines that respond to the priority health needs of a specific population (WHO, 2007).

Essential maternal health medicines: Medicines needed to prevent and treat pregnancy and childbirth related complication (WHO, 2007). In this study, these medicines will include oxytocin, MgSO4, and Misprostol.

Access: Availability at all times, adequate amounts, appropriate dosage forms, cost effective, proven efficacy, quality & safety (WHO, 2014). In this study, it refers to availability at all times, affordability and accessibility.

Availability of medicines: presence of oxytocin, MgSO4, and Misoprostol in health facilities and central medical stores; and the frequency of oxytocin and MgSO4 stock outs in health facilities and central medical stores.

Accessibility of Medicines: Misoprostol is piloted for home births, misoprostol is scaled up for home births, and number of ANC visits.

Affordability of Medicines: Medicines are freely available to women in the health facility and at home births.

Assumptions

Assumption 1

The data on access to medicines as well as health systems components may be under-or overestimations of the current situation and may introduce bias in the weighted results. The last survey took place about 2012. Since then, the multiple countries in the survey has experienced repeated political and economic instability. The current statistics are based on MCHIP and WHO

projections and may be far from reality. Using these estimates could result in under- or overestimated results.

Assumption 2

Countries studied were representative of the other countries in the region. The process of purposive sampling helped in selecting an unbiased sample of countries with maternal health programs.

Assumption 3

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

Scope and Delimitations

This study assessed the relationship between one dependent variable (access to essential maternal health medicines) and six independent variables (health system characteristics). In line with Ishikawa diagram – a complex adaptive system model, the study will examine a subset of determinants that could be related to access to maternal health medicines. For this reason, the selection of the independent variables prioritizes health system characteristics.

The choice of the cross-sectional design meant that the analysis aimed to establish the associations, not the cause-and-effect relationships or the reasons for these associations. This

study was limited to establishing the relationships between the health system characteristics and women's access to essential maternal health medicines.

For this project, study participants are represented by country programs for the prevention and management of postpartum hemorrhage and pre-eclampsia/eclampsia. The geographical areas of focus included countries in Africa, Asia, and Latin America, focusing on those USAID priority countries that face the highest burden of maternal morbidity. The results of this study are generalizable to the women needing access to essential maternal health medicines in the study areas.

Limitations

The study used a cross-sectional survey design that did not allow for manipulation of the independent variables or establishing the temporal sequence of events. For that reason, this study design could not establish a cause-and-effect relationship. In addition, the lack of manipulation may have weakened the study's internal validity.

Although the selection of study participants with ongoing national programs for prevention of PE/E was intended to minimize recall bias, there may have remained a likelihood of recall bias because study participants had to pull data from already existing sources.

Furthermore, the use of secondary data may result in missing other important variables for the analysis. The analysis will depend on the data collected through the MCHIP 2012 global survey and the WHO Pharmaceutical sector country surveys. Therefore, this study did not identify all possible factors associated with access to maternal health medicines; variables not collected through the MCHIP surveys and WHO Pharmaceutical sector country surveys will not be analyzed.

Summary, Significance, and Conclusions

Although reduced in recent years, maternal deaths due to Preeclampsia, Eclampsia, and PPH remains high. These pregnancy-related complications and resulting maternal deaths are not distributed evenly across the globe, but disproportionately affect women living in resources poor settings. To reduce the incidence of these deaths, WHO recommends that oxytocin is provided as a first-line PPH preventive intervention for facility-based deliveries and Misoprostol as an alternative for oxytocin – which can also be used for home deliveries. MgSO4 is to be used for treatment of PE/E.

Global and national organizations alike have implemented interventions to promote access to these essential maternal health medicines but gaps remain. Poor and vulnerable women still lack sufficient access to these medicines – as illustrated by current high maternal mortality ratios in these regions. There is evidence showing that the vertical approaches that characterize these efforts are not as effective as horizontal approaches that consider holistically, the dynamic interaction between components of the health system and access to medicine. According to the literature, the role of medicines is often narrowed down to a single isolated health system input instead of an integral part of a functioning health system that affects and is affected by other components. In this regard, the literature shows that in other to improve access to essential maternal health medicines, it is critical to understand and incorporate the full spectrum of the health system in research and practice regarding access to maternal health medicines (Paina and Peters, 2011; Bigdeli et al., 2013; p.2; (Adam, Ahmad, Bigdeli, Ghaffar, & Røttingen, 2011).

These recommendations - though recently recognized - appear to be characterized by debates regarding 1) how access to medicines should be defined, 2) which health system input

affect access to medicines, and 3) how each health system input interact with each other and with the desired outcome – access to and use of medicine.

In the early days, access was defined mostly from a supply side perspective. People were thought to have access to health services if facilities that provided the services were present. But subsequent studies started to demonstrate that this approach was less than comprehensive because the potential to utilize a service should be perceived as different from actually utilizing a service. Hence access should be defined and measured by actual utilization of service. Other studies further suggested that this definition should go beyond utilization to include the extent to which clients are able to continue utilizing services if needed.

While these dimensions of access may be applied to measuring access to pharmaceutical products like essential maternal health medicines, researchers suggest that they present with limitations if applied on their own. For example, defining and measuring access to pharmaceuticals through the lens of service utilization would not be sufficiently objective since it fails to account for the characteristics of the product delivered through a given service. It also leaves out the role of some pertinent demand and supply related factors that are typical to pharmaceutical products and are important aspects of a functioning health system.

As a result, a unique dimension was added by other researchers. In their view, access should be defined by the degree of interaction between supply (the health system) and demand (individual and household) related factors. In the last two decades, interest on this interaction seems to have increased.

Multiple frameworks have evolved. Most emphasize the 4As proposed by earlier researchers (Availability, Affordability, acceptability, Accessibility) but present more broadly,

dimensions that represent access constraints beyond the health sector. Dimensions recommended include factors related to the availability, affordability, and acceptability of products, health service outcomes, equity of access, and equality of expenditure. Examples of factors in these regard include time and monetary cost of seeking care (Le & 1982; Mooney,1983), household income, service quality, personal inconvenience, cost and information.

Other dimensions include those related to governance and policies internal and external to the health sector of a country. They include factors like public accountability and transparency, bureaucracy in governance and dynamics of trade and economic goals for pharmaceutical markets. International level influence like donor priority/agenda are also highlighted as key determinants of access to medicines.

However, studies on the relationship between these factors and access to maternal health medicines appear limited – both in number and scope (Bigdeli et al., 2012). They tend to focus on examining the relationship between single or a few select combination of health system factors on access to medicines, comparatively across countries – (on one occasion (Smith, 2011; Trans and Bero, 2015; Bigdeli et al., 2015). While some use implementation research methods – i.e. looking at how the quality of implementation program affect access - most were mixed methods studies that included structured interviews, observations, and periodic audits. In terms of analytical framework, some studies use the WHO health system framework, while the fish bone Ishikawa diagram appear more popular with studies on access to essential maternal health medicines. Common health system dimensions studied include governance and leadership, health service delivery, pharmaceutical supply systems, financing, and human resources for health. Common Access indicators include availability affordability, acceptability and rational use.

In terms of predictors of access, the most obvious themes observed in the literature included governance, pharmaceutical supply system and quality of products and services – although the impact of quality on access seem mixed –since quality is cross-cutting and touches on several core levels of a health system. Common governance indicators observed include – presence on essential medicines list, availability of necessary regulation, and national corruption index. Pharmaceutical supply system indicators appear to be procurement and logistics related. Examples of quality indicators that facilitate access include perception of clients, availability of services, efficiency of service delivery infrastructures, access to antenatal care services. However, in one study, physician density - though used as measure of quality - was not significantly associated with access.

According to the literature, most countries studied seem to have medicines on EML, but global variations exist. Overall Oxytocin was more prevalent on lists compared to Misoprostol. However, misoprostol was more likely listed on WPRO region than any other region. Inadequate provision for preservation was cited as a reason for this – since oxytocin require refrigeration but misoprostol does not. Availability of Standard Treatment Guideline seem inconsistent across countries. There seemed to be more demand for Oxytocin than for MGSO4. However, where there was demand for MGSO4, it was procured from private sector – even in countries where it is not being licensed for use for treatment. Availability of medicines in health facilities and central stores seems to vary by country and medicine. All three medicines seem affordable in most settings – as most are provided for free. Although in a few countries, women are made to purchase them, even when a national policy say it should be free. Accessibility is largely

impaired by poor access to skilled care, plus in most countries, midwives are not authorized to diagnose PE/E and administer MGSO4.

In conclusion, several factors are said to predict access to medicines more broadly. But, little is known about the relative impact of these dimensions on access to essential maternal health medicines. In order to best understand how innovations and interventions will affect access to essential maternal health medicines, the open and dynamic relationships that exist in a health system should be analyzed more so across geographies. Predicting patterns of emergent behavior from various sources will serve to enhance understanding and to better plan and evaluate interventions that can lead to improved access to medicines and in turn better health outcomes for women (de Savigny & Adam, 2009; Anderson and McDaniel, 2000; Plsek, & Wilson, 2001).

