TRENDS IN MATERNAL HEALTH SERVICE UTILIZATION IN PRE AND POST-INTERVENTION OF HEALTH EXTENSION PROGRAM (HEP): IMPLICATION OF HEP IN MEKET WOREDA OF AMHARA REGION

BY

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SUBMITTED TO
ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF DEVELOPMENT STUDIES
CENTER FOR POPULATION STUDIES

February, 2019

Addis Ababa University

School of Graduate Studies

Trends in Maternal Health Service Utilization in Pre and Post-Intervention of Health Extension Program (HEP): Implication of HEP in Meket Woreda of Amhara Region

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A Thesis Submitted To:

College of Development Studies of Addis Ababa University in Partial Fulfilment of the Requirements for the Degree of Master of Science in Population Studies

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February, 2019

Declaration

I hereby declare that, the thesis is my original work and all sources and materials used for writing it have been duly acknowledged. I declare that I have not so far submitted this thesis to any other institution anywhere for that award of any academic degree, diploma or certificate.

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This is to certify that, the thesis prepared by Tigist Adane entitled to"***Trends in Maternal Health Service Utilization in Pre and Post-Intervention of Health Extension Program (HEP): Implication of HEP in Meket Woreda of Amhara Region***" partial fulfilment of the requirements for the Masters of Science in Population Studies compiles with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

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Acknowledgements

First of all, I would like to thank my great Almighty God for being there with me in every step I took. Next my immense appreciation and honest gratitude go to my advisors, Prof. Assefa H/Mariam and Dr. Chalachew Getahun for their supervisions, kind helps, invaluable advices, professional guidance, useful comments and suggestions throughout my study.

My heartfelt thanks go to my families and relatives, for their financial and moral support. My sincere appreciation also goes to my friends and colleagues whoever explicitly or implicitly backed my work in whatsoever means. Finally, I would like to acknowledge all members at Addis Ababa University especially, my instructors and Meket Woreda administration health office for providing me the quantitative data used in this analysis.

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List of Acronyms and Abbreviations

ACF = Auto Correlation Function

AIDS = Acquired Immune Deficiency Syndrome

ANC = Antenatal Care

ARIMA = Autoregressive Integrated Moving Average

BEmNOC = Basic Emergency and Neonatal Obstetric Care

CBRHA = Community Based Reproductive Health Agent

CEmNOC = Comprehensive Emergency and Neonatal Obstetric Care

CI = Confidence Interval

CNHDE = Center for National Health Development in Ethiopia

CPR = Contraceptive Prevalence Rate

CSA = Central Statistics Authority.

DC = Delivery Care

DF = Degree of freedom

DRC = Democratic Republic the Congo

EDHS = Ethiopian Demographic Health Survey

FMOH = Federal Ministry of Health

FP = Family Planning

HEP = Health Extension Program

HEWs = Health Extension Workers

HIV = Human Immunodeficiency Virus

HSDP = Health Sector Development Program

HTC = HIV Testing and Counselling

MDGs = Millennium Development Goals

MMR = Maternal Mortality Ratio

OR = Odds Ratio

PNC = Post Natal Care

PPH = Post-Partum Haemorrhage

P- Value = Probability Value

SD = Standard Deviation

s.e = Standard Error

SPSS = Statistical Package for Social Scientists

TBA = Traditional Birth Attendant

TTM/BC = Trans-Theoretical Model of Behaviour Change

TT2 = Tetanus-Toxoid Vaccine (second)

UNICEF = United Nations Children's Fund

UN = United Nations

VCHWs = Voluntary Community Health Workers

WB = World Bank

WHO = World Health Organization

CHAPTER ONE

Abstract

Maternal health refers to the health of women during pregnancy, childbirth, and the postpartum period. It encompasses the health care dimensions of family planning, prenatal, delivery and postnatal care in order to reduce maternal morbidity and mortality. Complications of pregnancy and childbirth are the leading causes of disability and death among women in the reproductive age (15-49) years in developing countries (WHO, 2009). The purpose of this study is to measure level and trends in selected maternal health services during pre and post-intervention period of the Health Extension Program in Meket Woreda, Amhara Region using administrative data extracted from the woreda health office. In this study, administrative data from July 2001 – June 2017 based on HEP from Meket Woreda was used for analysis of levels and trends in maternal health service utilizations. Due to the time series nature of data being used, polynomial regression trend models with ARIMA specification was fitted for residuals in order to make appropriate inferences. The finding reveal that there has been an overall increasing trend in antenatal care, HIV test, delivery care, family planning and postnatal care service utilizations after the introduction of the health extension program in the woreda. As literacy and socio-economic status of the population improve, the demand for quality and comprehensive services also increases. Besides, changes in demographic trends and urbanization require more comprehensive services covering a wide range of quality health services. So a potential researcher may include those variables to do further researches in the area by widening the scope of the study.

Keywords: Health Extension Programme, Maternal Health**,** Meket Woreda.

1.1. Background of the Study

Maternal health refers to the health of women during pregnancy, childbirth, and the postpartum period. It encompasses the health care dimensions of family planning, prenatal, delivery and postnatal care in order to reduce maternal morbidity and mortality. Complications of pregnancy and childbirth are the leading causes of disability and death among women in the reproductive age (15-49) years in developing countries (WHO, 2009). Global maternal mortality statistics reflect the widening gap between the developed and developing countries. A woman who gives birth in Africa is 300 times more likely to die from complications related to pregnancy or childbirth compared to the case in a developed country (Annan, 2010). About 60% of maternal deaths occur during labour, delivery and immediate postpartum period (Annan, 2010). More than 80% of maternal deaths can be prevented if pregnant women access essential maternity care like antenatal care, institutional delivery, postnatal care and assured of skilled attendance at childbirth as well as emergency obstetric care (Angela, 2011).

Health systems in Sub-Saharan African countries often suffer from weak infrastructure, lack of human resources, and poor supply chain management systems. Access to health services is particularly low in rural areas, where the majority of the population still lives. The few private outlets that are available usually favour urban or wealthy areas. Together with uneven distribution of health workers, this pattern often results in little availability and poor quality of health services in rural areas. Ethiopians' access to services was particularly low before the government came up with innovative ways of scaling up the delivery of essential health interventions, in particular through its Health Extension Program (HEP) (Admassie *et al.*, 2009). The Health Extension Programme (HEP) serves as the primary vehicle for prevention, health promotion, behavioural change communication, and basic curative care. The HEP is an innovative health service delivery program that aims at universal coverage of primary health care. The programme is based on expanding physical health infrastructure and developing Health Extension Workers (HEWs) who provide basic preventive and curative health services in the rural community (EDHS, 2012).

The Health Extension program was introduced under health sector development program (HSDP) II in 2002/03 with a fundamental philosophy that if the right health knowledge and skill is transferred, households can take responsibility for producing and maintaining their own health. Substantial investments in human resources, health infrastructure, pharmaceutical

supplies and operational costs have been made for the successful implementation of the program (FMOH, 2010).

The design of the package of HEW-provided health interventions was based on an analysis of major disease burdens for most of the population. The package consists of 17 health interventions from the four major categories (i.e., family health (maternal, new born, and child health care), disease prevention and control, personal and environmental hygiene, and health education). Disease prevention and control includes in Ethiopia's case diagnostic and treatment services for malaria and pneumonia, the leading causes of morbidity and mortality of adults and children, respectively (USAID, 2011).

The major health problems of the country remain largely preventable communicable diseases and nutritional disorders. Despite major progresses have been made to improve the health status of the population in the last one and half decades, Ethiopia's population still face a high rate of morbidity and mortality and the health status remains relatively poor (FMOH, 2010). In terms of women health, MMR for Ethiopia is 470 deaths per 100,000 live births and women have very low prenatal and postnatal service utilization though it still remains to be among the highest (CSA, 2011). The major causes of maternal death are obstructed/prolonged labour, ruptured uterus, severe pre-eclampsia/eclampsia, malaria, complications from abortion. Shortage of skilled midwives, weak referral system at health centre levels, lack of adequate availability of basic emergency and neonatal obstetric care (BEmNOC[1]) and comprehensive emergency and neonatal obstetric care (CEmNOC[2]) equipment, and under financing of the service were identified as major supply side constraints that hindered progress. On the demand side, cultural norms and societal emotional support bestowed to mothers, distance to functioning health centres and financial barrier were mentioned to be the major causes.

[1] If we use the UN EmNOC Handbook configuration of 4 BEmNOC facilities and 1 CEmNOC facility per 500 000 people, 25 EmNOC facilities in total are required of which at least 5 are supposed to provide CEmNOC and 20 provide BEmNOC.

[2] According to the UN EmNOC guidelines there should be at least 5 EmNOC facilities per 500 000 people of which a minimum of 1 must be a CEmNOC facility

1.2. Statement of the Problem

Women comprise a large proportion of a given society, still many of them in developing countries are at a greater disadvantage in terms of high maternal morbidity and mortality. In developed nations, where women have access to basic health care, giving birth is a positive and fulfilling experience whereas, for many women in poor countries it is associated with suffering, ill health and even death. A large number of women are dying due to factors related to pregnancy and childbirth. In 2008, an estimated 358,000 women died due to complications developed during pregnancy and childbirth (WHO, 2010). For every woman who dies, at least 20 more suffer injury, infection or disability from maternal causes approximately seven million women every year (WHO, 2005). Seventy-five percent of maternal deaths occur during childbirth and the postpartum period, and the vast majority of maternal deaths and injuries are avoidable when women have access to health care before, during and after childbirth (UN 2007; World bank 2007). Ninety-nine percent of maternal deaths occur in developing countries. The chances of a woman dying in pregnancy or childbirth is one in 14 in Somalia and one in 31 in sub-Saharan Africa, compared with just one in 15,200 in Italy and one in 4,200 in Europe (WHO 2010).

Maternal mortality in Ethiopia remains among the highest in the world (Hogan *et al.,* 2010). Ethiopia is among the six high burden countries for maternal death, along with Afghanistan, the Democratic Republic of Congo (DRC), India, Nigeria and Pakistan, which collectively account for roughly 50 percent of all maternal deaths worldwide.

Millions more women survive but suffer from illness and disability related to pregnancy and childbirth. The leading causes of maternal death in Ethiopia are postpartum haemorrhage (PPH), unsafe abortion, infection, pregnancy related hypertension, and obstructed labour (Koblinsky *et al.,* 2010). Ensuring availability of modern contraceptives and essential life-saving maternal/RH medicine is a major challenge in Ethiopia, where unmet need is very high and funding for supplies is almost completely donor dependent (Morrison and Brundage 2012).

Utilization of maternal health services is associated with improved maternal and neonatal health outcomes. Health care utilization in Ethiopia is very low resulting in poor health outcomes particularly among children and mothers. The rate of child and maternal mortality are among the highest in the world with 569 deaths per 100,000 live births (EDHS, 2016). The

Ethiopian government launched the health extension program (HEP) in 2003 to make health services accessible to the rural communities by deploying women health extension workers (HEWs). The HEP is also regarded as a principal means of implementing the Health Sector Development Program (HSDP) by bringing key maternal, neonatal and child health interventions to the community.

Ethiopia is one of the 189 countries that signed the Millennium Declaration. The UN Millennium Development Goals (MDG #4 and #5) calls for Ethiopia to reduce child and maternal mortality by a two-third and three-fourth respectively by the year 2015. Pursuant of these goals, the Ethiopian Ministry of Health has undertaken a number of important public health initiatives aimed at improving the health outcomes of women and children (FMOH, 2010a). One of these initiatives is the launching of the Health Services Extension Program (HEP) in 2003; an innovative way of scaling up the delivery of essential health interventions targeting the household and community level.

A similar study was made on the Health Extension Program and its association with maternal health services (Gebrehiwot, 2015), but it did not consider some selected maternal health services like family planning and HIV testing which have a significant role on health extension program.

The present study was conducted to measure level and trends in selected maternal health services during pre and post-intervention period of the Health Extension Program in Meket Woreda, Amhara Region using administrative data extracted from Woreda Health office. It specifically seeks to assess whether the health extension program has increased trends in selected maternal health service utilizations practices after its introduction in the woreda.

1.3. Research Questions

The hypotheses tested in this study were:

a. What is the level and trends of selected maternal health service utilization in the study area?
b. What is the status of HEP with selected maternal health service utilization during pre-intervention and post-intervention period in the research area?

1.4. Objectives

1.4.1. General Objective

The overall objective of this study is to measure level and trends in selected maternal health services during pre and post-intervention period of the Health Extension Program in Meket Woreda, Amhara Region.

1.4.2. Specific Objective

a. To measure level and trends of the utilization of selected maternal health services in the research area.
b. To assess whether Health Extension Program improved pre-intervention period utilization of selected maternal health service in the study area.

1.5. Significance of the Study

The Health Extension Program (HEP) is one of the most innovative community based health program launched by the Ethiopian Federal Ministry of Health to make health services accessible to rural communities by setting-out women Health Extension Workers (HEWs) in rural Health Posts (Amare, 2013). The HEWs are premised to provide basic, largely preventive, primary health services to rural villages and the program gives special attention to children and mothers (Negussie and Girma, 2017). Ethiopia's HEP has shown tangible positive impacts on community health, in disease prevention, family health, and environmental hygiene and sanitation (Wang *et al.,* 2016). A large number of published studies document the effectiveness of the health extension program in improving access to services and health outcomes but there is no such studies done in the research area even though it is important to assess the implementation of health extension program and its association with the utilization of maternal health service. So, the finding of this study will serve as base line information for policy makers, planners and other interested researchers to design appropriate interventions in the

areas related to health extension program. This study will be done using administrative data to measure level and trends of the utilization of selected maternal health services in Amhara region, Meket Woreda.

1.6. Scope and Limitations of the Study

1.6.1. Scope of the Study

The study covered issues related to the levels and trends in selected maternal health service utilizations as a result of Health Extension Program introduction in the study area. The data used for this analysis is obtained from an administrative record as a result some important demographic, socio-economic and other external factors which might affect results of study are not considered.

1.6.2. Limitations of the Study

The data collected from administrative sources is not primarily produced for statistical purposes as a result data quality issues might be a problem to use such data for purpose of statistical analysis. In addition to this the administrative data used for current study also lack demographic, socio-economic and household data. Consequently, the results obtained from the quantitative data are analyzed with some reservation.