In this quantitative cross-sectional survey, I used the Ishikawa model as theoretical framework to examine the relationship between health system factors and women's access to essential maternal health medicine in Low and Middle-income Countries (LMIC). The Ishikawa diagram was suitable for this cross-sectional analysis since it allowed for accounting for various factors that potentially predict access at various levels, and has been previously applied to similar studies.

The evidence from this study could guide health policy makers and program managers in their efforts to build a health system that is responsive to the needs of rural women and children to save lives among vulnerable populations. Because of resource and data constraints, this study did not compare the relative impact of all factors predicting access to essential maternal health

medicines in all geographies. So analysis was limited to a few select health system indicators in some low and middle-income countries.

Section 2: Research Design and Data Collection

Introduction

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

Research Design and Rationale

This study was a quantitative cross-sectional survey using secondary data to determine the relationship between health system characteristics and access to three essential maternal health medicines. Cross-sectional surveys are commonly used research design in social sciences (Frankfort-Nachmias & Nachmias, 2008). The cross-sectional survey design used had some advantages and limitations. Some limitations include that it did not allow me to manipulate the independent variables or sequence the occurrence of events. For that reason, causal inferences and before-and-after comparisons was not possible (Frankfort-Nachmias & Nachmias, 2008). Further, it may have introduced recall bias since primary data was collected from information collected in the past (Rossetti, 2015).

Despite these limitations, the cross-sectional survey design was most appropriate for this non-experimental analysis. It gave a snapshot of the situation in the study location and allowed

for comparison between different or similar geographies at a point in time. This design also allowed for ease of administration of data collection materials telephone interviews, online platforms, mobile devices, mail, email, or computer kiosks. It also allowed for collection of large amounts of data to increase statistical power and allow more sophisticated analysis. It was cost effective when compared with experimental and cohort studies (Rossetti, 2015). As such, the use of secondary data for analysis in this study saved cost and time, and enhanced the privacy of study participants (Frankfort-, Nachmias & Nachmias, 2008).

Study Variables

The study aimed to investigate the nature of association between health system characteristics (the independent variables) and access to three essential maternal health medicines – the dependent or outcome variable. Frankfort-Nachmias and Nachmias (2008) defined dependent variables as those for which researchers work to explain change, and independent variables as those that explicate change in the dependent variables.

The independent variables were health-system characteristics that may influence women's access and use of these medicines. In this regard, five health system levels or domains was assessed: government and regulatory, pharmaceutical supply system, health facility, health financing, and health professional (health services). For each domain, two to three health system variables that best represent a domain were analyzed (table 3.1). The outcome variable for this study was 'access', defined as the availability, affordability and accessibility three essential maternal health medicines combined (Oxytocin, Egometrin and Magnesium Sulfate).

Table 3

Health System Determinants of Access to Maternal Health Medicines

Variable/Domain	Questionnaire Item
Governance/Regulation	1.Medicines approved at national level 2. Availability of Standard Treatment Guidelines 3. Policy provision for AMTSL 4.Good Governance
Pharmaceutical Supply	5.Procurement/ Logistics
Health Facility	6. Adequate Equipment's and Supplies 7. Education/Trainings
Service Delivery	8. Adequate human resources 9. Midwife/skilled birth attendants scope of practice
Health Financing	10.National Health spending

Note. These are the 5 health system characteristics identified as independent variables for the purpose of this study

Research Design Connection to the Questions and Scientific Knowledge

This study investigated the relative effect of selected health system factors on access to three live-saving maternal health medicines (Oxytocin, Misoprostol and Magnesium Sulfate). Past research has examined similar questions through mixed-method studies without manipulation and secondary data analysis of cross-sectional surveys. In that regard, the cross-sectional survey design used in this study has remained a popular research design in studies of the determinants of access to medicines and health systems (Ridge et al., 2010; Bigdeli, Zafar, Assad, & Ghaffar, 2013; Muldoon et al (2011; Denton, et al.,1990; and Akin, et al., 1990)

A cross-sectional household survey was considered more relevant for this study because of the paucity of data on access to live saving maternal health medicines. This study was implemented as a secondary analysis of data from quantitative cross-sectional facility and household surveys conducted independently by the World Health Organization (WHO) and the

United States Agency for international development (USAID) Maternal and Child Health Integrated Program (MCHIP).

As Frankfort-Nachmias and Nachmias (2008) observed, a secondary data analysis is less expensive than studies requiring primary data collection. In advancing knowledge, this study will be an initial step in establishing the relative effects of health system characteristics and access to essential maternal health medicines. It will lay the ground for further studies.

Methodology

Target Population

The USAID MCHIP survey included countries from Africa, Asia and Latin America - focusing on those USAID priority countries that face the highest burden of maternal morbidity. The WHO survey proposed for this study – the WHO pharmaceutical sector country survey was a comprehensive assessment of the pharmaceutical sector in countries in the same region.

Settings

The WHO pharmaceutical sector survey was implemented in nearly all WHO countries. In 2010, the country profiles project was piloted in 13 countries during 2011, the World Health Organization had supported all WHO Member States to collect similar pharmaceutical country data. It is a comprehensive assessment of the pharmaceutical sector aimed to measure key aspects of the pharmaceutical sector and systematically monitor the progress of efforts to improve access to essential medicines.

The USAID MCHIP survey assessed 37 national programs for the prevention and management of PPH and PE/E. The survey has been implemented twice (2011 and 2012). It

captured a cross-section of countries that are either priority countries within USAID's global health strategy, or engaged in relevant maternal mortality reduction efforts.

Sampling and Sampling Procedures

A sample is a subset of sampling units that has the attributes of the target population. It has to be representative to allow generalization of the findings to the entire population (Frankfort-Nachmias & Nachmias, 2008). In this study, the sampling unit was a country that implemented a national program for the prevention and management of PPH and PE/E, and participated in USAID MCHIP survey.

There are two main sampling designs: probability sampling and nonprobability sampling. This study will use the purposive non-probability sampling to base on set criteria (Frankfort-Nachmias & Nachmias, 2008). The inclusion criteria were countries with a national program for the prevention and management of PPH and PE/E who participated in the USAID MCHIP survey. The exclusion criteria included countries that did not participated in the USAID MCHIP survey.

Procedures for Archival Data

Main Study Data Collection

MCHIP Survey: Data collection was coordinated by the MCHIP maternal health team in Washington, D.C., during the months of January, February and March 2012. Contact information was compiled for an identified focal person in each of the 43 countries initially targeted by the survey. The contact list from 2011 was used and the individual's continuing engagement with national activities was confirmed. Additional sources were contacted in an effort to ensure that there was an appropriate coordinator for the data-gathering activities in each country.

The coordinator for each country was sent an e-mail with anticipated dates and activities six weeks in advance of receiving the survey. He or she was instructed to contact national counterparts in the government as well as leading implementing partners. The country coordinator was given a timeline of pending requests and asked to arrange meetings with national consultative groups to ensure a national participatory process for the completion of the survey instruments. In most cases this was possible. Key stakeholders from government, ministries, MCHIP programs, other USAID bilateral programs, UN partners and other implementing agencies met to collect data and respond to the 46-item questionnaire and the scale-up map. In most cases, these consultative groups found it necessary to meet twice to ensure accuracy and completeness of responses.

The questionnaire and scale-up maps were revised from the 2011 versions, based on responses, questions and feedback from the 2011 survey administration. Surveys were sent out via e-mail in English French and Spanish, and countries received copies of their 2011 surveys, which served as a starting point. Stakeholders met in-country to collect data and respond to the survey, and contacted the MCHIP maternal health team with questions. Responses were shared via e-mail in English, French and Spanish. Professional translators translated French and Spanish survey responses into English.

WHO pharmaceutical sector country survey: Data collection in all 193 member states was conducted using a user-friendly electronic questionnaire that included comprehensive instruction manual and glossary. Countries were requested to enter the results from previous surveys and to provide centrally available information compiled data comes from international sources (e.g. the World Health Statistics), surveys conducted in the previous years and country

level information collected in 2011.

Access to the dataset and permissions: Data set for both surveys are publicly available and can be found on the website of both organizations. An email will be sent to contact persons in both organizations to clarify any limitations to the use of data by the public for secondary analysis. Where relevant a data use agreement will be provided to clarify the details of the data elements needed, the responsibilities of the data provider and beneficiaries, and the boundaries of the data use.

Instrumentation and operationalization of constructs: The main source of information for this study will be the limited dataset provided by the WHO pharmaceutical sector country profile, and USAID MCHIP survey data - which contains the identified information. It includes relevant sociodemographic characteristics, health-system characteristics and access indicators for each country. Information on the health system characteristics encompassed indicators in five domains – government/regulator, pharmaceutical supply, health facility, health service delivery, and information systems – as shown in table 3.1.

The 46-item questionnaire included six core components: policy, training, drug distribution and logistics, national reporting of key maternal health indicators, programming, and challenges to and opportunities for scale-up.