CHAPTER TWO

Review of Literature

2.1. Theoretical Considerations

Different theories have been developed on maternal health care. It is a real fact that theories guide research. Social theory is useful in thinking about childbirth birth maternity care. I now want to suggest some ways in which social theory can form an important tool for critical thinking and analysis, which helps nurses and midwives to foster the skills and knowledge to develop, interpret, question, debate and apply evidence in practice. At the level of public health (at the macro-level of analysis), social theory helps to analyse and explain the social determinants of health and the complexity of the ways in which socio-economic conditions, life chances, access to knowledge and power can shape health status and wellbeing. Maternity care is central to public health as wellbeing in pregnancy and the pre natal period profoundly influences the future health of the child and even following generations as well as the health of the mother. The impact of health care, even maternity care, takes place at a less fundamental level. At the outset of pregnancy, the health of some women and their babies is already disadvantaged through social inequalities based on class, ethnic background and residence. Inequalities are also gendered, as is the power to influence social structure and policy, the delivery of health care and relationships in care. So, even before the journey of pregnancy and birth begins, social theory should play a role in informing maternity professionals about the factors influencing maternal and infant health. Such factors have also been shown to influence both the access to care and the quality of care received by different women in society, in such a way that maternity care may compound, rather than counter, existing social inequalities in health. Political economy can help to explain both the inequalities in the care received by different women, but also the inequalities of power between obstetricians, nurses and midwives and the economic and institutional drivers for medicalization of care.

If we turn to the healthcare institutions such as hospitals and clinics and the professions such as obstetrician or midwife, we can use social theory in order to analyse and understand the ways in which care is organised and provided, the division of professional roles and the attitudes and practices of those professionals, as well as their inter-relationships (McCourt, 2014).

The trans-theoretical model of behaviour change (TTM/BC): The TTM theorizes that health behaviour involves evolution through the stages of change: pre-contemplation, contemplation, preparation, action, and maintenance. The TTM is based on purposeful behaviour change that results in changed awareness .The acknowledgment of such behaviour promotes a predictability that the output will lead to adherence and sustainability of the desired health behaviour (Prochaska & Prochaska, 2011). The TTM is a tool that is used to modify a person's perception with the goal of promoting a behavioural routine that will result in adherence with the desired comportment (Prochaska & Prochaska, 2011). This approach to behaviour change incorporates all aspects of a person's wellbeing (Nash *et al.,* 2011). The TTM is a self-efficacy method for behaviour modification that involves the individuals' confidence and their readiness and feeling that the desired health action can be accomplished to their benefit. The model has shown positive patient outcomes in various settings, including community healthcare. Programs that apply behavioural change models to reduce risks have been successful in fostering adherence to health behaviours (Nash *et al.,* 2011). This model will be useful to promote the behavioural change of delivering at health care facilities rather than at home.

Antenatal care is one of the components of maternal care. It is "care before birth", and includes education, counseling, screening and treatment to monitor and to promote the well-being of the mother and fetus (Mario et al,. 2005). Antenatal care provides an important entry point for women to the health care system. It presents an opportunity to assess the future mother's overall condition, diagnose and treat infections, screen for anemia and HIV/AIDS, enroll women in programs to prevent transmission of HIV to infants, and prevent low birth weight The WHO Technical Working Group has recommended a minimum level of care to be four visits throughout the pregnancy. The first visit which is expected to screen and treat anemia, syphilis, screen for risk factors and medical conditions that can be best dealt with in early pregnancy and initiate prophylaxis if required is recommended to be held by the end of fourth month. The second, third and fourth visits are scheduled at 24-28, 32 and 36 weeks, respectively (UNFPA 2004)

Antenatal care is an effective health intervention tool for reducing the risk of maternal morbidity and mortality, particularly in places where the general health status of women is poor. Studies indicate that the risk of maternal morbidity and mortality is significantly higher among women who do not receive antenatal health-care services compared to women who do so (Royston E, Armstrong A 1989). Prenatal care is also associated with fewer complications

during pregnancy, higher birth weights, and lower rates of prenatal, neonatal, infant and child mortality (Donaldson JP, Billy JO 1989).

More than half of all women in the developing world receive at least four antenatal visits during pregnancy (the number recommended by WHO), although those with less education are vastly underrepresented. Women with secondary schooling are two to three times more likely to receive antenatal care as women with no education. Poor women, too, are far less likely to receive antenatal care, as with all health services.(WHO/UNICEF, 2003)

The achievement from expanded antenatal health care utilization is greatest in countries such as Ethiopia where fertility and mortality are high. According to the EDHS 2011 report, 34 percent of mothers received ANC care from health professionals; there are large differences between urban (76%) and rural (26%) in utilization of ANC service (CSA and ORC Macro, 2011). While good quality antenatal care can improve women's health in the period immediately before and after birth, it does not have a significant impact on maternal death risks unless it is linked with delivery care.

Delivery care is an important component of efforts to reduce the health risks of mothers and children is to increase the proportion of babies delivered under the supervision of health professionals in different health institution (public hospitals, private hospitals or other health care institutions). Proper medical attention and hygienic conditions during delivery can reduce the risk of complications and infections that may cause death or serious illness to either the mother or the baby or both. Though most women experience no major problems during labor and delivery, complications that do occur can be unpredictable and in sudden onset, requiring immediate action. Maternal and antenatal outcome in such instances are improved when such complications occur in the presence of a trained attendant. Provision for adequate medical attention during delivery is important for the well-being of mother and child. Absence of such care and lack of hygienic conditions at the time of birth may lead to complications that would increase the risk of death of the mother or child or both (Shanna Elaine et al, 2004). A skilled attendant can influence maternal mortality by utilizing safe and hygienic techniques during delivery. However, these measures will not prevent most life-threatening infections, which are due to delayed treatment of complications such as prolonged labor, ruptured uterus or retained products. A skilled attendant is a professionally trained health worker usually a doctor, midwife or nurse with the skills to manage a normal labor and delivery, recognize complications early on and perform any essential interventions, start treatment and supervise the referral of mother

and baby to the next level of care if necessary. Trained and untrained traditional birth attendants (TBAs) are not considered skilled attendants (WHO1999).

Only 63% of births in the developing world are attended by skilled health workers – including midwives as well as doctors and nurses with midwifery skills – up from 53% in 1990 (WHO, 2010).The percentage of births attended by skilled health workers remains even lower in Southern Asia (45%) and sub-Saharan Africa (46%) the two regions with the greatest number of maternal deaths (UN, 2010).

According to EDHS 2005 report only 10 percent of births are delivered with the assistance of a trained health professional, that is, a doctor, nurse, or midwife, and 28 percent are delivered by a traditional birth attendant and 61% of births are attended by a relative or some other person .Five percent of all births are delivered without any type of assistance at all. The FMOH report in 2007 showed that out of 2,753,434 deliveries, 16.4 percent took place at health facilities, 7.3 percent deliveries were attended by health extension workers (CSA and ORC Macro, 2005, FMOH 2006/07). The 2011 EDHS report indicate that the delivery by skilled provider increase to 10 percent the trend shows increment in health professional assisted delivery from 6 percent in 2005 to 10 in 2010. Coming to Amhara region, the FMOH reported that from 73,975 expected deliveries in the region 7.9 percent of deliveries assisted by skilled health professionals while 12.3 % of expected deliveries were attended by health extension workers (FMOH 2006/07).

A baseline survey done in South and North Wollo Zone showed that 5.5 % deliveries were managed by health professionals while health extension workers were mentioned to be involved at delivery only by nine of the respondents (Habte, Sheferaw, & Seme 2007). A study done in north Gondor 13.5 percent of the respondent had delivered in health institution. The reasons for not utilizing the service were 44.7 % of the respondents reported that labor was short and smooth, needed relatives attention during labor 14.3%, facility too far and the presence of TBA were 15.2% and 14.9% respectively. About seven percent gave a reason lack of money (Nigussie. 2004).

Conceptual Framework: Access to Community Based Primary Health Care

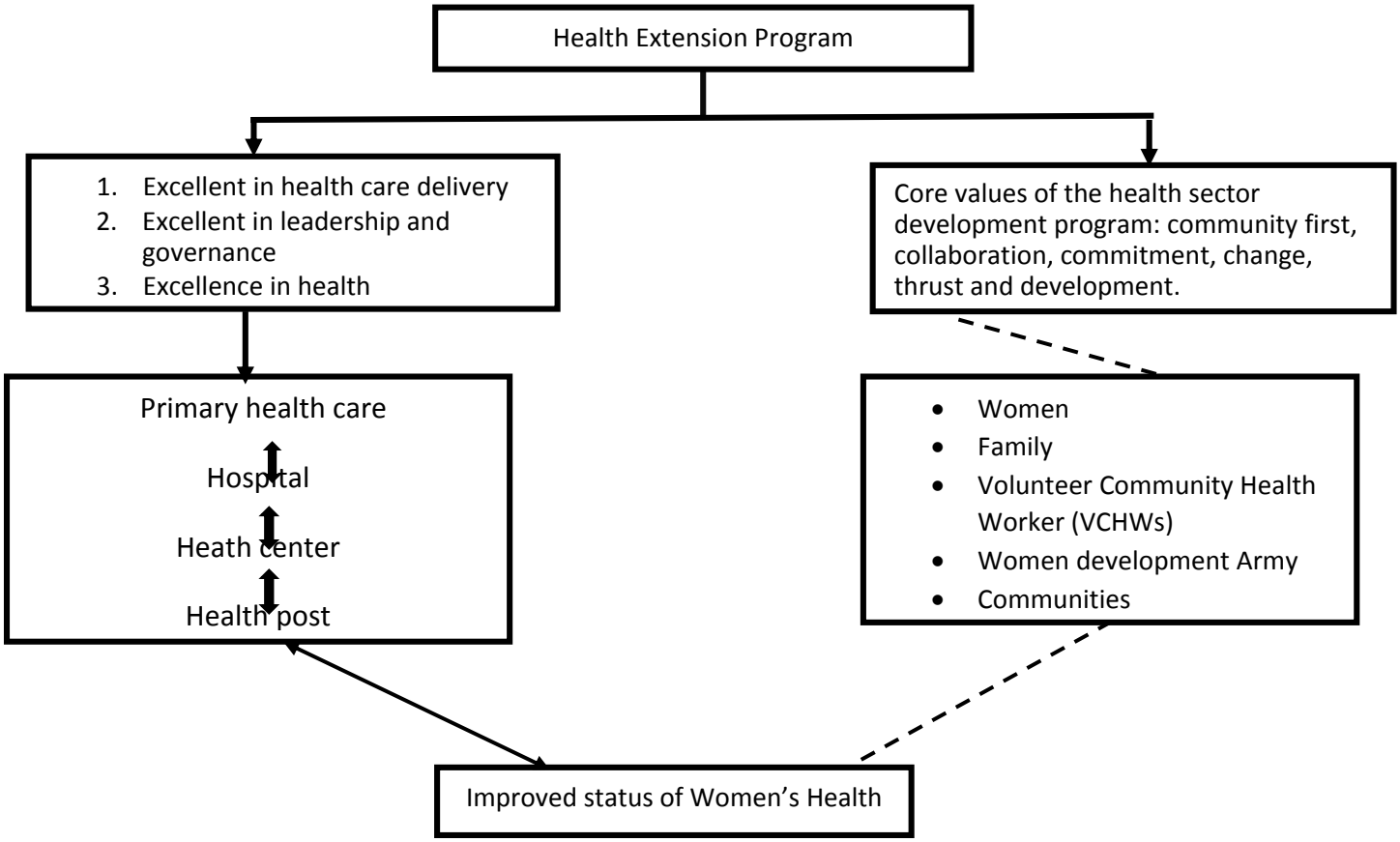


Figure 1: Conceptual framework of access modified from Thomas and Pechansky

2.2. The Health Extension Program in Ethiopia

The Health Extension Program (HEP), a flagship program of the Government of Ethiopia, was launched by the Federal Ministry of Health in 2003 with the goal of improving health outcomes in Ethiopia by targeting households and communities. The program was originally launched in 2003 in the country's four big agrarian regions and has made important contributions to Ethiopia's achievements in the area of health. The HEP, which has been expanded to the remaining regions in the country, started tailoring the program to the particular requirements of the pastoral and agro pastoral communities in 2006, and to urban areas in 2010. (World Bank, 2013). The health service extension program is pacing two government salaried female health extension workers in every kebele in the country. Each kebele may have a health post which will be operational center for two HEWs so as to provide outreach services for 5,000 households. The program is based on expanding physical health infrastructure of 15,000 health posts in15, 000 kebeles and developing a cadre of health service extension workers of 30,000 by 2009 who will provide basic promotes preventive and curative health services in the country. (Alula, 2008)

The HEP promotes four areas of care: Disease Prevention and Control, Family Health, Hygiene and Environmental Sanitation, and Health Education and Communication. Health service extension program introduced 16 packages in four main areas that include. (Alula, 2008)

A. Hygiene and Environmental Sanitation (Seven packages).

- Proper and safe excreta disposal system;
- Proper and safe solid and liquid waste management;
- Water supply safety measures;
- Food hygiene and safety measures;
- Healthy home environment;
- Arthropods and rodent control;
- Personal hygiene;

B. Disease Prevention and Control (four packages).

- HIV/AIDS prevention and control;
- TB prevention and control;
- Malaria prevention and control;
- First AID;

C. Family Health Services (Five packages)

- Maternal and child health;
- Family planning;
- Immunization;
- Adolescent reproductive health;
- Nutrition;

D. Health Education and Communication

Model Families: Model families are those households that are (1) trained in maternal health, malaria prevention and control, and hygiene and environmental sanitation packages; (2) able to implement these packages after the training; and (3) able to influence their relatives and neighbors to adopt the same practices. Before the introduction of the health development army, model families were expected to gather regularly for experience-sharing. They now work as part of the army to engage communities for health improvement (Wang *et al.*, 2016).

Candidates during the early phase of model family training include households with models in the agricultural extension program, traditional birth attendants, volunteer community health workers, or health focal persons in the kebele, because it is believed they are ready for change and can also influence the behavior and practice of community members (Wang *et al.*, 2016).

When implementing the training, priority is given to activities that are easy and inexpensive to implement, and are not contradictory to the community's values. This strategy ensures acceptability by the community and facilitates the scale-up of changes in the community (Wang *et al.*, 2016).

2.3. Some Empirical Findings

2.3.1. Health Extension Program and Antenatal Care

Antenatal care (ANC) from a skilled provider is important to monitor pregnancy and reduce morbidity and mortality risks for the mother and child during pregnancy, delivery, and the postnatal period (within 42 days after delivery). With the aim of reducing maternal mortality, HEWs are trained on how to provide care to pregnant mothers through pregnancy. HEWs inform pregnant mothers on safe motherhood when they provide antenatal care (ANC). The 2016 EDHS results show that 62 percent of women who gave birth in the five years preceding the survey received antenatal care from a skilled provider at least once for their last birth.