Operationalization of Variable

Independent Variables

Independent variables for the study included: Medicines Approved at National Level, Accessibility of Standard Treatment Guidelines, Policy Provision for Active management of third stage of labor (AMTSL), Good Governance, Procurement and Logistics, Equipment's and

Supplies, Education/Training, Human Resources, Midwife/Skilled Birth Attendant Scope of practice, Health Spending, National Reporting on Selected Maternal Health Indicators. The USAID MCHIP survey instrument suggest that data was collected on these variables as outlined in Appendix 1:

Dependent Variable

The dependent variables included the availability, and accessibility of the three medicines in focus for this study. The USAID MCHIP survey gathered data on these variables as follows:

Availability of medicines: The dataset included information on the availability of oxytocin, MgSO4, and Misoprostol in health facilities and central medical stores; and the frequency of oxytocin and MgSO4 stock outs in health facilities and central medical stores.

Accessibility of Medicines: the dataset included information about home birth and ANC attendance. Specifically, data was collected on whether misoprostol is piloted for home births, misoprostol is scaled up for home births, and number of ANC visits.

Affordability of Medicines: The dataset included information on whether these medicines are freely available to women or not.

Data Analysis Plan

Statistical Software.

IBM SPSS Statistics 21 software was used to analyze data collected. The software was used to run both the descriptive and inferential analyses.

Data Cleaning and Screening Procedures.

Dataset contained about 41 variables needed for this analysis. As a first step, data was coded and inputted into SPSS. As next step, I produced frequency tables by variable to assess for

irregular entries. This step help me to check for coding errors, missing data, and outliers. Variables that have either outliers or more than 5% missing data were identified and excluded.

Research Questions and Hypotheses

The Study had five research questions:

Research Question One

1. Is there a significant association between governance and access to essential maternal health medicines in low and middle-income countries?

Ho1: there is no significant association between governance and access to essential maternal health medicines in low and middle-income countries?

Ha1: there is a significant association between the governance and access to essential maternal health medicines in low and middle-income countries?

Research Question Two

2. Is there a significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Ho2: there is no significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Ha2: there is a significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Research Question Three

3. Is there a significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Ho3: there is no significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Ha3: there is a significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Research Question Four

4. Is there a significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Ho4: there is no significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Ha4: there is a significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Research Question Five

5. Is there a significant relationship between health financing and access to essential maternal health medicines in low and middle-income countries?

Ho5: there is no significant association between health financing and access to essential maternal health medicines in low and middle-income countries?

Ha5: there is a significant association between health financing and access to essential maternal health medicines in low and middle-income countries?

Statistical Analysis.

Data Weighting.

The primary study selected a disproportional sample of 37 countries from Asia, Africa and Middle East regardless of continent. Therefore, the preparation for data analysis will include

the data weighting to account for population size (no of countries) differentials between the continents.

Testing for Multicollinearity.

Before running the full analysis, I tested for multicollinearity to ascertain the independence of independent variables from each other. Forthofer, Lee, and Hernandez (2007) defined multicollinearity as a significant correlation between independent variables that can negatively affect the regression estimates by inflating the variance and standard errors. Multicollinearity occurs when an independent variable is a duplicate of another variable or is a redundant variable that measures the same thing. The analysis included a pairwise correlation analysis that correlated independent variables with each other in a bivariate correlation matrix. Any bivariate correlation equal or above .80 was considered an indication of a potential collinearity between two variables (Field, 2013).

I also calculated the tolerance and variance inflation factor (VIF). Field (2013) defined Tolerance as the proportion of variance in the independent variable not attributable to the other independent variable: 1-R 2. The higher the tolerance, the lower the risk of multicollinearity. A tolerance of .10 or less is considered problematic. Likewise, the VIF reflects an inflation of the standard error due to multicollinearity: 1/ (1-R2). A VIF of 10 or more is considered problematic (Field, 2013; Forthofer et al., 2007).

Checking for Outliers.

I checked for the presence of outliers on originally numerical variables. Field (2013) defined outliers as values that are either extremely high or extremely low in the data (Field, 2013). They have the potential to skew the data in one direction or the other and bias the

statistics. I will use the descriptive analysis function of SPSS to compare the mean and trimmed mean – mean without the 5% lowest and highest values – to see if there is a considerable difference. Besides, Z scores were created to identify outliers as all values with Z scores above 3.29. Furthermore, a graphic presentation using histograms and boxplots was used to spot the outliers.

Descriptive Analysis.

The first step was to compute a total score for all items representing each variable (in table 3.1) and set cut-off score for variable categories. Then convert each variable into dichotomous variable (e.g. Highly available, Poorly available; highly accessible, poorly accessibility; highly affordable, poorly affordable).

The second step of the descriptive analysis included a chi-square test to analyze the proportion of countries by variable category and estimate the standard deviations. The comparison also focused on comparing each variable category with sociodemographic characteristics, and each independent variable. A p-value < .05 was considered statistically significant. The variables achieving a p-value < .05 indicated the characteristics of difference between the two groups of countries. These two analyses will help to identify the independent variable categories with high access.

Inferential Analysis.

For the inferential analysis, applied the logistic regression in two steps to assess the association between health system variables and access to focus medicines.

First step or Model 1. included a bivariate analysis of the crude association between each of the 6 dimensions and 16 health system variables (table 3.1) and two control variables

(sociodemographic variables.) and high access to medicines (dependent variable). The results was presented as crude OR, 95% CI, and p-value.

Second step or Model 2. included a multivariate analysis of the adjusted association between health system variables with $p < .05$ identified during the bivariate analysis and high access to medicines (dependent variable). A hierarchical order of factors to be included in the first iteration was the variables of governance/regulation. The second iteration included the variables of health facility. The third iteration included variables of health service delivery. The forth iteration included variables of pharmaceutical supply. The fifth iteration included variables of data collection/information systems; and The sixth iteration included variables of health financing. The multivariate adjusted logistic regression analysis was controlled for confounders that have a $p < .05$ in the bivariate analysis of their association with high access to medicines. The results are represented as the Adjusted OR, 95% CI, and p-value.

Threats to Validity

External Validity: There is a threat to external validity when the findings are erroneously generalized to individuals who do not have the study participants' characteristics, places that do not have the study setting characteristics, and different past or future situations (Creswell, 2013). The primary study minimized the threats to external validity by ensuring data was collected and confirmed with relevant stakeholders within each country. This helped to ensure the representativeness of the study participants to the target population. Besides, this study will restrict the generalization of its findings and claims to similar population groups and settings to enhance its external validity (Creswell, 2013).

Internal validity: Creswell (2013) observed that threats to internal validity include the

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

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

Statistical conclusion validity: The threat to statistical conclusion validity occur when the study findings are not accurate because of insufficient statistical power or the violation of key assumptions (Creswell, 2013). In this study, I used a sufficient sample of all 37 resource poor countries with a maternal health program that participated in the MCIP survey so that they achieve a computed power of .80 or more on all independent variables.

Besides, I ensured that the study met the assumptions required for a logistic regression analysis. First, the dependent variable – Access to medicines – was transformed into a dichotomous variable with two categories: High access and poor access based on z-scores computed for all measures in each variable category. Second, I assigned the code 1 to the category of 'high access' as the desired outcome. Third, only the variables with $p < .05$ on bivariate analysis were included in multivariate analysis through a hierarchical stepwise method. Fourth, I tested for multicollinearity to ensure the independent variables are independent of each

other. Fifth, I assessed for outliers and missing data and use multiple imputations to replace the missing data. Last, the study included an adequate sample size and the minimum number of cases per variable category was 18.

Ethical Procedures

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

Protection of Participants' Rights

This study used secondary data that have the advantage of enhancing the participants' privacy as I did not interact directly with the study participants. In addition, the limited dataset did not include personal identifiers to prevent linking the data to the study participants. Furthermore, the Walden University IRB approved this study to ensure that it fully meets the required ethical standards.

Data Protection

The limited dataset was stored on a password-protected computer with a backup on a password-protected hard drive. I will keep the data for 5 years after the end of the study and destroy it using appropriate. The results of this study were aggregated to protect the privacy of the study participants. I disseminated the results to WHO, USAID MCHIP, in national and international conferences, and through peer-reviewed journals.

Summary

This study was a quantitative cross-sectional survey using secondary data collected by the WHO pharmaceutical country survey and USAID MCHIP survey. Walden University IRB approved the study after verifying that it met the required ethical standards.

The sample included 37 countries that participated in the USAID 2012 MCHIP survey The dependent variable access to essential maternal health medicines defined by availability, affordability and accessibility of essential maternal health medicines.

The independent variables included measures such as if medicines are approved at National Level, Accessibility of Standard Treatment Guidelines, Policy Provision for Active management of third stage of labor (AMTSL), Good Governance, Procurement and Logistics, Equipment's and Supplies, Education/Training, Human Resources, Midwife/Skilled Birth Attendant Scope of practice, Health Spending, National Reporting on Selected Maternal Health Indicators. Data was analyzed using the IBM SPSS Statistical software version 21. It included a descriptive analysis of each country's characteristics as well as bivariate and multivariate logistic regressions of the health system characteristics that best predict access to essential maternal health medicines. Chapter 4 that follows will describes the secondary data analysis and presents its results.