A study conducted in Tigray, Ethiopia shows that HEWs have contributed substantially to the improvement in women's utilization of antenatal care (Medhanyie *et al.,* 2012).

A study made in Ethiopia by (Yitayal *et al.,* 2014) revealed that health extension workers conducted frequent visits to 52.7% (95% CI = 50.0 to 55.4%) of the households, and78.5% (95% CI = 76.2 to 80.7%) mothers visited health posts. Mothers who had frequent household visits by health extension workers were 1.289 more likely to visit the health posts (AOR = 1.289, 95% CI = 1.028 to1.826) than mothers who did not get frequent visits. Mothers from model households (3 years after graduation) were 2.150 times more likely to visit health post (AOR = 2.150, 95% CI = 1.058 to 4.365) compared to mothers from non-model households. Mothers who felt that they understood the Health Extension Program packages were 1.573 times more likely to visit the health posts (AOR = 1.573, 95% CI = 1.056 to 2.343) than mothers who did not feel they understood the program packages. Mothers from higher income families were 2.867 times more likely to visit health posts (AOR = 2.867, 95%CI = 1.630 to 5.040) compared to mothers from lower income families.

In line with these studies, (Gedefaw *et al.,* 2014) shows that the prevalence of ANC service utilization was 57% of these, more than 80% of them received ANC for ≥4times. This finding is more similar to the regional report (68%) than that of EDHS (2011) for Amhara Region (34%). Marital status, educational status and income were important predictors for ANC service utilization. The most outstanding finding of this study was that more than 20% and 60%of mothers received antennal care, and information about antenatal care from health extension workers. Antenatal care utilization is still low. Single, divorced, or separated mothers were less likely to utilize ANC while economically better off, and literate mothers were more likely to use ANC services than their counterparts.

2.3.2. Health Extension Program and Postnatal Care

A large proportion of maternal and neonatal deaths occur during the first 24 hours after delivery. For both the mother and infant, prompt postnatal care is important for treating complications that arise from delivery and providing the mother with important information on caring for herself and her baby. The 2016 EDHS found that among women age 15-49 giving birth in the 2 years before the survey, 17% had a postnatal check during the first 2 days after birth. Four in five women (81%) did not receive a postnatal check. With the aim of reducing maternal mortality, HEWs are trained on how to provide care to pregnant mothers through

postnatal period. HEWs inform pregnant mothers on safe motherhood when they provide postnatal care (PNC).

A research done using data from cross-sectional surveys in December 2008 and December 2010 are from preventative sample of 117 communities (kebeles), they estimated the prevalence of maternal and newborn care practices, and a program intensity score in each community. Women with children aged 0 to 11 months reported care practices for their most recent pregnancy and childbirth. The program intensity score ranged between zero and ten and was derived from four outreach activities of the HEP front-line health workers. Dose-response relationships between changes in program intensity and the changes in maternal and new born health were investigated using regression methods, controlling for secular trend, respondents' background characteristics, and community-level factors. Between 2008 and 2010, median program intensity score increased 2.4-fold. For every unit increase in the score, the odds of receiving antenatal care increased by 1.13 times (95% CI 1.03–1.23); the odds of birth preparedness increased by 1.31 times (1.19–1.44); the odds of receiving postnatal care increased by 1.60 times (1.34–1.91); and the odds of initiating breastfeeding immediately after birth increased by 1.10 times (1.02–1.20). Program intensity score was not associated neither with skilled deliveries, nor with some of the other new born health care indicators (Karim *et al.,* 2013). In contrary, the research conducted by Medhanyie et al, (2012) indicated that HEWs contribution to the improvement in health facility delivery and postnatal check-up seems insignificant.

2.3.3. Health Extension Program and Family Planning

One of targets of the Ministry of Health, with respect to improving maternal and child health, is to increase the contraceptive prevalence rate (CPR) to 66 percent by 2015. In order to achieve this target, the Ministry has given priority to the provision of safe motherhood services such as family planning in the community (FMOH, 2010).

Between 2005 and 2011, use of modern family planning methods among married women has more than doubled, increasing from 10.9 percent to 23.4 percent (CSA and ICF International 2012) . The HEP evaluation (CNHDE 2012) also reported a comparable figure, that is, 28.7 percent of married women currently use modern contraceptive methods. The current use of any contraceptive method among married women was higher among model-family households (44.3 percent).

According to (Yitayal *et al.,* 2014) mothers from households which fully benefited from the Health Extension Program ("model households") were 3.97 (adjusted odds ratio, 3.97; 95% confidence interval, 3.01–5.23) times more likely to use contraceptives compared with mothers from non-model households. Model household status contributed to 29.3% (t=7.08) of the increase in current contraceptive utilization.

A recent study done in Ethiopia indicates that, of all the women, 444 (84.7%) had heard of Implanon. Health extension workers were the primary source of information on Implanon as mentioned by 376 (71.8%) of the respondents. Little more than seven women in every ten, 319 (71.8%), had good knowledge of Implanon and 248 (55.5%) of the women had supportive attitudes towards Implanon use. Among the sample, 10.1% women were using Implanon, 33 (62.3%) reported having received their implanon at a health post from health extension worker. Women's employment (AOR: 2.73, 95% CI: 1.20–6.21), the number of modern contraceptive methods known (AOR: 2.24, 95% CI: 1.09–4.62), and the number of contraceptive methods ever used (AOR: 11.0, 95% CI: 5.06–23.90) were positively associated with Implanon use (Gebre-Egziabher *et al.,* 2017). In line with this study, Weidert *et al.,* (2017) shows that the results from household surveys at baseline and end line suggest that CHWs in this model made a significant contribution to family planning in the region.

2.3.4. Health Extension Program and Delivery Care

Increasing institutional deliveries is important for reducing maternal and neonatal mortality. However, access to health facilities in rural areas is more difficult than in urban areas because of distance, inaccessibility, and the lack of appropriate facilities. Although institutional delivery has been promoted in Ethiopia, home delivery is still common, primarily in hard-to-reach areas. Twenty-six percent of live births in the 5 years before the survey were delivered in a health facility (EDHS, 2016).

With the aim of reducing maternal mortality, HEWs are trained on how to provide care to pregnant mothers through delivery period. HEWs inform pregnant mothers on safe motherhood when they provide birth.

A study was done in Ethiopia the 2015 MDG target for the Maternal Mortality Ratio (MMR) is 218 while the 2005MMR estimate is 673. The HSDP target is 32% skilled birth attendant

use by 2010 but only about 12% use was found in the four most populated regions of the country in 2009 (Koblinsky *et al.*,2010).

In contrary, study done by Afework *et al.* (2014) shows that health facility delivery (skilled attendance at birth) was not significantly associated with visit by Health Extension Workers during pregnancy [Odds Ratio 0.87(95% CI 0.25,2.96)] .

Research done in Ethiopia by Gebrehiwot *et al.* (2015) the total number of consultations for ANC, DC and PNC increased constantly, particularly after the late-intervention period. Increases were higher for ANC and PNC at health post level and for DC at health centres. A positive statistically significant upward trend was found for DC and PNC in all facilities ($p<0.01$). The positive trend was also present in ANC at health centres ($p = 0.04$), but not at health posts.

Other study done in Ethiopia shows that however, overall service coverage of ANC (four and more visits), delivery and PNC services were low in the district as compared to the national status; and the input from the HEWs, in this regard, was unsatisfactory. The number of home visits was also inadequate for the necessary support of the mothers. The results of the multiple logistic regression indicated that mothers who listen to the radio (AOR 4.62; CI 1.66–12.85) and who had received information about the MCH services by HEWs (AOR 2.09; CI 1.06–4.14) were significantly associated with good MCH service utilization status (Negussie and Girma, 2017).

2.3.5. Health Extension Program and HIV Testing

Acquired immune deficiency syndrome (AIDS) is caused by the human immunodeficiency virus (HIV). HIV weakens the immune system, making the body susceptible to secondary and opportunistic infections. Without treatment, HIV infection leads to AIDS and death. The predominant mode of HIV transmission is through sexual contact. Other modes of transmission are mother-to-child transmission (in which the mother passes HIV to her child during pregnancy, delivery, or breastfeeding), use of contaminated blood supplies for transfusions, and injections using contaminated needles or syringes. AIDS is one of the most serious public health and development challenges in sub-Saharan Africa. According to the 2011 EDHS, 1.5 percent of adults age 15-49 are infected with HIV. HEWs are trained on how to educate women on the use of HIV testing. Asiimwe S *et al.*, (2017) has made an attempt to study on expanding

HIV testing and linkage to care in south western Uganda with community health extension workers and conclude that community health extension workers (CHEWs) can be rapidly trained to scale-up home-based HIV testing and counselling (HTC) and linkage to care in a high-quality and low-cost manner to large numbers of people in a rural, high burden setting. A combination HIV testing approach, such as adding partner testing to community-based testing, could increase the proportion of HIV-positive persons identified.

CHAPTER THREE
Method

This chapter focuses on the approach and methods used for conducting the study. Preparations of the data for analysis and models employed for the analysis are discussed. The chapter also presents the strategy used in the analysis of the data, including the operational definitions of the independent and dependent variables.

3.1. Description of the Study Area

Meket is one of the woredas in the Amhara Region of Ethiopia. It is named after a former district located approximately in this area. Located on the western side of the Semen Wollo Zone, Meket is bordered on the south by Wadla and Dawunt, on the west by the Debub Gondar Zone, on the northwest by Bugna, on the north by Lasta, on the northeast by Gidan, and on the east by Gubalafto. The administrative center of Meket is Filakit Gereger; other settlements include Agrit, Arbit, Gashena and DebreZebit.

This woreda extends from the divide between the Tekezé and Bashilo watersheds northwards, with elevations ranging from about 1200 at the north western most point to over 3000 meters above sea level along the eastern part of its southern bord. Rivers include the Checheho which has its source in this woreda. FilakitGereger lies on the main Debre Tabor - NefasMewcha highway (also known as the Chinese road), and except for those of the eastern lowland woredas it is the only woreda capital with an all-year link to the Zonal capital of Weldiya. Meket, as well as the other seven rural woredas of this Zone, has been grouped amongst the 48 woredas identified as the most drought prone and food insecure in the Amhara Region. To combat increasing droughts and improve crop yields, two irrigation projects have been undertaken in this woreda by the Commission for Sustainable Agriculture and Environmental Rehabilitation in the Amhara Region, affecting 75 hectares and benefiting 270 households.

This woreda has a total population of 226,644, an increase of 17.02% over the 1994 census, of whom 114,398 are men and 112,246 women; 11,750 or 5.18% are urban inhabitants. With an area of 1,909.25 square kilometers, Meket has a population density of 118.71, which is less than the Zone average of 123.25 persons per square kilometer. A total of 50,478 households were counted in this woreda, resulting in an average of 4.49 persons to a household, and 49,078 housing units. The majority of the inhabitants practiced Ethiopian Orthodox Christianity, with 95.26% reporting that as their religion, while 4.72% of the population said they were Muslim.

The 1994 national census reported a total population for this woreda of 193,683 in 44,142 households, of whom 98,249 were men and 95,434 were women; 4,761 or 2.46% of its population were urban dwellers. The largest ethnic group reported in Meket was the Amhara (99.95%). Amharic was spoken as a first language by 99.77%. The majority of the population practiced Ethiopian Orthodox Christianity with 94.69% professing this belief, while 5.3% of the population said they were Muslim.(CSA, 2012)

3.2. Research Approach

This study mainly followed a quantitative research approach for testing the proposed hypothesis by examining trends in maternal health service utilization indicators.

3.3. Research Method

3.3.1. Data sources

The secondary data is obtained from the administrative time series data extracted from Meket Woreda Health Office spanning from 2001 to 2017 to examine trends of the Health Extension Program with improved utilization of selected maternal health services in the woreda. The dataset provides information on target population of the catchment area and number of women utilizing the selected services provided, namely: antenatal care, defined as the number of women who attended a HP or HC at least once during their pregnancy, delivery care, the number of women assisted by skilled health personnel at health centers and clean and safe deliveries by HEWs at health posts, post-natal care, the number of women checked by a health worker at HC or by a HEW at a HP or during a household visit at least once during the 45-day period after delivery, took HIV test and use family planning service.

3.3.2. Data Analysis Techniques

In this study, administrative data from July 2001 – June 2017 in Meket Woreda was used to assess the association of the Health Extension Program with improved utilization of selected maternal health services in the selected woreda. The dataset is categorized under the three phases of the intervention periods named as pre (the period before the program started, July 2001-June 2005), immediate (initiation of HEP, July 2005-June 2010) and late intervention (when the program runs smooth, after July 2010). July 2005 is selected as the starting point of the HEP, because it was the time where HEP implementation in the study wereda started with minimum resources.

Graphical Analysis

The first step in any time series data analysis is to plot the series and examine the main features of the graph. The bar graphs are used to analyse level of maternal health services both targeted and achieved by the woreda during the entire investigation period of the study.

Trend Analysis

This study involved trend analysis techniques to observe the trends in selected maternal health service indicators of Meket Woreda and ARIMA forecasting to predict the future scenario of these health indicators. Data analysis is done in R environment.

Trend analysis of time ordered observations using traditional regression model is not appropriate, since the errors of the regression line in such a case are typically auto-correlated. Presence of autocorrelation results sub-optimal estimate of the trend with incorrect estimate of standard error. This study utilizes ARIMA model to errors of the trend equation for treating autocorrelation problem and making prediction as well. The ARIMA model, introduced and popularized by econometricians is an indispensable tool for modeling and forecasting sequence of observations in time (Abraha *et al.*, 2009; Engmann *et al*, 2015).

Regression Methods

The classical statistical method of regression analysis may be readily used to estimate the parameters of common none-constant mean trend models. We shall consider the most useful ones: linear, quadratic, seasonal means, and cosine trends.

Because of its flexibility, a polynomial trend model is implemented to represent maternal health service indicators:

$$Y_t = \alpha + \beta_1 t + \beta_2 t^2 + \cdots + \beta_k t^k + e_t,$$

Where Y_t is a time series realization of maternal health service indicator, t represents the time, and α, β_1 ... β_k are parameters of the model. In the case, where k=1, the above equation becomes a simple linear regression line. The errors, e_t, of the equation is a de-trended series and can further be model with an ARIMA (p, d, q) specification:

$$\nabla^d e_t = c + \emptyset_1 \nabla^d e_{t-1} + \emptyset_2 \nabla^d e_{t-2} + \cdots + \emptyset_p \nabla^d e_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \cdots + \theta_q \varepsilon_{t-q}$$

Where ∇ = difference operator ($\nabla^d e_t = e_t - e_{t-1}$); $\varepsilon_t =$ white noise error term; $c, \emptyset_1, \emptyset_2, \dots, \emptyset_p, \theta_1, \theta_2, \dots, \theta_q$ are parameters; p= number of autoregressive terms; q= number of moving average terms and d= number of differencing.

In cases where the errors of the trend model are white noise (no autocorrelation), no ARIMA modeling is necessary. The procedure of ARIMA model estimation is an iterative process involving four steps: model identification, parameter estimation, model validation and prediction. A number of literatures are available on computational detail of ARIMA model; however, now a day, computation can be done easily in R and other software's as well (Sarpong, 2013).

Modeling Non-Stationary Series

Much of the theory in the time-series literature is applicable to stationary processes. In practice most real time series have properties that do change with time, albe it slowly in many cases which result in non-stationarity. Many time series are non-stationary due to deterministic trends and/or seasonal effects. Time series may also be non-stationary because the variance is serially correlated, i.e. they are conditionally heteroskedastic. Such series, often from financial or economic background, usually exhibit periods of high and low volatility.

Some methods for dealing with non-stationarity like the use of differencing with ARIMA models allows stationary models to be fitted, while various explicit models for trend have already been introduced (Priestley, 1988).

Time Series Diagnostics Measures

For diagnostic measures it is necessary try to find out the pattern in the residuals of the chosen model by plotting the ACF of the residuals, and doing a portmanteau test. We need to try modified models if the plot doesn't look like white noise.

Box-Ljung test: It is a test of independence at all lags up to the one specified. Instead of testing randomness at each distinct lag, it tests the "overall" randomness based on a number of lags, and is therefore a portmanteau test. It is applied to the residuals of a fitted ARIMA model, not the original series, and in such applications the hypothesis actually being tested is that the residuals from the ARIMA model have no autocorrelation.

3.3.3. Parameters used for trends analysis of Maternal Health Service

Based on the review of literatures that help to answer research questions, the following indicators as described in table 1 below were identified and used to measure trends in maternal health service during 2001 to 2017 as a result of health extension program.

Table 1: Parameters used for trends analysis of maternal health service

Indicator	Description
Antenatal care (ANC)	If the mother attended a health facility for ANC, at least ones in her pregnancy during the time of data collection period.
Postnatal care (PNC)	If the mother visited a Health Centre/Health Post within 42 Days of her give birth during the time of data collection period.
Family Planning (FP)	If the mother has been using any contraceptive method during the time of data collection period.
Health Facility Delivery Care (DC)	Whether the woman gave birth at a health facility during the time of data collection period.
HIV Testing (HIV)	Whether the woman ever had an HIV test during the time of data collection period.

Health Extension program which considered as an influence for the above indicators is an innovative health service delivery program that aims at universal coverage of primary health care.

CHAPTER FOUR

Results and Discussions

This chapter describes graphical and model based analyses that were performed to test the proposed research questions. Firstly, the descriptive results are presented and discussed; secondly different regression and time series models used to analyze trends in maternal health service indicators for Meket Woreda will be described.

4.1. Graphical Analysis of Maternal Health Care Services

The figure shown below describes number of mothers who utilized antenatal care service during pre-intervention, intervention and post-intervention period of HEP in Meket Woreda. As results clearly indicated number of antenatal care services utilizers during pre-intervention period of 2001 to 2004 was very small as compared with targeted figures by the woreda health bureau. On the other hand, the figure shows large increments from year 2005 to 2008 which was the intervention period of the program followed by slight drop out in year 2009 and 2010. During the post-intervention period of 2011-2017 the achieved antenatal care services shows an increasing trend from year to year. Overall the descriptive measure clearly showed that number of women utilizing antenatal care services have been increased during intervention and post-intervention periods as compared to pre-intervention periods.

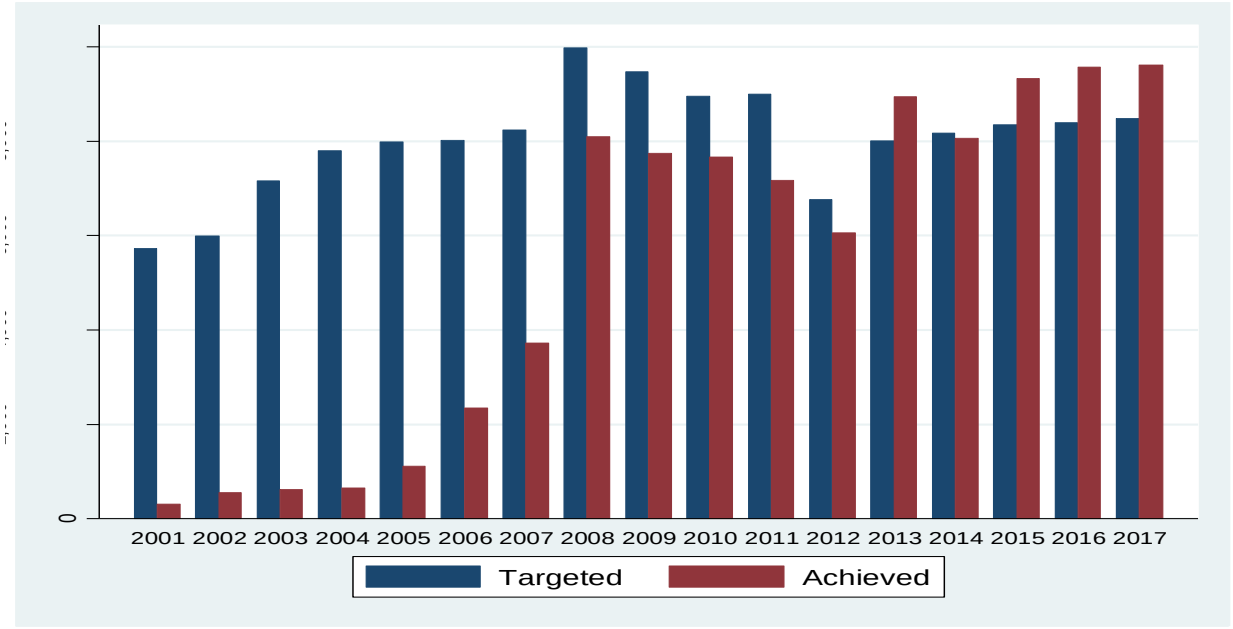


Figure 2: Antenatal care service utilization for the entire investigation period (July2001-June2017)

The bar graph as shown below indicated maternal delivery care services utlization in meket wereda for the entire investigation period of july 2001 – june 2017. The graph shows very small delivery care services and huge gaps between achievement and targeted numbers during pre-intervention period of 2001 to 2004. But during intervention periods of 2005 to 2009 level of service utlization has shown positive increaments from year to year while narrowing target and achevements numbers significantly. After showing some fluctuations between year 2010 and 2012 the series shows highest achieved pick values in year 2013 followed by gradual increase up to year 2016. However, due to unknown case the level of maternal delivery service decreased during year 2017 as compared with the previous four preceeding years of investigation. Overall from the graphical analysis it is evident to conclude that maternal delivary care service utlization has shown great improvements since HEP starts in the wereda.

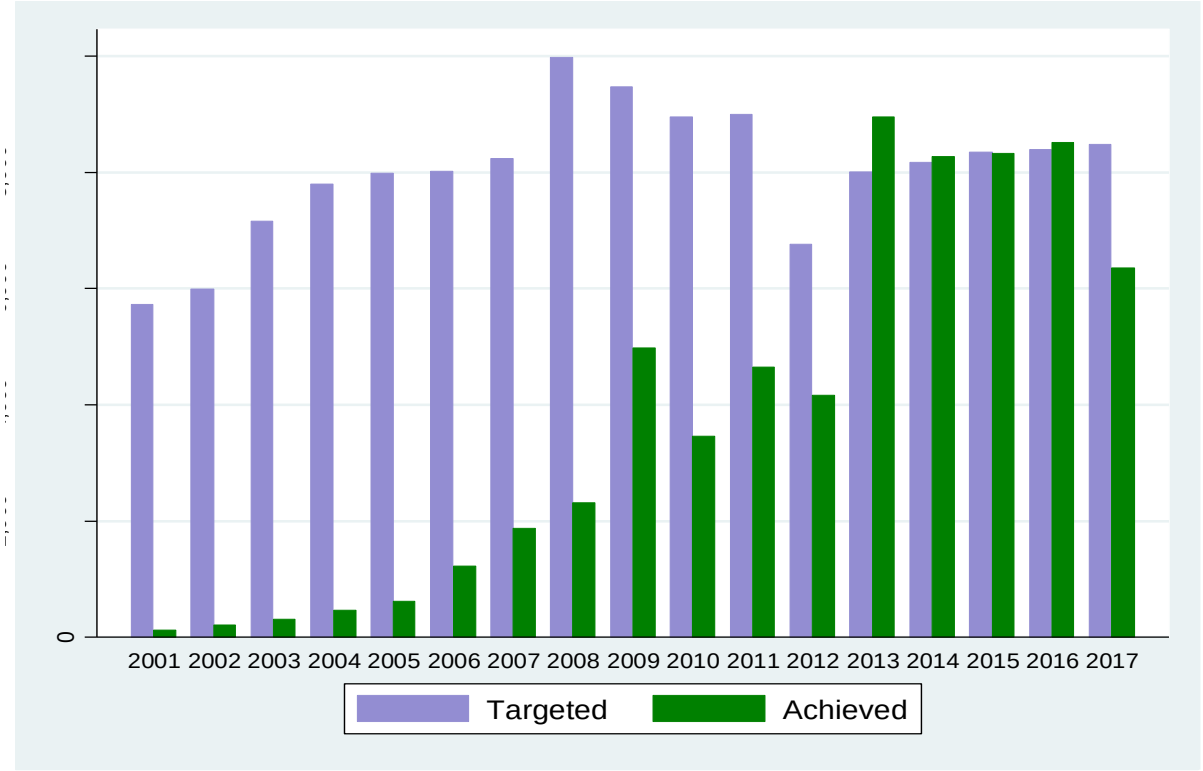


Figure 3: Delivery care service utilization for the entire investigation period (July2001-June2017)

The bar graph as shown below indicated maternal postnatal care services utlization in meket wereda for the entire investigation period of july 2001 – june 2017. The graph shows very small level of services utlized and huge gaps between achievement and targeted number of services during pre-intervention period of 2001 to 2004. As clearly observed from the graph, level of service utlization during intervention periods of 2005 to 2010 has shown positive and fastest increaments from year to year while narrowing the gaps between target and achevement levels

of each year significantly. However, the level of service at early post intervention year of 2011 shows downturn followed by a slight and highest improvements in year 2012 and 2013, respectively. In the following post intervention year 2014 the series shows some decline and again very positive improvements in 2013. After year 2013 figures show some slight up down fluctuations in number of service utlizations but still improvements as compared with pre-intervention and intervention period. Generally from the graphical analysis it is evident to conclude that postnatal care service utlization has been improved significantly since HEP intervention started in the wereda.

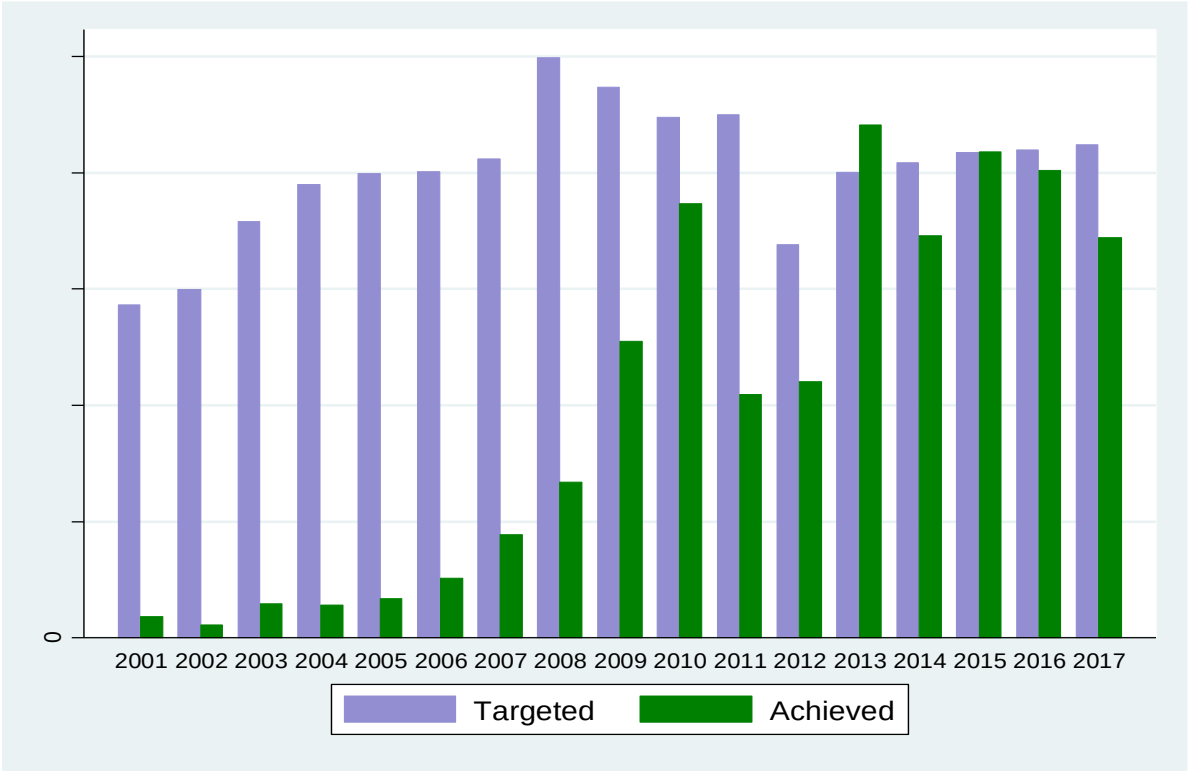


Figure 4: Postnatal care service utilization for the entire investigation period (July2001-June2017)

The bar graph as shown below indicated family planning services utlization in meket wereda for the entire investigation period of july 2001 – june 2017. The graph shows very small level increaments in number of women attending health centers for family planning services and wider gaps between achievement and targeted number of services during pre-intervention period of 2001 to 2004. As clearly observed from the graph, level of service utlization during intervention periods of 2005 to 2010 has shown positive and fastest increaments from year to year while narrowing the gaps between target and achevement levels of each year significantly. During post-intervention period the level of service at early post intervention year of 2011 shows increaments then followed by a slight downturn in 2012. In the following post-

intervention years the series shows horizontal trend except some minor fluctuations. The stablization of the trend around the end periods can be reasoned out as, most of womens in the wereda have gone utilizing the family planning service. Hence no more new case can arive to the service then the trend will stabilize, have a horizonatal trend (Fig 4).