Section 3: Results

Introduction

The purpose of this quantitative cross-sectional survey using secondary data analysis was to investigate the association between health-system characteristics and access to maternal health medicines. The study participants included 37 low and middle-income countries who participated in USAID MCHIP and WHO pharmaceutical 2011/2012 survey. I used the IBM SPSS Statistics 21 software to answer the questions and test the hypotheses listed below:

Question 1: Is there a significant association between governance and access to essential maternal health medicines in low and middle-income countries?

Ho1: there is no significant association between governance and access to essential maternal health medicines in low and middle-income countries?

Ha1: there is a significant association between the governance and access to essential maternal health medicines in low and middle-income countries?

Question 2: Is there a significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Ho2: there is no significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Ha2: there is a significant association between pharmaceutical supply and access to essential maternal health medicines in low and middle-income countries?

Question 3: Is there a significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Ho3: there is no significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Ha3: there is a significant association between the quality of health facility and access to essential maternal health medicines in low and middle-income countries?

Question 4: Is there a significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Ho4: there is no significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Ha4: there is a significant association between quality of service delivery and access to essential maternal health medicines in low and middle-income countries?

Question 5: Is there a significant relationship between health financing and access to essential maternal health medicines in low and middle-income countries?

Ho5: there is no significant association between health financing and access to essential maternal health medicines in low and middle-income countries?

Ha5: there is a significant association between health financing and access to essential maternal health medicines in low and middle-income countries?

Data Collection

Data set for both surveys are publicly available and can be found on the website of WHO and USAID MCHIP. There was no discrepancy between the plan presented in Chapter 3 and the actual data collection.

Primary data for the MCHIP survey was coordinated by the MCHIP maternal health team in Washington, D.C., during the months of January, February and March 2012. Contact information was compiled for an identified focal person in each of the 43 countries initially targeted by the survey. An identified coordinator for each country was sent an e-mail with anticipated dates and activities six weeks in advance of receiving the survey. He or she was instructed to contact national counterparts in the government as well as leading implementing partners. The country coordinator was given a timeline of pending requests and asked to arrange meetings with national consultative groups to ensure a national participatory process for the completion of the survey instruments. In most cases this was possible. Key stakeholders from government, ministries, MCHIP programs, other USAID bilateral programs, UN partners and other implementing agencies met to collect data and respond to the 46-item questionnaire and the scale-up map. In most cases, these consultative groups found it necessary to meet twice to ensure accuracy and completeness of responses.

The WHO pharmaceutical country survey data was collected from all 193 member states using a user-friendly electronic questionnaire that included comprehensive instruction manual and glossary. Countries were requested to enter the results from previous surveys and to provide centrally available information compiled data comes from international sources (e.g. the World Health Statistics), surveys conducted in the previous years and country level information collected in 2011.

Inclusion and Exclusion Criteria

The original MCHIP survey dataset included records of 37 countries from Africa, Asia and the Americas; while those of WHO country surveys included records for 193 member countries. The records were assessed for eligibility based on the inclusion and exclusion criteria. Countries were included if they participated in the USAIDS MCHIP survey. They were excluded if they did not participate in the MCHIP survey.

Review of Statistical Assumptions

The study analysis included standard multiple regressions on one outcome variable (Access to live-saving maternal health medicines) and six independent variables (Strength of health system governance, pharmaceutical procurement and distribution, quality of health services and facilities, health care financing, and reporting of relevant maternal health medicine indicators). Responses to forty-four numeric and string question items that best represented these variables were collected and grouped to form composite variables for the regression analysis. I reviewed the key assumptions of logistic regression analysis, in particular, the magnitude of missing data, presence of multi-collinearity and outliers, and the compliance with a minimum of 10 cases per variable category.

Outliers. Using Z-score method to identify outliers, analysis showed that data were positively skewed in four numeric indicators (number of hospital beds per 10,000; pharmacist per 10,000pop; and physicians per 10,000 population and Nurses and midwives per 10,000 population) with skewness ranging of 4.148, 3.154, 4.891, 2.910 respectively. To make data normally distributed and suitable for further analysis, I applied a two-step process. Data were

first ranked using SPSS transform function. They were then transformed and computed to form new variables using SPSS Transform and IDF normal function.

Missing data. The first part of the missing data analysis showed that 17 of the 44 indicators for the independent and dependent variables included in the study had some missing data. The top five indicators were: public insurance coverage for medicines on EML (43.2%), Access to essential Medicines as part of fulfilment of the right to health (43.2%), Total health expenditure as percent of GDP (37.8%), availability of national guidelines for good distribution practices (37.8%), and presence of public sector procurement policies (35.1%).

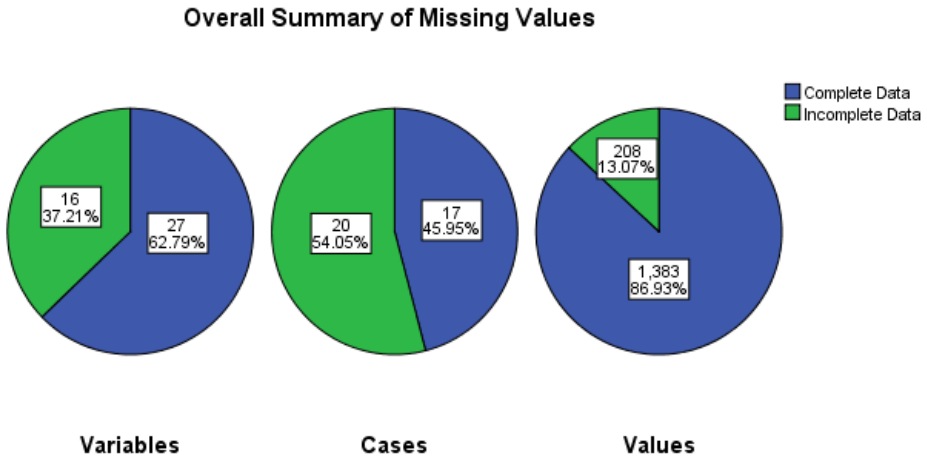

Figure 2. Summary of missing data in the study database. Generated from SPSS multiple imputation analysis of missing data patterns.

High rates of missing data can introduce bias and compromise the validity of the study findings. Analysis of missing value patterns suggested some monolithic pattern of missing values across some variables. Multiple imputations, one of the most recommended missing data handling techniques, were used to replace the missing values with five imputations based on the predictive values derived from the observed data (Sterne et al., 2009).

Multicollinearity. Another test was a bivariate correlation analysis of the 12 independent variables in SPSS using the Pearson correlation coefficient. The results showed no value of the Pearson correlation coefficient equal or above .80, confirming that there was no multicollinearity between the variables of interest. All the correlation coefficients were below .60. The second test was the collinearity diagnostics in linear regression that examined the tolerance rate and variance inflation factor (VIF) (Field, 2013). The results found no tolerance rate below .10 or VIF above 10. All the tolerance values were above .70 and VIF below two, indicating that there was no multicollinearity.

Sample Size and Minimum Number of Cases in Each Variable Category.

As a rule of thumb, each category of the independent variables included in logistic regression analysis must have a minimum of 10 cases (Vittinghoff & McCulloch, 2007). In that regard, the total sample of 37 was large enough to achieve sufficient statistical power. Some categories of the independent variables were combined to satisfy the rule of 10. The lowest cell count was 27 cases. All the other categories had more than 27 cases.

Variable Categorization and Coding

The analysis included one outcome and six independent variables. Responses to forty-four numeric and string question items that best represented these variables were collected and combined to form composite dichotomous variables for the regression analysis.

The outcome variable, Access to Medicines had three variables (coded 1. Yes, 2. No): availability of medicines, affordability of medicines, accessibility of medicines. Countries with less than 50% of the combined scores were assumed to have poor access (coded: 0,) while those with above 50% of combined score, good access (desired outcome, coded 1).

Similar procedures were used to organize the six independent variables. Strength of Health System Governance (coded 1 strong health system governance, 2. Weak health system governance) comprised of three items: medicine is approved at national level, guidelines for treatment are available, access to medicines and technologies are recognized as part of the right to health. Health system procurement, distribution and supply variable (coded, 1. Strong, 2. Weak) comprised of two items: medicines procurement system, medicines distribution and supply system. Quality of health facility variable (coded 1. High quality, 2. Poor quality) had one item: Number of hospital beds per 1000 population. Similarly, the quality of health services variable (coded 1. High quality, 2. Poor quality) had three items (adequacy of human resources for health, comprehensiveness or education and trainings for human resources for health, Midwife and Birth attendants scope of practice. Health system financing (coded 1. Robust 2. Not robust) had three items: Total health expenditure as % of GDP, Total Pharmaceutical, expenditure as % of health expenditure, private health expenditure as % of total health expenditure. Finally, the sixed variable – reporting of key maternal health medicines (coded 1. Strong reporting and 2. reporting had a single item: national reporting on key maternal medicines indicators

Descriptive Analysis

About 53% of countries enrolled in the study reported relatively good access to essential maternal health medicines compared to 47% that reported poor access – based on three indicators: availability, affordability, and accessibility of essential maternal health medicines. Medicines were often (75% of the time) available in only 24% of countries, affordable in 56% of

countries and accessible in 13.5% of countries. Oxytocin was more readily available (75% of the time) in 44% of countries compared with MgSO4 in 37% of countries.