Generally from the graphical analysis it is evident to conclude that family planninge service utlization has been greatly improved since HEP intervention started in the wereda.

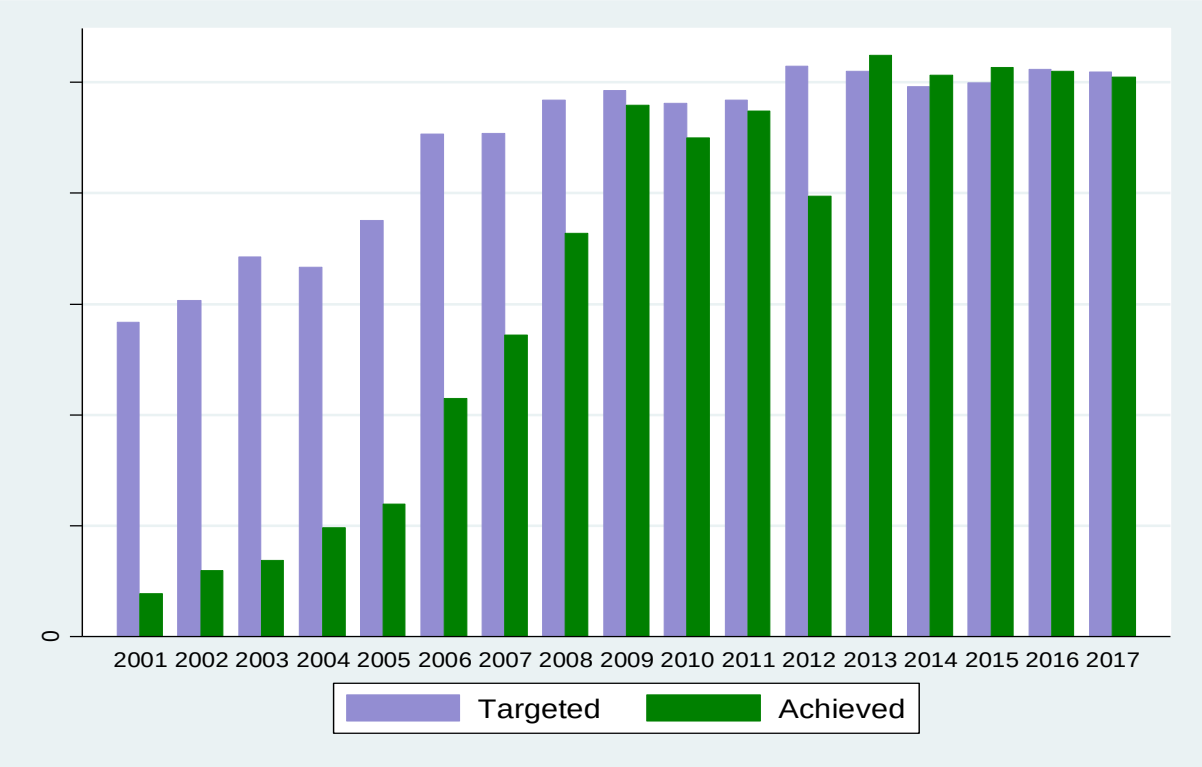


Figure 5: Family planning service utilization for the entire investigation period (July2001-June2017)

The figure below describes levels of maternal HIV service utlization in meket wereda for the entire investigation period of july 2001 – june 2017. But due to data unavailability the values for year 2001-2005 are not included in graphical analysis. The graph sows that level of maternal HIV service utlization during the early years of intervention period such as 2006 and 2007 were very small followed by increasing trend up to year 2010. Similarly, during post-intervention period of HEP, the figure indicates an increasing in magnitude of service utlizers and narrowing gap between tragets and achivements. Generally, from graphical description of maternal HIV service utlization one clearly understood that, the level of service was increasing while the gaps between tragets and achievements were decreasing in both intervention and post-intervention period.

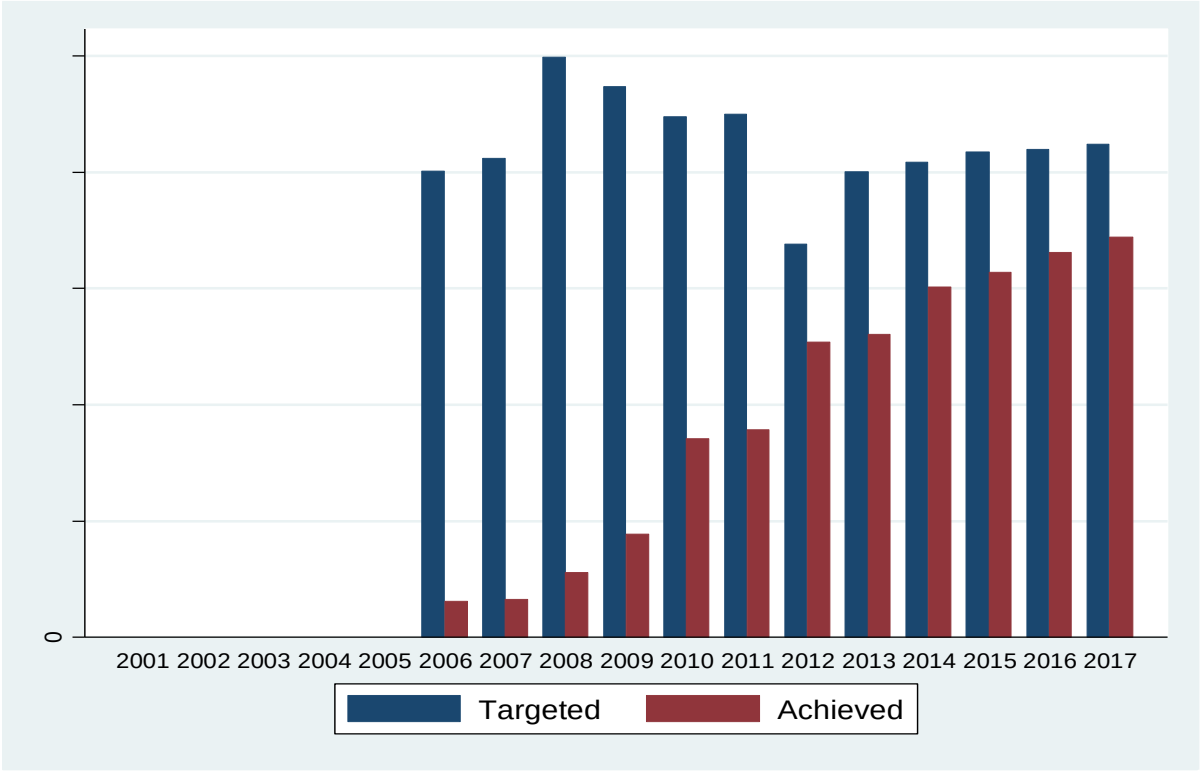
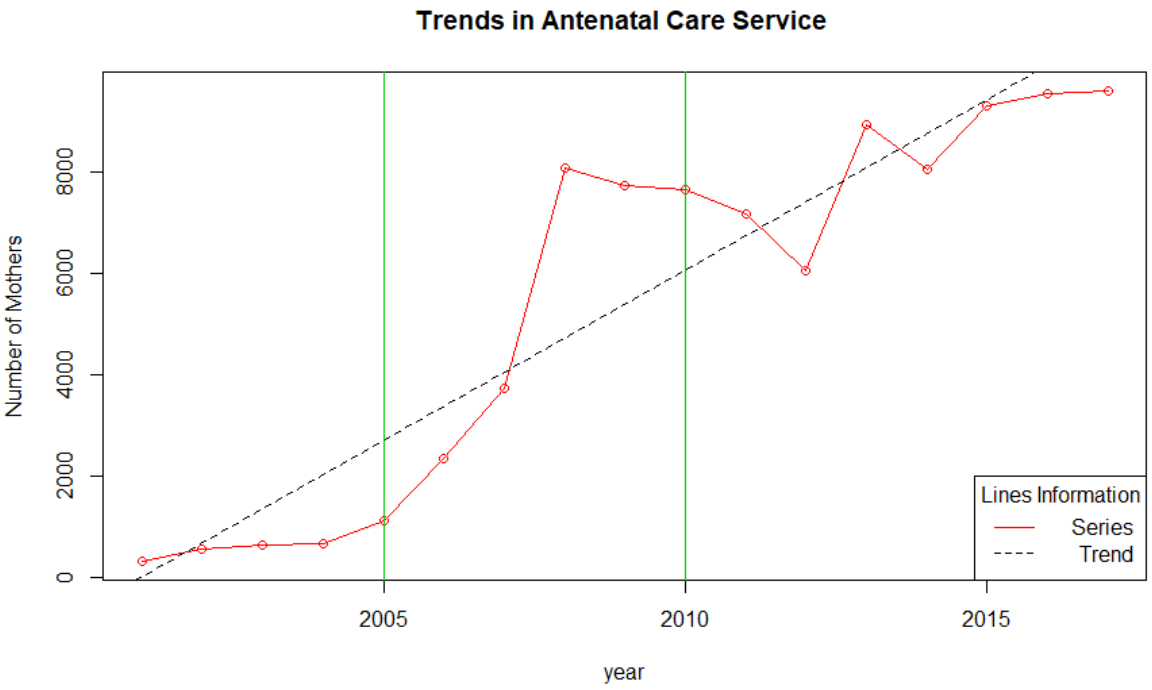


Figure 6: HIV service utilization for the entire investigation period (July2001-June2017)

4.2. Trends in Maternal Health Service Utilization

4.2.1. Trends in Antenatal Care Service

The upper panel of Fig 7 shows the observed and trends of antenatal care service in Meket Woreda for the period 2001 to 2017. We observe a linearly increasing trend model fits the series. A linear trend model with an ARIMA (0, 1, 0) specification is given to fit the series. The diagnosis plot in Fig 10 shows the errors are white noise and refers that the fitted trend model and its ARIMA specification is adequate. The three-year forecast at 95% confidence interval is displayed in lower panel of Fig 7. It shows an increasing trend of antenatal care service in Meket Woreda in the following years.



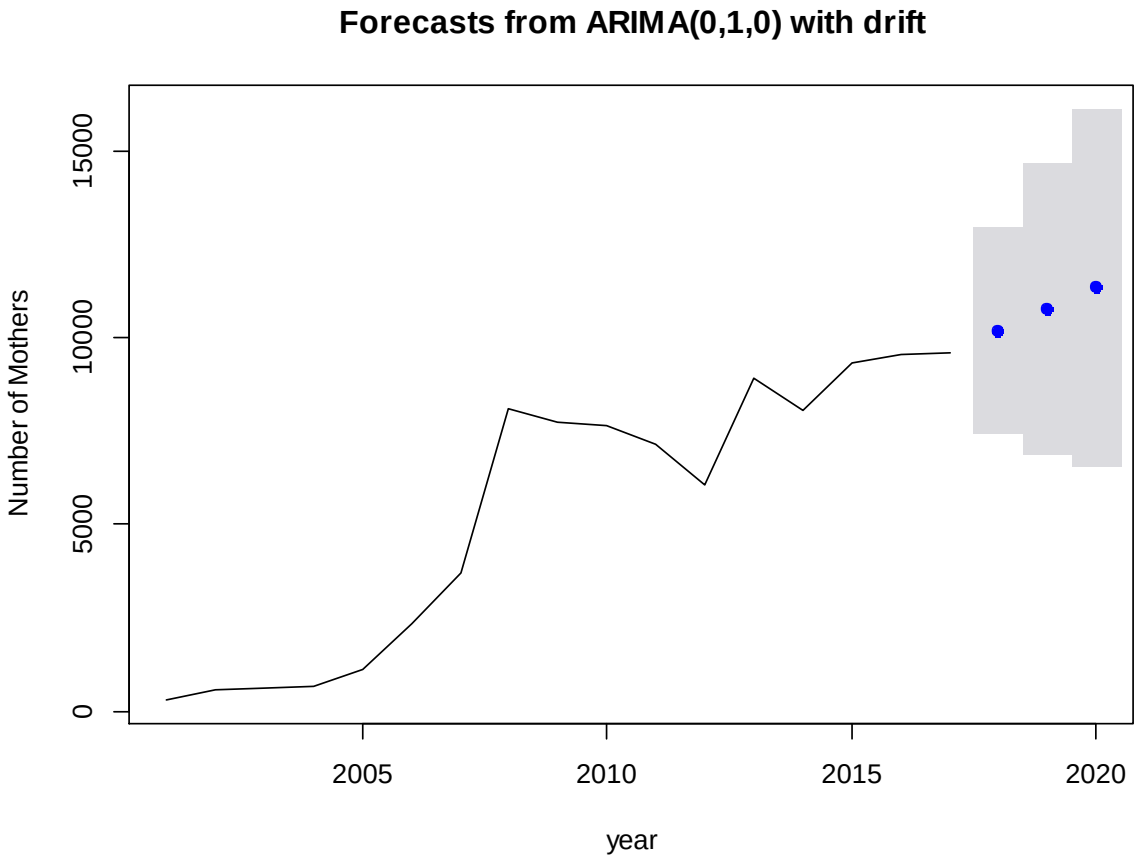


Figure 7: Trends in Antenatal Care Service with ARIMA forecasts

Inspection of the time plot of the standardized residuals in figure below shows no obvious patterns. Notice that there are outliers, however, with a few values exceeding 3 standard deviations in magnitude. The ACF of the standardized residuals shows no apparent departure from the model assumptions, and the Q-statistic is never significant at the lags shown.