Regarding health systems governance, more countries (61.7%) recognize access to medicines as a right to health in their constitution compared with those that had maternal health medicines on their EML (52.8%) and had guidelines treatment (49.3%). However, amongst all three indicators for strength of health system governance, availability of medicines on the EML seemed to have a statistically significant relationship with access to medicines ($p<0.001$).

Countries seemed to have better medicine procurement systems than distribution systems. More countries (62%) had strong procurement systems than they did strong distribution systems (and 44% respectively). Independently cross-tabbed, neither of these indicators showed statistically significant association with the outcome variable. In terms of quality of health facilities, only 24% of countries reported relatively substantial infrastructures for health and this indicator had a statistically significant association with access to essential maternal health medicines ($p <0.001$).

Results differed slightly with indicators for quality of health services. Comparatively, their appeared to be the most gap in midwives and birth attendants scope of practice among countries. Nearly half (45%) of countries reported less comprehensive education and trainings for human resources for health while a little more than half (59% and 67% respectively) reported relatively less adequate human resources for health and narrow scope of practice for midwives and birth attendants. Except for education and training, other indicators for quality of health services showed statistically significant associations with the outcome variable. Few countries (14% and 35% respectively) appeared to have robust health system financing and report key

maternal health medicines indicators. These indicators showed statistically significant association with access to essential maternal health medicines.

Table 4

Background Characteristics of the Countries

Variables	Characteristics	All countries n (%)	Yes <50% n (%)	No >50% n (%)	Chi-Square	P-value
Health System Governance	Medicines Approved at National Level	36(100)	19(53)	17(47)		
	Availability of Standard Treatment guidelines	37(100)	18(49)	19(50)	26.260	0.000
	Access to Medicine recognized as right to Health in Constitution	37(100)	23(62)	14(38)		
Medicine Procurement, Distribution and supply System	Strong Medicine Procurement System	37(100)	23(62)	14(38)		
	Strong Medicine Distribution &Supply System	37(100)	16(44)	21(54)		
Quality of Health facilities	Have Substantial Infrastructure.	37(100)	24(65)	13(34)	14.300	0.000
Quality of Health Services	Human resources for Health have Comprehensive Education and Training	37(100)	20(54)	17(45)	5.896	0.015
	Human Resources for Health are relatively substantial	37(100)	15(41)	22(59)		
	Midwives/Birth Attendants have broad Scope of Practice	37(100)	12(33)	25(67)	4.434	0.035
Robustness of Health Financing	Health and pharmaceutical expenditure	37(100)	5(14)	32(85)	38.068	0.000
National Reporting of Key Maternal Health Medicine Indicators	Strong National Reporting of Key Maternal Health Medicine Indicators	37(100)	12(35)	25(65)	8.680	0.003

Statistical Analysis Findings by Research Questions and Hypotheses

The analysis report below includes the outcomes of bivariate and logistic regression analyses, based on a sample of 37 resource poor countries in Africa, Asia, and America who met the inclusion criteria. The first step was a bivariate (Chi-square) analysis of the association between six independent variables (Health system Governance, medicine procurement, distribution and supply, quality of health facilities, quality of health services, health financing and data reporting for key maternal health medicines.) and Access to essential maternal health medicines. Findings showed that all the independent variables, with the exception of quality of health services had a statistically significant association with access to maternal health medicines and achieved a p-value < .05. The second step included a multiple logistic regression analysis to test which of the five independent variables that had a statistically significant association with the outcome variable and a p-value < .05. significantly predicted access to essential maternal health medicines. The results of the regression indicated that three predictors explained 27% of the variance ($R2 = .266$, $F(5,162)=13.12$, $p<.01$). It was found that the strength of a country's medicine procurement, distribution, and supply system significantly predicted access to essential maternal health medicines ($\beta= -.41$, $p<.001$), as did robustness or health system financing ($\beta= -.51$, $p<.001$), and quality of health facilities ($\beta= -.34$, $p<.05$).

Research question 1. The first question was stated as follows: Can access to live-saving maternal health medicines be predicted based on the strength of a country's health system governance?

Ho1: Access to essential maternal health medicines cannot be predicted based on the strength of a country's health system governance?

Ha1: Access to essential maternal health medicines can be predicted based on the strength of a country's health system governance?

A chi-square test of independence was performed to examine the relation between strength of health system governance and access to live-saving maternal health medicines. The vast majority (71.8%) of countries enrolled in the study had weak health system governance as compared to 28.2% with strong health system governance.

The standardized deviations to measure the magnitude of the difference between observed and expected values on women's access to essential maternal health medicines by the strength of a country's health system governance (Spiegel, Schiller, and Srinivasan, 2009) showed that stronger health system governance had a negative deviation towards poor access to essential maternal health medicines. The inverse direction was observed for relatively weaker health system governance (table 6). A negative standardized deviation indicates that the observed values are lower than expected and a positive standardized deviation that the observed values are higher than expected. More countries (28%) with weaker health system governance had poor access to essential maternal health medicines compared with those with strong health system governance (11%).

Table 5

Standardized Deviations of Health System Governance by Access to Maternal Health Medicines

		Access to Maternal Health Medicines	
		Good	Poor
Health Systems Governance	Strong	+1.6	-3.3
	Weak	-1.0	+2.1

The bivariate analysis showed a statistically significant association between health system governance and access to essential maternal health medicines $\chi(1) = 18.999$, OR = 1.368, CI [1.239, 1.150], $p = .000$. This finding may suggest that women in countries with stronger health system governance were more likely to have better access to maternal health medicines than those in countries with weaker health system governance. However, a multivariate analysis that followed did not retain the statistically significant association between the strength of health system governance and access to essential maternal health medicines ($\beta = -.160$, t = -1.351, CI [-0.394, 0.074], $p = .178$). Therefore, I accept the null hypothesis and conclude that access to essential maternal health medicines cannot be predicted based on the strength of a country's health system governance.

Research question 2. The second question was stated as follows: Can access to essential maternal health medicines be predicted based on the strength of a country's medicine procurement, distribution, and supply system?

Ho2: Access to essential maternal health medicines cannot be predicted based on the strength of a country's medicine procurement, distribution, and supply system?

Ha2: Access to essential maternal health medicines can be predicted based on the strength of a country's medicine procurement, distribution, and supply system?

A chi-square test of independence was performed to examine the relation between strength of Medicine procurement, distribution and supply system and access to essential maternal health medicines. The vast majority (64.3%) of countries enrolled in the study had weak medicine procurement, distribution and supply system compared to 35.7% with strong medicine procurement, distribution and supply system.

The standardized deviations to measure the magnitude of the difference between observed and expected values on women's access to essential maternal health medicines by the strength of a country's health system governance (Spiegel, Schiller, and Srinivasan, 2009) showed that stronger medicine procurement, distribution and supply system had a negative deviation towards poor access to essential maternal health medicines (table 6). A negative standardized deviation indicates that the observed values are lower than expected and a positive standardized deviation that the observed values are higher than expected.

More countries (24.8%) with weaker medicine procurement, distribution and supply had poor access to essential maternal health medicines compared with those with strong Medicine procurement, distribution and supply system (8.1%).

Table 6

Standardized Deviations of Medicine procurement, distribution and supply by Access to Maternal Health Medicines

		Access to Maternal Health Medicines	
		Good	Poor
Medicine procurement, distribution and supply	Strong	+1.0	-2.1
	Weak	-.8	1.6

The bivariate analysis showed a statistically significant association between medicine procurement, distribution and supply system and access to essential maternal health medicines $\chi(1) = 8.676$, OR = 3.740, CI [1.486, 9.411], $p = .003$.

A multivariate analysis that followed retained the statistical significant association between medicine procurement, distribution and supply system of a country and access to essential maternal health medicines ($\beta = -.411$, $t = -3.641$, CI [- 0.634, -.188], $p < 0.001$). These

findings suggest that women in countries with stronger health medicine procurement, distribution and supply systems were more than 3 times more likely to have better access to maternal health medicines than those in countries with weaker medicine procurement, distribution and supply system. Therefore, I reject the null hypothesis and conclude that access to essential maternal health medicines can be predicted based on the strength of a country's medicine procurement, distribution and supply system.

Research question 3. The third question was stated as follows: Can access to essential maternal health medicines be predicted based on the quality of health facilities in a country?

Ho3: Access to essential maternal health medicines cannot be predicted based on the quality of health facilities in a country

Ha3: Access to essential maternal health medicines can be predicted based on the quality of health facilities in a country.

A chi-square test of independence was performed to examine the relation between quality of health facility and access to live-saving maternal health medicines. The vast majority (65.6%) of countries enrolled in the study had relatively good quality health facilities compared to 34.4% with poor quality.

The standardized deviations to measure the magnitude of the difference between observed and expected values on women's access to essential maternal health medicines by the strength of a country's health system governance (Spiegel, Schiller, and Srinivasan, 2009) showed that countries with good quality health facilities had a negative deviation towards poor access to essential maternal health medicines (table 6). The reverse was the case for countries with poor quality health facilities. A negative standardized deviation indicates that the observed

values are lower than expected and a positive standardized deviation that the observed values are higher than expected.

More countries (33.7%) with poor quality health facilities had poor access to essential maternal health medicines compared with those with higher quality health facilities (11.7%).

Table 7

Standardized Deviations of Quality of Health Facilities by Access to Maternal Health Medicines

		Access to Maternal Health Medicines	
		Good	Poor
Quality of Health Facilities	Strong	+1.0	-2.0
	Weak	-1.3	+2.8

The bivariate analysis showed a statistically significant association between quality of health facilities and access to essential maternal health medicines χ (1) = 14.600, OR = 3.781, CI [1.849, 7.733], p <0.001. A multivariate analysis that followed retained the statistical significant association between the quality of health facilities in a country and access to essential maternal health medicines (β= -.342, t = - 3.055, CI [- 0.563, -.121], p <0.05). These findings suggest that women in countries with higher quality health facilities were more likely to have better access to maternal health medicines than those in countries with poor quality of health facilities. Therefore, I reject the null hypothesis and conclude that access to essential maternal health medicines can be predicted based on the quality of health facilities in a country.

Research question 4. The Forth question was stated as follows: Can access to essential maternal health medicines be predicted based on the quality of health services provided in a country?

Ho4: Access to essential maternal health medicines cannot be predicted based on the quality of health services provided in a country

Ha4: Access to essential maternal health medicines can be predicted based on the quality of health services provided in a country.

A chi-square test of independence was performed to examine the relation between quality of health services and access to essential maternal health medicines. The vast majority (77.9%) of countries enrolled in the study reported relatively poor quality health services compared to 22.1% with poor quality.

The standardized deviations to measure the magnitude of the difference between observed and expected values on women's access to essential maternal health medicines by the strength of a country's health system governance (Spiegel, Schiller, and Srinivasan, 2009) was not significant (< +- 1.95).

Table 8

Standardized Deviations of Quality of Health Services by Access to Maternal Health Medicines

		Access to Maternal Health Medicines	
		Good	Poor
Quality of Health Services	Strong	+0.2	-0.5
	Weak	-0.1	+0.3

The bivariate analysis did not show a statistically significant association between quality of health services and access to essential maternal health medicines χ (1) = 0.462, OR = 1.389, CI [0.537, 3.598], p = .497. Therefore, I accept the null hypothesis and conclude that women's

access to essential maternal health medicines cannot be predicted based on the quality of health services.

Research question 5. The fifth question was stated as follows: Can access to essential maternal health medicines be predicted based on the robustness of a country's health financing?

Ho5: Access to essential maternal health medicines cannot be predicted based on the robustness of a country's health financing?

Ha5: Access to essential maternal health medicines can be predicted based on the robustness of a country's health financing.

A chi-square test was performed to examine the relation between health care financing and access to essential maternal health medicines. The vast majority (85.7%) of countries enrolled in the study had relatively robust health care financing compared to 14.3% with poor quality.

The standardized deviations to measure the magnitude of the difference between observed and expected values on women's access to essential maternal health medicines by the strength of a country's health system governance (Spiegel, Schiller, and Srinivasan, 2009) showed that countries with more robust health financing had a negative deviation towards poor access to essential maternal health medicines (table 8) than those with less robust health financing. The reverse was the case for countries with less robust health care financing. A negative standardized deviation indicates that the observed values are lower than expected and a positive standardized deviation that the observed values are higher than expected.

More countries (60.0%) with less robust health care financing reported poor access to essential maternal health medicines compared with those with more robust (12.2%).

Table 9

Standardized Deviations of Health Care Financing by Access to Maternal Health Medicines

		Access to Maternal Health Medicines	
		Good	Poor
Health Financing	Robust	+1.0	-2.1
	Less Robust	-2.5	+5.1

The bivariate analysis showed a statistically significant association between the robustness of health care financing and access to essential maternal health medicines $\chi(2) = 38.068$, OR = 10.773, CI [4.578, 25.352], $p = .000$. Women in countries with more robust health care financing were more likely to have better access to maternal health medicines than those in countries with less robust health care financing. A multivariate analysis that followed retained the statistical significant association between the quality of health facilities in a country and access to essential maternal health medicines ($\beta = -.514$, t = - 4.993, CI [- 0.720, - 0.309], $p < 0.001$). These findings suggest that women in countries with more robust health financing were more likely to have better access to maternal health medicines than those in countries with less robust health financing. Therefore, I reject the null hypothesis and conclude that access to essential maternal health medicines can be predicted based on robustness of a country's health financing.

Research question 6. The Sixth question was stated as follows: Can access to essential maternal health medicines be predicted based on the strength of data reporting on key maternal health medicines indicators in a country?

Ho6: Access to essential maternal health medicines cannot be predicted based on the strength of data reporting on key maternal health medicines indicators in a country

Ha6: Access to essential maternal health medicines can be predicted based on the strength of data reporting on key maternal health medicines indicators in a country.

A chi-square test of independence was performed to examine the relation between health care financing and access to essential maternal health medicines. The vast majority (64.9%) of countries enrolled in the study had relatively weak reporting for key maternal health medicines indicators compared to 35.1% with stronger reporting.

The standardized deviations to measure the magnitude of the difference between observed and expected values on women's access to essential maternal health medicines by the strength of a country's health system governance (Spiegel, Schiller, and Srinivasan, 2009) showed that countries with stronger reporting had a negative deviation towards poor access to essential maternal health medicines (table 8) than those with weak reporting. A negative standardized deviation indicates that the observed values are lower than expected and a positive standardized deviation that the observed values are higher than expected.

More countries (23.6%) with weak maternal health medicines indicator reporting mechanisms reported poor access to essential maternal health medicines compared with those with stronger mechanisms (7.7%).

Table 10

Standardized Deviations of National Reporting of Key Maternal Health Medicine Indicators by Access to Maternal Health Medicines

		Access to Maternal Health Medicines	
		Good	Poor
National Reporting of MH Indicators	Strong Reporting	+1.0	-2.1
	Weak Reporting	-0.7	+1.6

The bivariate analysis showed a statistically significant association between the national reporting of key maternal health medicine indicators and access to essential maternal health medicines $\chi(2) = 8.680$, OR = 3.709, CI [1.482, 9.282], $p = .003$. Women in countries with better reporting of indicators were more likely to have better access to maternal health medicines than those in countries with weak reporting.

However, a multivariate analysis that followed did not retain the statistically significant association between national reporting of key maternal health medicine indicators and access to essential maternal health medicines (β= -.0.047, t = -.394, CI [-0.281, 0.487], p =.694). Therefore, I accept the null hypothesis and conclude that access to essential maternal health medicines cannot be predicted based on national reporting of key maternal health medicine indicators.

Summary

This study included 12 questions and 6 hypotheses investigating the association between health system characteristics and women's access to essential maternal health medicines in 37 low and middle-income countries.

The analysis involved bivariate and multivariate analyses. Bivariate analyses showed that five of the six health system characteristics examined (strength of health system governance, strength of medicine procurement, distribution and supply system, quality of health facilities, robustness of health system financing, and national reporting of key maternal health medicine indicators) had a statistically significant association with women's access to essential maternal health medicines with a p-value < .05. quality of health services had no statistically significant association with women's access to essential maternal health medicines $p > .05$.

Multivariate analyses included the five independent variables above, which had a *p*-value <.05. The second step included a multiple logistic regression analysis to test of the five independent that had a statistically significant association with the outcome variable and a p-value < .05. significantly predicted access to essential maternal health medicines. The results of the regression indicated that three predictors explained 27% of the variance (R2 =.266, F(5,162)=13.12, p<.01). It was found that the strength of a country's medicine procurement, distribution, and supply system significantly predicted access to essential maternal health medicines (β= -.41, p<.001), as did robustness or health system financing (β= -.51, p<.001), and quality of health facilities (β= -.34, p<.05).

I conclude that the strength of a country's medicine procurement, distribution, and supply system medicines, the robustness of health system financing and quality of health facilities (β= -.34, p<.05). significantly predicted access to essential maternal health medicines in low and middle-income countries.

Chapter 5 includes a discussion of health system characteristics that have shown a statistically significant association with access to maternal health medicines in 37 low and middle-income countries and a comparison of these findings with previous studies. It presents the study limitations, its implications for positive social change, and recommendations for research, policy and practice.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

This study was a quantitative cross-sectional survey using secondary data from the USAID MCHIP and WHO pharmaceutical 2011/2012 survey. It examined the association between health system characteristics and women's access to essential maternal health medicines. Postpartum hemorrhage (PPH), pre-eclampsia and eclampsia together account for nearly half (41%) of the 289,000 pregnancy-related deaths worldwide (WHO, et al., 2014). Access to oxytocin, misoprostol and magnesium sulfate (herein referred to as essential maternal health medicines) - three medicines that prevent and treat these pregnancy-related complications (Fujioka, & Smith, 2011), has remained suboptimal, in particular among women in developing countries (USAID, Landscape Analysis: Postpartum Hemorrhage Solutions, unpublished data, 2012). The suboptimal access to these medicines may explain in part the persisting high maternal mortality rates in developing countries. This study was conducted to identify the health system determinants of women's access to essential maternal health medicines in developing countries.