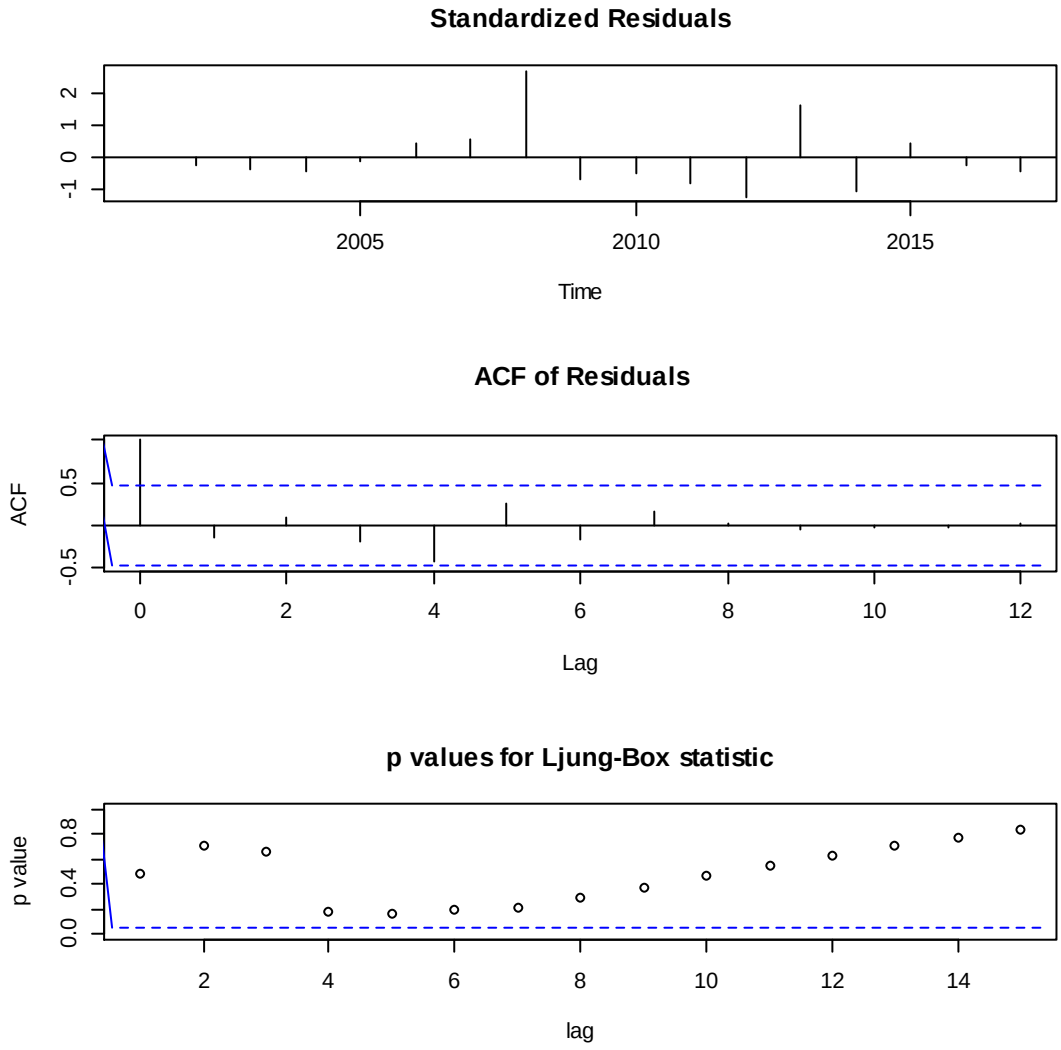


Figure 8: Diagnostic Plots of ARIMA (0, 1, 0) model for Residuals: Antenatal Care Service

The fited linear regression model is given in Table 4. The regression coefficient for time variable shows significance at α=0.05 level. The goodness of fit statistics for the model shows (Adjusted R-squared: 0.8498) the model fits the data well. Positive value for coefficient of time (675.4) tells us there is an increasing in number of antenatal care service utilizers during the intervention and post intervention period of HEP in Meket Woreda.

Table 2: Summary of fitted Linear Trend Model for Antenatal Care Service

Coefficients	estimate	Std. Error	t value	p
Intercept	-1351505.9	141832.8	-9.529	9.39e-08 ***
t	675.4	70.6	9.567	8.92e-08 ***

Residual standard error: 1426 on 15 degrees of freedom, Multiple R-squared: 0.8592, Adjusted R-squared: 0.8498. F-statistic: 91.53 on 1 and 15 DF, p-value: 8.919e-08

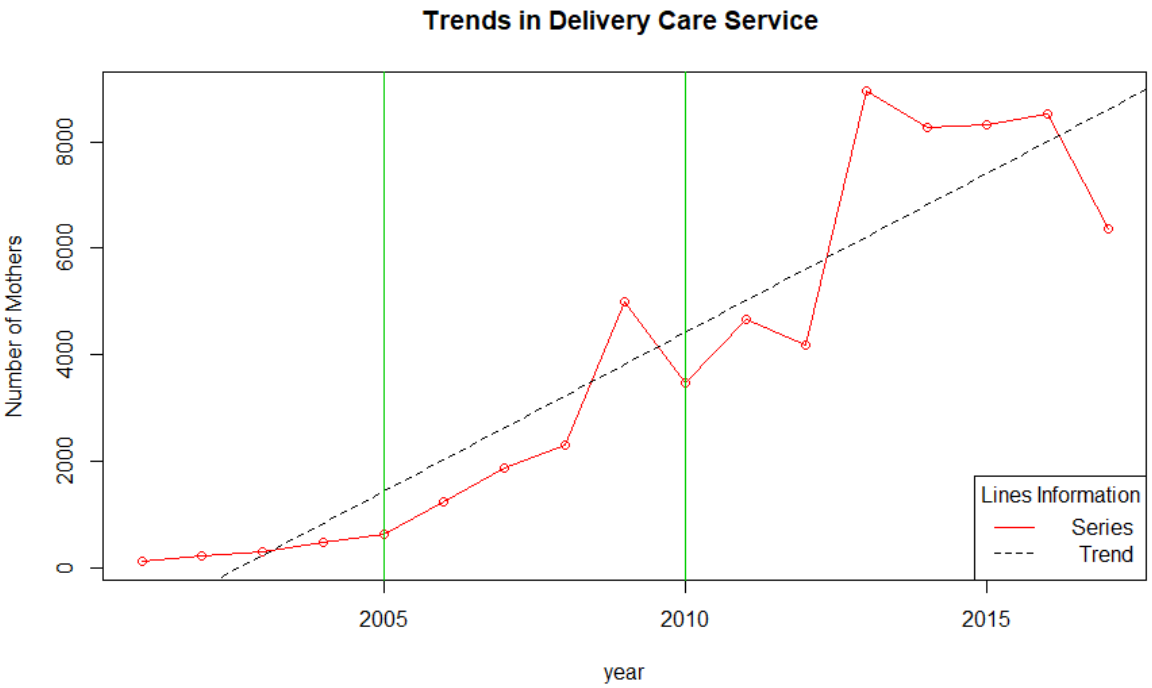
ARIMA model for residuals of the fitted trend model:

Coefficints of ARIMA(0,1,0) with drift is 580.8125, s.e. 340.3640

sigma^2 estimated as 1977120: log likelihood=-138.16: AIC=280.33: AICc=281.25: BIC=281.87

4.2.2. Trends in Delivery Care Service

The upper panel of Fig 9 shows the observed and trends of delivery care service utlization in Meket Wereda for the period 2001 to 2017. We observe a linearly increasing trend model fits the series. A linear trend model with an ARIMA (1,1,1) specification is fited the series. The diagnosis plot in Fig 10 shows the errors are white noise and refers that the fitted trend model and ARIMA specification is adequate. The three-year forecast at 95% confidence interval is displayed in lower panel of Fig 9. It shows approximately a horizontal trend of antenatal care service in Meket Woreda in the following years.



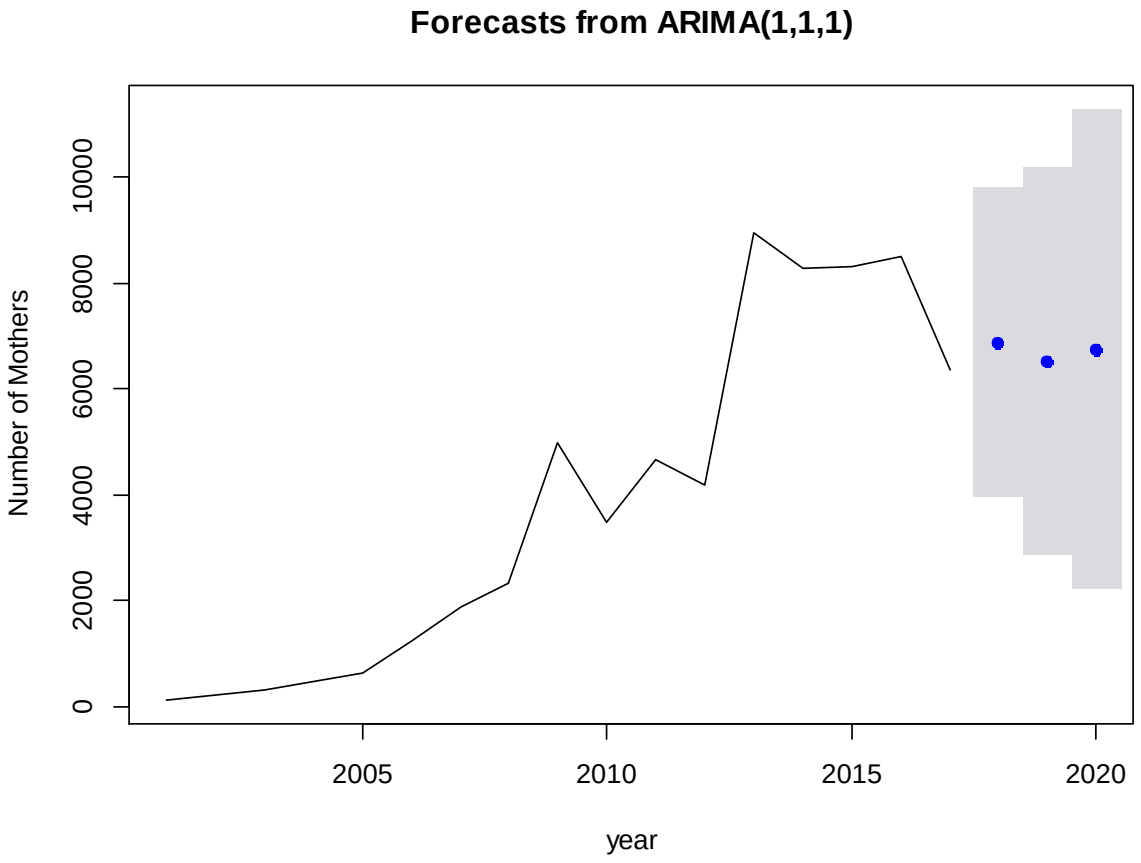


Figure 9: Trends in Delivery Care Service with ARIMA forecasts

Inspection of the time plot of the standardized residuals shows no obvious patterns. Notice that there are outliers, however, with a few values exceeding 3 standard deviations in magnitude. The ACF of the standardized residuals shows no apparent departure from the model assumptions, and the Q-statistic is never significant at the lags shown.

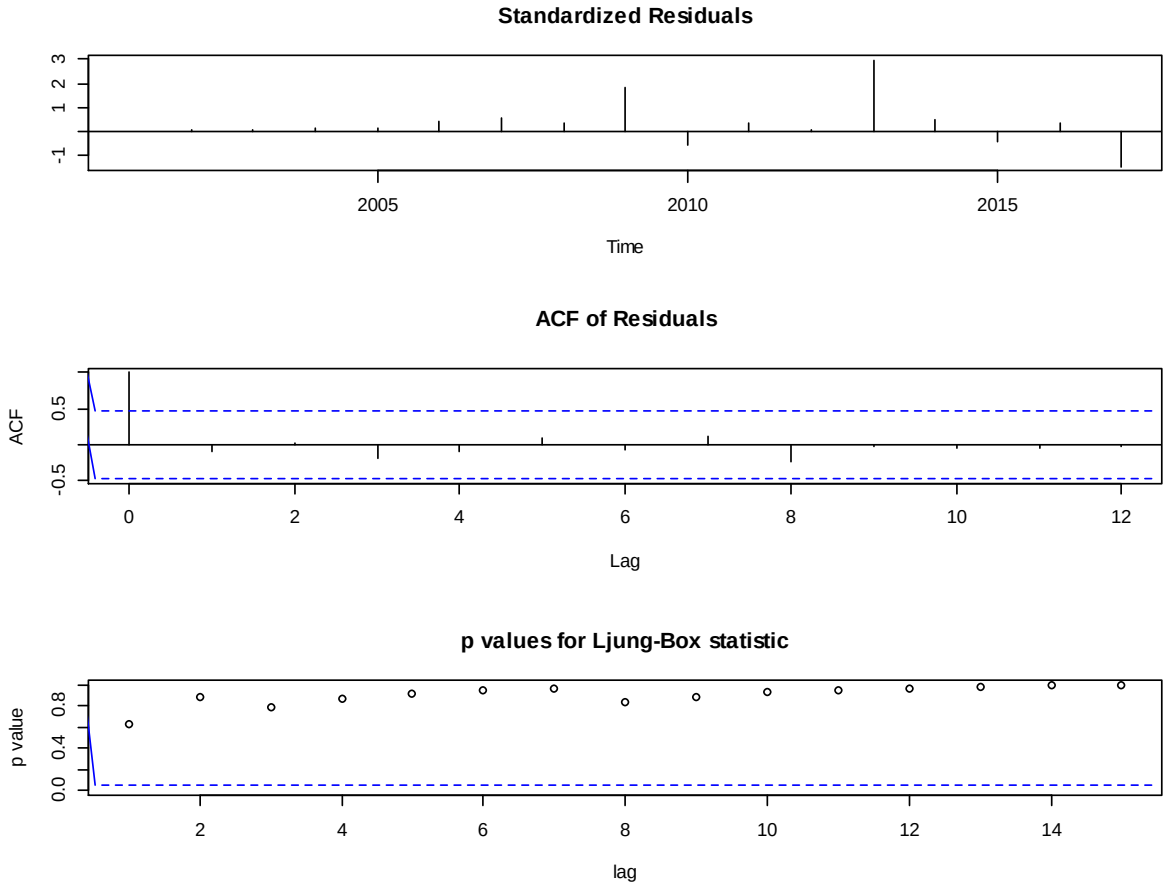


Figure 10: Diagnostic Plots of ARIMA (1, 1, 1) model for Residuals: Delivery Care Service

The fited linear regression is given in Table 3. The regression coefficient for time variable shows significance at $\alpha = 0.05$ level. The goodness of fit statistics for the model shows (Adjusted R-squared: 0.8458) the model fits the data well. Positive value for coefficient of time (127400) indicates that there is an increasing in number of antenatal care service utilizers during the intervention and post intervention period of HEP in Meket wereda.