The data analysis included bivariate and multivariate analyses that showed that the strength of a country's medicine procurement, distribution, and supply system, robustness of health system financing, and quality of health facilities had a statically significant association with women's access to maternal health medicines. The findings showed that women in countries with stronger health system governance AOR = 1.368, 95% CI [1.239, 1.150], $p < .01$; stronger medicine procurement, distribution and supply system AOR = 3.740, 95% CI [1.486, 9.411], $p < .05$; better quality of health facilities AOR = 3.781, 95% CI [1.849, 7.733], $p < 0.001$; more robust health care financing AOR = 10.773, 95% CI [4.578, 25.352], $p < 0.01$; better

reporting for maternal health medicines indicators AOR = 3.709, 95% CI [1.482, 9.282], p <0.01; were more likely to have better access to maternal health medicines. The quality of health services, had no statistically significant association with women's access to maternal health medicines.

Interpretation of the Findings

Study Findings and Past Research

Strength of health system governance and access to essential maternal health medicines. The study analysis showed that pregnant women living in countries with stronger health system governance were more likely to have better access to essential maternal health medicines. Although more countries (61.7%) recognize access to medicines as a right to health in their constitution compared with those that had maternal health medicines on their EML (52.8%) and had treatment guidelines (49.3%), availability of medicines on the EML seemed to be the only measure with statistically significant relationship with access to medicines ($p<0.001$). Observations regarding these three measures indicate a level of political will for reversing high maternal mortality rate in developing countries. Availability of essential maternal health medicines in EML also indicate a level of recognition for promoting rational use of essential maternal health medicines as per WHO recommendations (WHO 2004).

This study supports findings from studies conducted by Ridge et al. (2010), Muldoon et al (2011), Smith et al., (2014), Tran & Bero (2015). Ridge et al., showed that a critical component for adequate access to and use of MgSO4 was the inclusion of MgSO4 in National Essential Medicines List (NEML), the availability of Standard Treatment Guidelines (STG) and

registration of medicines in the country for use in treatment of severe pre-eclampsia and eclampsia.

Smith et al., found that countries that reported infrequent availability of misoprostol indicated a lack of a national policy supporting misoprostol as a principle cause. Similarly, Tran & Bero found that the first common facilitator of quality use of oxytocin egometrin and magnesium sulfate at the government policy level was that all three essential medicines were consistently listed on national EMLs.

Medicines supply system. This study examined the association between the strength of a country's medicine supply system and women's access to essential maternal health medicines. The results showed, in a bivariate and multivariate analysis, that women in countries that had stronger medicines supply system had a higher likelihood of having access to essential maternal health medicines than those with weak medicines supply systems. Descriptive statistics for each measure of medicine supply system assessed (medicines procurement and medicines distribution) further showed that more countries had stronger medicines procurement system than they did medicines distribution systems, and countries with stronger distribution systems were more likely to have better access than those with stronger procurement systems.

These findings are similar to Hopu, Ranganathan & Dodoo, 2011 assertions that countries lack essential medicines because of fragile supply systems and poor-quality products. Ridge, Bero & Hill (2010) found that poor availability of magnesium sulfate in Zambia reflected a limitation of the countries procurement system. Another similar observation made by Ridge et al., (2010) study is that procurement was based on presence of medicines in a country's essential medicines list, and supply of medicines to health facilities depended on availability of medicines

in central medical stores – which aligns with findings from this study that found a significant relationship between medicines distribution systems and access to medicines.

Findings from this study however differed from those of Haddad and Fourniew (1995) who found that in Zaire, s steady supply of medicines did not reverse a reduction in utilization. Similarly, Mwabu (1993) found that greater availability of medicines had a negative relationship with utilization of these medicines. These findings may be attributed to Ridge et al. (2010) observation that lack of demand by health professionals at the health center level negatively affected access to essential maternal health medicines.

Quality of health facilities: The study examined the association between the quality of health facilities in a country and women's access to essential maternal health medicines. Observations from the literature suggest that the concept of quality could be a difficult factor to capture in both cross-sectional and time-series analyses. Hence for the purpose of this study, a key indicator for quality used included number of hospital beds per 10,000 population. Findings of bivariate and multivariate analyses showed that women in countries with better quality health facilities had a higher likelihood of receiving essential maternal health medicines when needed.

Findings from this study aligns with findings from studies carried out by Bitran, 1989, Yoda, 1989, Hutton, 2004; and James et al., 2006. These studies found that utilization was lower where quality of care was perceived to be lower. They also found that utilization ins smaller-phased -in programs increased when combined with quality improvements. Also, Denton, et al. (1990) and Akin, et al. (1990) in their study in Nigeria found that facility conditions were significantly associated with service utilization.

However, findings from this study differed from those of Chalker (1995), Anis (1981), Chalker and Anis found that rural health post had reasonable good quality facilities but were not used. Denton et al., and Akin et al., in the same study mentioned earlier, noted that Machineries (x-ray machine, and laboratories) were not significantly associated with service utilization.

Quality of health services provided in a country: The study examined the association between quality of health services and women's access to maternal health medicines. Nearly half (45%) of countries reported less comprehensive education and trainings for human resources for health while a little more than half (59% and 67% respectively) reported relatively less adequate human resources for health and narrow scope of practice for midwives and birth attendants. Except for education and training, other indicators for quality of health services showed statistically significant associations with the outcome variable. However, the association between the quality of health services and access to maternal health medicines not statistically significant in bivariate analysis.

These findings agree with findings from seven studies by Anis, (1981), Denton, et al. (1990) and Akin, et al. (1990), Javadi, and Bigdeli, (n.d) Heller (1982) and Ainstworth et al., (1993) Ridge et al. (2010); (Muldoon et al., 2011).

Denton, et al. (1990) and Akin, et al. (1990) findings suggested that number of support personnel, nurses, and doctors per capita was not significantly associated with service utilization. Rouse (2008), Javadi, and Bigdeli, (n.d) found that service delivery affected how medicines can reach patients and the extent to which rational use are upheld. Heller (1982) and Ainstworth et al., (1993) also found that the association between the probability of being seen by a physician and service access was insignificant. Nurses, doctors and skilled attendant density were

associated with decreased mortality for infants (Muldoon et al., 2011). Ridge et al. (2010) found a lack of in-service training in the use of specific medication as a barrier to access to that medication.

National health system financing: The study examined the association between the robustness of a countries health system financing and access to essential maternal health medicines and found that women in countries with more robust health system financing were more likely to have better access to these medicines.

This study aligns with Javadi and Bigdeli, (n.d) who found that financing systems are a major bottle neck to access due to low affordability of medicines. Without national policies to give universal access to essential maternal health medicines.

Study Findings and Ishikawa (Cause Effect) Model

This study used the Ishikawa (cause effect) model that posits that multiple factors with dynamic processes influence a given outcome are varying levels. The model has been used to illustrate the relationship between a given outcome and all the factors that influence this outcome, and provide additional insight into the behavior of processes (Ishikawa, 1960).

Ridge et al (2010) fishbone diagram advanced that barriers and facilitators to availability and use of maternal health medicines occur at different levels of a health system including regulatory, government, supply, procurement, distribution, health facility, and health professional levels. The 2010 model advanced that certain primary determinants lead to improved availability and use of essential maternal health medicines.

This study examined health system building blocks as an intervention to improve availability, affordability and accessibility (access) of essential maternal health medicines (health

outcomes). Its findings support Ridge et al's model. They showed that women living in countries with stronger health system governance, stronger medicine supply system, better quality of health facilities, more robust health care financing, and better reporting for maternal health medicines indicators were more likely to find maternal health medicines available, affordable and accessible when needed.

Further, certain individual characteristics such as presence of medicines in a countries essential medicines list, midwives scope of practice, and strength of medicines distribution system played an important role in women's access to maternal health medicines. In this regard, Ishikawa cause effect model was a useful model that guided the identification of the study variables, design of study questions and hypotheses, data analysis, and interpretation of findings.

Limitations of the Study

There were five limitations in this study. First, the study used a cross-sectional quantitative design with institutional level data collected at one point in time (Sedgwick, 2014). The cross-sectional quantitative nature of this study did not allow any causal inferences, nor explanatory dimensions to observations.

Second, different measures of equity and economic status have been considered as predictors of access in developing countries (Wegstaff, 2000b; Filmer & Pritchett, 2001; Heller, 1982; Dzator et al., 2004). Since this study was not a household survey, data was not collected at the household or population level. Consequently, the study missed out of demand side factors of a health system that potentially affect access.

Factors like geographical location, age, hospital waiting time, time spent travelling to health facility, education or occupation, household consumption and literacy levels are important

factors that would have provided greater insights into the relationship between demand side dynamics of a countries health system and access to maternal health medicines. Other important aspects of health system determinants not covered in this study include aspects of market dynamics like procurement prices of medicines, monopoly of few pharmaceutical companies and small markets.