Table 3: Summary of fitted Linear Trend Model for Delivery Care Service

Coefficients	estimate	Std. Error	t value	p
Intercept	-1.197e+06	1.274e+05	-9.393	1.13e-07 ***
t	5.976e+02	6.342e+01	9.423	1.09e-07 ***

Residual standard error: 1281 on 15 degrees of freedom, Multiple R-squared: 0.8555, Adjusted R-squared: 0.8458; F-statistic: 88.78 on 1 and 15 DF, p-value: 1.087e-07

ARIMA model for residuals of the trend model was fitted following Box-Jenkins iterative approach for constructing time series models.

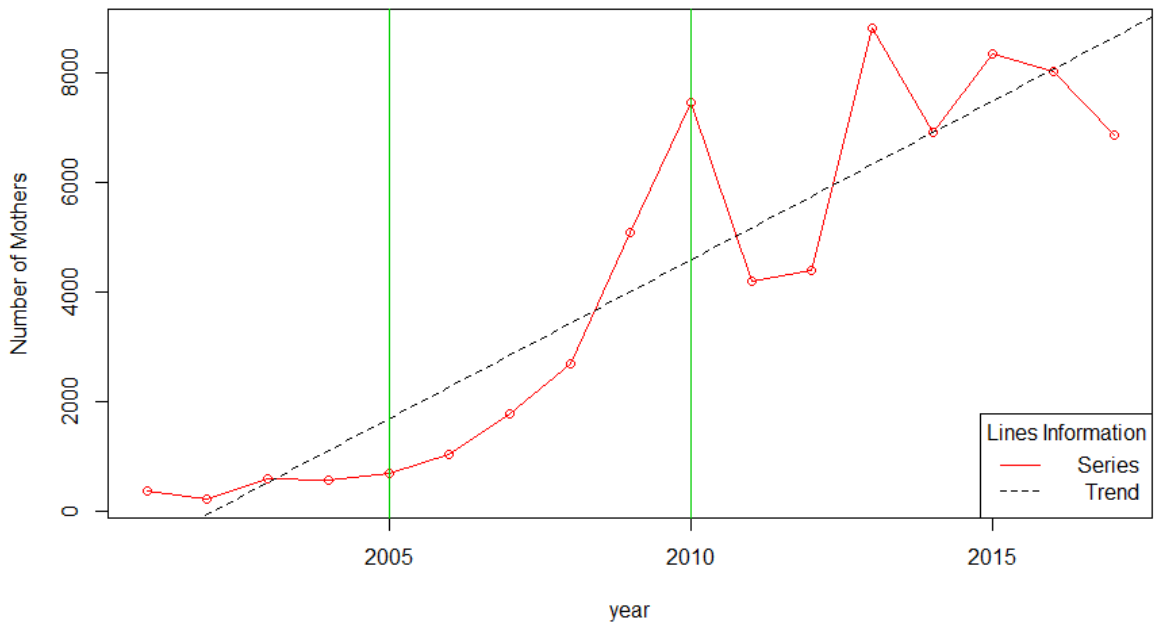
Estimated ARIMA (1,1,1) for residuals of the fitted trend model are given below:

	ar1	ma1
	-0.6544	0.4013
s.e.	0.3617	0.4280

sigma^2 estimated as 2232911: log likelihood = -139.72, aic = 285.43

4.2.3. Trends in Postnatal Care Service

The upper panel of Fig 11 shows the observed and trends of postnatal care service utlization in Meket Wereda for the period 2001 to 2017. We observe a linearly increasing trend model fits the series. A linear trend model with an ARIMA (0,1,1) specification is given to fit the series. The diagnosis plot in Fig 12 shows the errors are white noise and refers that the fitted trend model and ARIMA specification is adequate. The three-year forecast is displayed in lower panel of Fig 11. It shows a slightly increasing trend of postnatal care service in Meket Woreda in the following years.



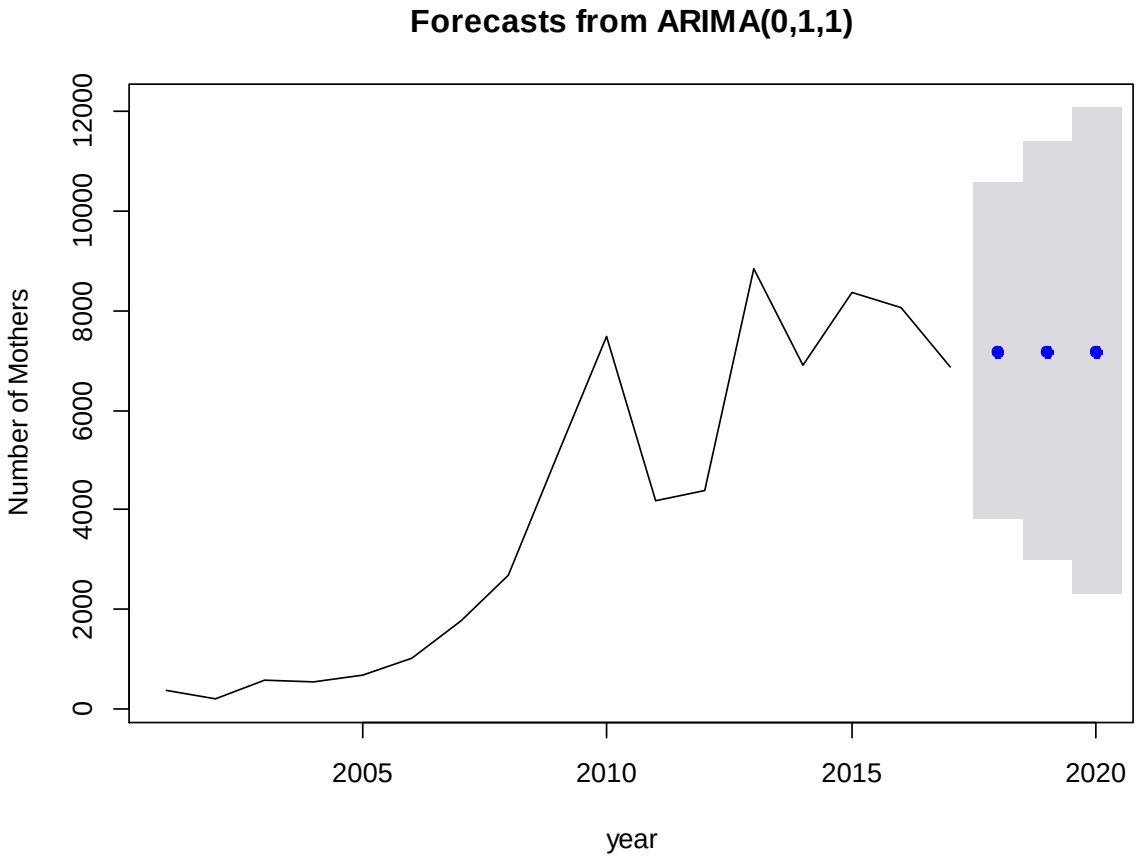


Figure 11: Trends in Postnatal Care Service with ARIMA forecasts

Inspection of the time plot of the standardized residuals shows no obvious patterns. Notice that there are outliers, however, with a few values exceeding 3 standard deviations in magnitude. The ACF of the standardized residuals shows no apparent departure from the model assumptions, and the Q-statistic is never significant at the lags shown.

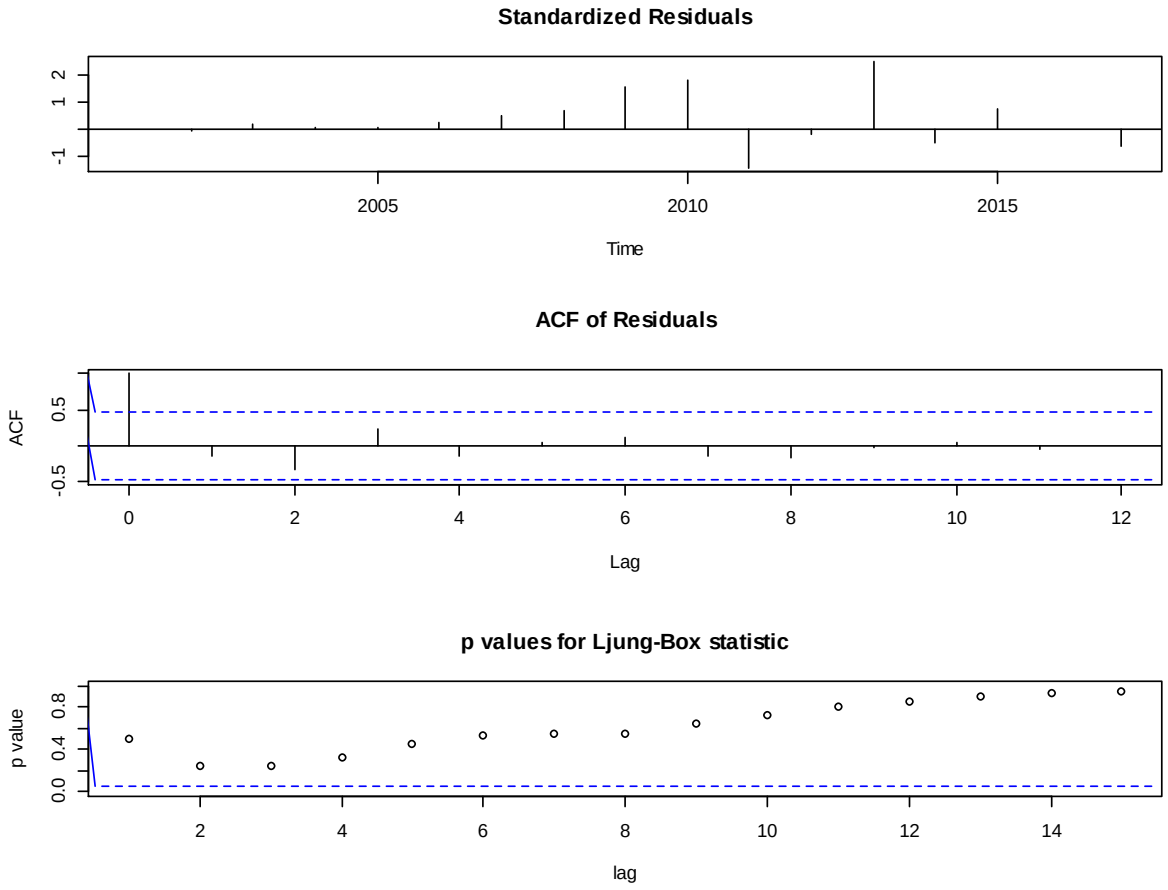


Figure 12: Diagnostic Plots of ARIMA (0, 1, 1) model for Residuals: Postnatal Care Service

The fited linear regression is given in Table 4. The goodness of fit statistics for the model shows (Adjusted R-squared: 0.8204) the model fits the data well. The regression coefficient for time variable shows significance at α=0.05 level. Positive value for coefficient of time (582.4) indicates that there is an increasing in number of antenatal care service utilizers during the intervention and post intervention period of HEP in Meket wereda.

Table 4: Summary of fitted Linear Trend Model for Postnatal Care Service

Coefficients	estimate	Std. Error	t value	p
Intercept	-1.166e+06	1.359e+05	-8.579	3.60e-07 ***
t	5.824e+02	6.766e+01	8.609	3.45e-07 ***

Residual standard error: 1367 on 15 degrees of freedom, Multiple R-squared: 0.8317, Adjusted R-squared: 0.8204, F-statistic: 74.11 on 1 and 15 DF, p-value: 3.451e-07

ARIMA model for residuals of the trend model is provided below, the model was fitted following Box-Jenkins iterative approach for constructing time series models.

Coefficients for ARIMA(0,1,1):

ma1

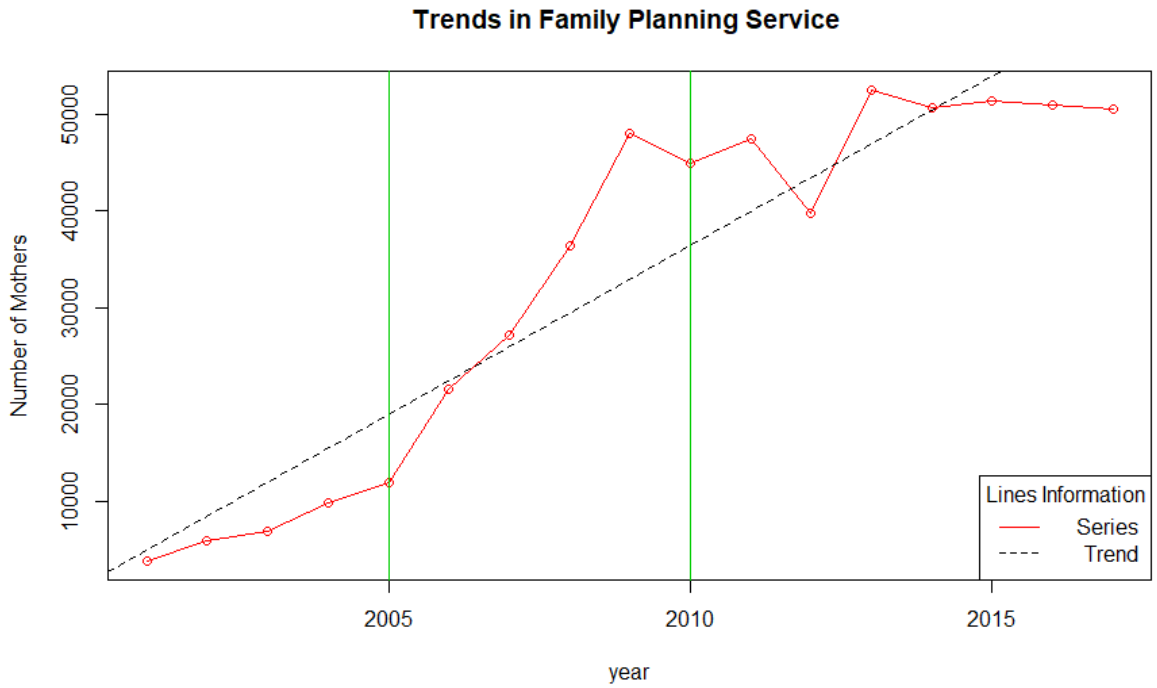
-0.2649

s.e. 0.2319

sigma^2 estimated as 2968523: log likelihood = -141.97, aic = 287.94

4.2.4. Trends in Family Planning Service

The upper panel of Fig 13 shows the observed and trend of familiy planning utlizers in Meket wereda for the period 2001 to 2017. We observe a linearly increasing trend model fits the series. A linear trend model with an ARIMA (1,1,1) specification is given to fit the series. The diagnosis plot in Fig 14 shows the errors are white noise and refers that the fitted trend model and ARIMA specification is adequate. The three-year forecast is displayed in lower panel of Fig 13. It shows a slightly increasing trend of family planning service in Meket Woreda in the following years.