Third, the self-reporting countries were at risk of social desirability bias by giving socially acceptable answers. Third, the observational nature of the study did not allow any cause-and-effect analysis in the absence of variable manipulation. Forth, the cross-sectional nature of the study did not allow any sequencing of events between independent and dependent variables nor any trend analysis on the study outcome.

Recommendations for Further Research

This study was the first cross sectional study to examine the health system determinants of access to maternal health medicines in 37 low and middle-income countries. It has highlighted the important role of quality of health care facilities, public health financing and data collection and monitoring of maternal health medicines indicators with access to essential maternal health medicines. It has also pointed to some knowledge gaps and areas for further research.

The cross-sectional quantitative nature of this study did not allow any causal inferences, nor explanatory dimensions to observations. A prospective study of access to essential maternal health medicines can help understand the sequencing of events and establish cause-and-effect relationships among independent variables. Furthermore, future studies should include other health system characteristics (independent variables) not measured in this study and should

include qualitative dimensions to foster more in-depth understanding of the intricate dynamics of access to maternal health medicines.

The achievement of better access to maternal health medicines for woman in developing countries will depend on the effectiveness and level of implementation of innovative strategies specific to the context and realities of each country. Therefore, further studies are needed to identify the most effective strategies to strengthen health systems in developing countries – in other to improve women's access to essential maternal health medicines.

Implications

Implications for Positive Social Change

This study examined an important health issue affecting vulnerable women in developing countries where health disparities and social injustices are evident through the disproportional burden of maternal deaths (DHS Program, n.d.). Access to maternal health medicines has remained suboptimal in many developing countries despite government's and international development efforts. Limited understanding of the drivers of access to these medicines in these countries may have contributed to the persisting inequalities in access to these medicines.

This study will foster positive social change by generating knowledge on the predictors of access to live-saving maternal health medicines among women in resource-poor settings to help policy makers, health mangers, and service providers understand not only the barriers to access faced by this vulnerable population, but the comparative strength of each barrier in mitigating access to medicines.

The findings, if used appropriately, could guide the design of public health interventions aimed at improving access to essential maternal health medicines in resource poor settings, and reduce the southern - western gap in Maternal health outcomes.

For these reasons, the dissemination of the study findings will target the Ministries of Public Health, International public health agencies, nongovernmental organizations (NGO's), donors and research institutions. Local and international civil society advocates and experts will also be targeted through program, policy, and strategic meetings and conferences. Besides, the study will be published in peer-reviewed journals to further share its findings with the international community.

Implications for Practice

This study may play an important role in the design of interventions to improve availability, affordability and accessibility of maternal health medicines in developing countries. Its findings have pointed to three important areas of work: the quality of care, funding for public health, and data reporting for maternal health medicines indicators. While it is important to take be holistic in addressing health system barriers to access to medicines, ministries of health may consider prioritize programs based on their relative potentials to maximize impact, more so in this era of shrinking resources for public health.

Financing for public health in these countries emerged as the stronger predictor of access to maternal health medicines. In this era of declining resources for public health, National and local level maternal health programs may want to consider thinking creatively on avenues to mobilize resources with the limited resources available. Exploring and establishing partnerships with the private sector and other individual sponsors may be a strategic direction to go in coming

years. could use the evidence generated in this study to identify health system factors limiting access to and use of maternal health medicines, and prioritize programs based on their relative potentials to maximize impact.

The Ministry of Public Health should establish Maternal health medicines Quality Improvement programs (MHM-QIP) to ensure that women experience pregnancy related emergencies receive all the medicines they need for the well-being of the mother-baby pair.

Like many developing countries (Lehmann, Dieleman, & Martineau, 2008), countries studied in this project suffer from the maldistribution of health professionals, limited scope of practice for few health professionals available, and inadequate health care facilities Therefore, the Ministry of Public Health should put in place a human resource policy that encourages the training and redistribution of roles and scope of practice for midwives and nurses. The efforts of government and its implementing partners should aim at getting and retaining trained midwives and nurses in every rural public health facility.

Conclusion

The persisting high maternal mortality in developing countries testifies to the prevailing social injustice in access to quality maternal health medicines in disadvantaged populations. This study was the first to examine the comparative relationship between health system characteristics and women's access to three essential maternal health medicines across a wide range of developing countries. Its findings support the hypothesis that health system characteristics, in particular, health systems financing, procurement systems and quality of health facilities; can predict women's access to essential maternal health medicines.

This new knowledge is useful to guide global health agencies and national health authorities in design of interventions, in particular, health financing advocacy, quality improvements in health care facilities and pharmaceutical supply infrastructure and process improvement. If successfully implemented, these interventions should help close the developed – developing country gap in maternal health outcomes. Further research is needed to understand the demand side drivers of poor access to maternal health medicines at household and institutional levels in developing countries.

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Appendix

Appendix 1: Variables and Data Source

Domain/Level	Variable Name	Questionnaire Item	Data Sources
Health system	Government/Regulatory	Oxytocin on EML for prevention and treatment of PE/E	2012 NCHIP Survey database)
	Medicines Approved at National Level	Misoprostol on EML for prevention and treatment of PE/E	NCHIP Survey
		Misoprostol on the EML	NCHIP Survey
		MgSO4 is national policy for treatment of PE/E	NCHIP survey
		Diazapern is national policy for PE/E	NCHIP Survey
	Accessibility of Standard Treatment Guidelines	Standard treatment guideline translated into suitable local protocol	WHO pharmaceutical country profile data
		Recommended treatment in national standard treatment guideline	WHO pharmaceutical country profile data
	Policy Provision for Active management of third stage of labor (AMTSL)	AMTSL is national policy	NCHIP Survey
		AMTSL in service delivery guidelines	NCHIP Survey
	Good Governance	National good governance policy present?	WHO pharmaceutical country profile data
		Access to essential medicines/technologies as part of the fulfillment of the right to health, recognized in the constitution or national legislation?	WHO pharmaceutical country profile data
Pharmaceutical Supply System	Procurement and Logistics	Procurement procedure document in place	WHO pharmaceutical country profile data
		Medicine supplied to health care facility	WHO pharmaceutical country profile data

Health Facility	Equipment's and Supplies	Equipment and supplies available for diagnosis of complications and drug storage	WHO pharmaceutical country profile data
		Equipment and supplies are available to administer medicine	WHO pharmaceutical country profile data
	Education/Training	Pre-service education curricula include AMTSL	NCHIP Survey
		Current global management principles for PE/E included in in-service training courses	NCHIP Survey
		AMTSL included in in-service training curricula	NCHIP Survey
		Pre-service education curricula include current global management principles for PE/E	NCHIP Survey
		Students assessed for competency in performance of AMTSL	NCHIP Survey
		Health providers aware medicine is first–line treatment	
Health Delivery	Human Resources	Physicians per 10,000 pop	WHO pharmaceutical country profile data
		Number of hospital beds per 10,000	WHO pharmaceutical country profile data
		Nurses and midwives per 10,000 pop	WHO pharmaceutical country profile data
		Trained staff available to administer medicine	WHO pharmaceutical country profile data
		Midwives authorized to perform manual	NCHIP Survey

			removal of placenta	
		Midwife/Skilled Birth Attendant Scope of practice	Midwives authorized to perform AMTSL with oxytocin	NCHIP Survey
			Midwives authorized to diagnose severe PE/E and administer MgSO4	NCHIP Survey
	Health Financing	Health Spending	Total health expenditure as % of Gross Domestic Product	WHO pharmaceutical country profile data
			Private health expenditure as % of total health expenditure (% of total expenditure on health)	WHO pharmaceutical country profile data
			Pharmaceutical expenditure as a % of Health Expenditure (% of total health expenditure)	WHO pharmaceutical country profile data
Access to MHLSM Medicine	Data Collection and Reporting	National Reporting on Selected Maternal Health Indicators	AMSTL included in national HMIS	NCHIP Survey
			Indicator to monitor severe PE/E included in national HMIS	NCHIP Survey
		Availability of Oxytocin	Availability of Oxytocin in health facility	NCHIP Survey
	Availability		Availability of Oxytocin in regional/central medical stores	NCHIP Survey
		Availability of MgSo4	Availability of MgSo4 in health facilities	NCHIP Survey
			Availability of MgSO4 in Central Medical Stores	NCHIP Survey
		Availability of Misoprostol	Availability of Misoprostol in maternity centers	NCHIP Survey
		Stock Out	Frequency of oxytocin stock outs	NCHIP Survey
			Frequency of MgSO4 stock outs	NCHIP Survey
	Accessibility	Home Birth	Misoprostol piloted for home birth	NCHIP Survey
			Misoprostol at home birth scaling up	NCHIP Survey

	ANC attendance	Antenatal care or skilled birth attendance)	NCHIP Survey
Affordability	Cost of Medicines	Medicine is free of Charge to patients in health facility	NCHIP Survey
		Population covered by a public health service or public health insurance or social health insurance, or other sickness funds of total population)	WHO pharmaceutical country profile data