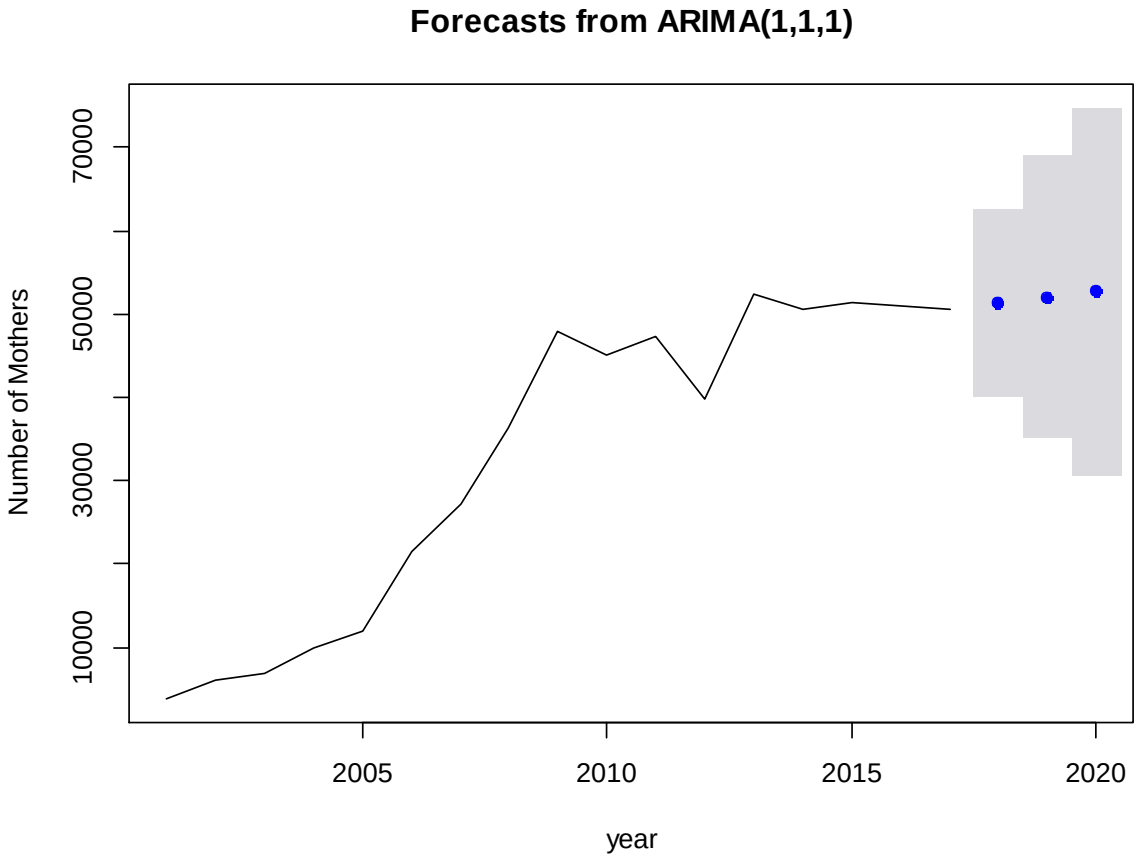


Figure 13: Trends in Family Planning Service with ARIMA forecasts

Inspection of the time plot of the standardized residuals shows no obvious patterns. Notice that there are outliers, however, with a few values exceeding 3 standard deviations in magnitude. The ACF of the standardized residuals shows no apparent departure from the model assumptions, and the Q-statistic is never significant at the lags shown.

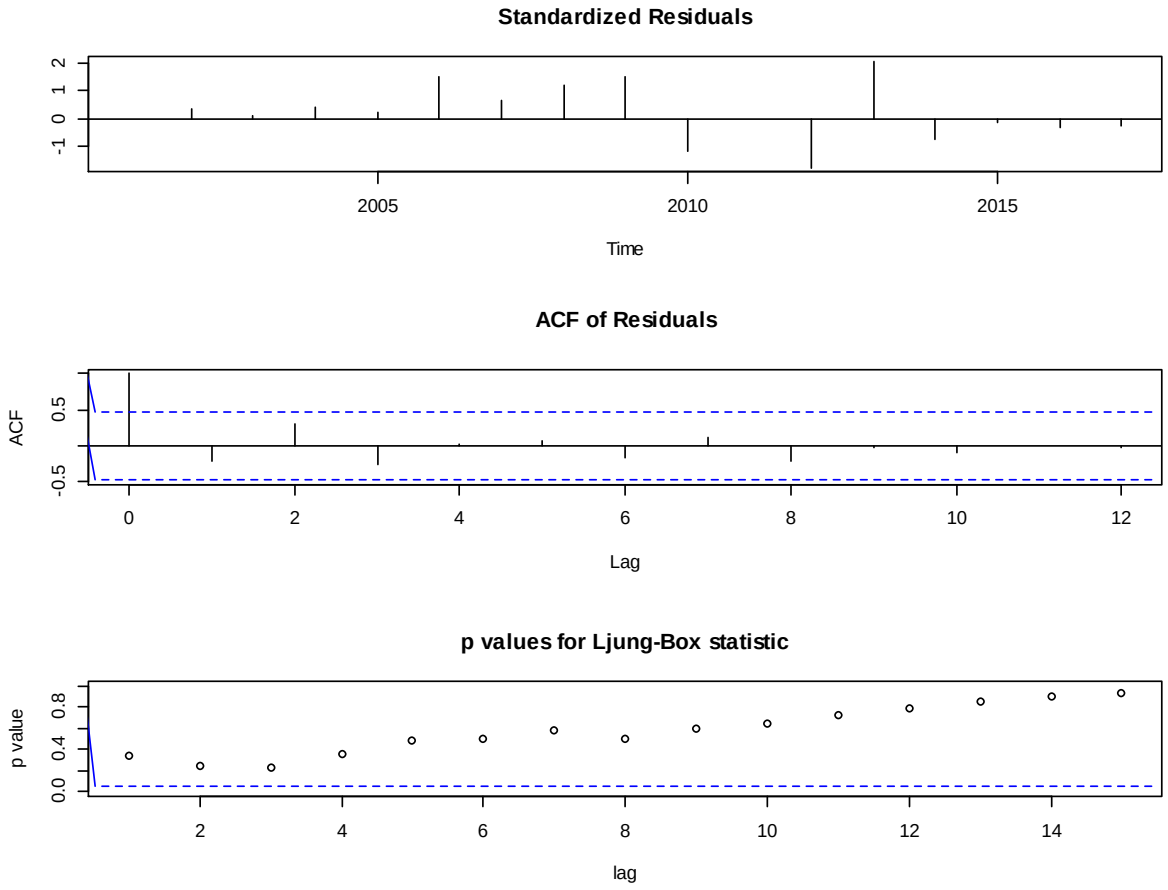


Figure 14: Diagnostic Plots of ARIMA (1, 1, 1) model for Residuals: Family Planning Service

The fitted linear regression model for the series is provided in Table 5. The goodness of fit statistics for the model shows (Adjusted R-squared: 0.8736) the model fits the data well. The regression coefficient for time variable shows significance at α=0.05 level. Positive value for coefficient of time (3489.6) indicates that there is an increasing in number of family planning service utilizers during the intervention and post intervention period of HEP in Meket wereda.

Table 5: Summary of fitted Linear Trend Model for Family Planning Service

Coefficients	estimate	Std. Error	t value	p
Intercept	-6977780.7	688553.1	-10.13	4.19e-08 ***
t	3489.6	342.7	10.18	3.94e-08 ***

Residual standard error: 6923 on 15 degrees of freedom, Multiple R-squared: 0.8736, Adjusted R-squared: 0.8652 , F-statistic: 103.7 on 1 and 15 DF, p-value: 3.94e-08

ARIMA model for residuals of the trend model is provided below, the model was fitted following Box-Jenkins iterative approach for constructing time series models.

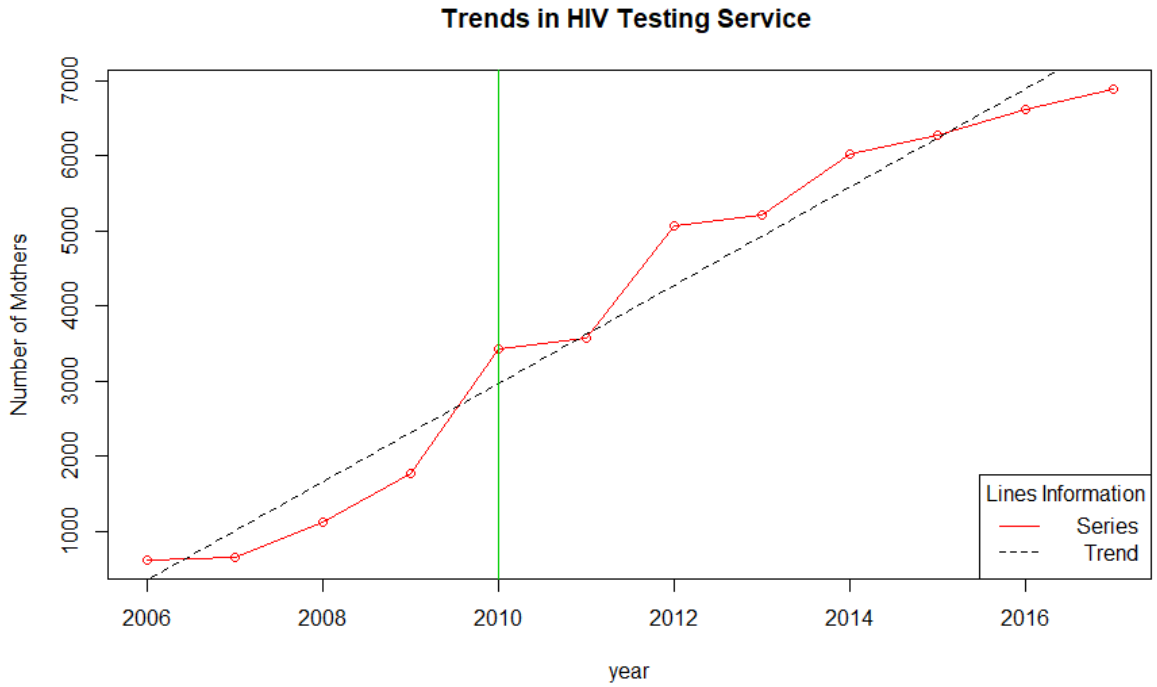
ARIMA (1,1,1) coefficients are given below:

	ar1	ma1
	0.9213	-0.7943
s.e.	0.2415	0.3786

sigma^2 estimated as 33011383: log likelihood = -161.33, aic = 328.66

4.2.5. Trends in HIV Test Service

The upper panel of Fig 15 shows the observed and trend of HIV service utlization in Meket wereda for the period 2006 to 2017. Like other maternal health services presented above the administrative record data for HIV test for year 2001 – 2005 was not obtained from Meket Woreda. We observe a linearly increasing trend model fits the series. A linear trend model with an ARIMA (2,1,1) specification is given to fit the series. The diagnosis plot in Fig 16 shows the errors are white noise and refers that the fitted trend model and ARIMA specification is adequate. The three-year forecast is displayed in lower panel of Fig 15. It shows an increasing trend of HIV test service in Meket Woreda in the following years.



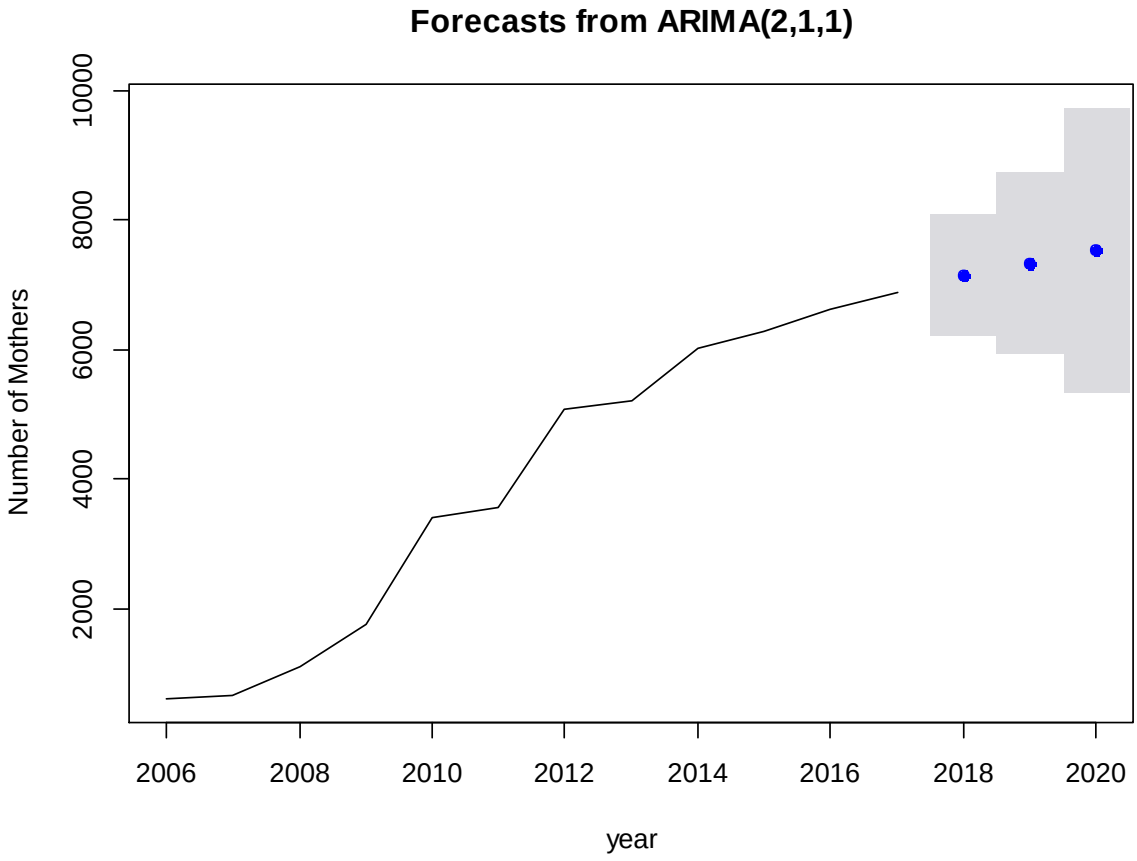


Figure 15: Trends in HIV test Service with ARIMA forecasts

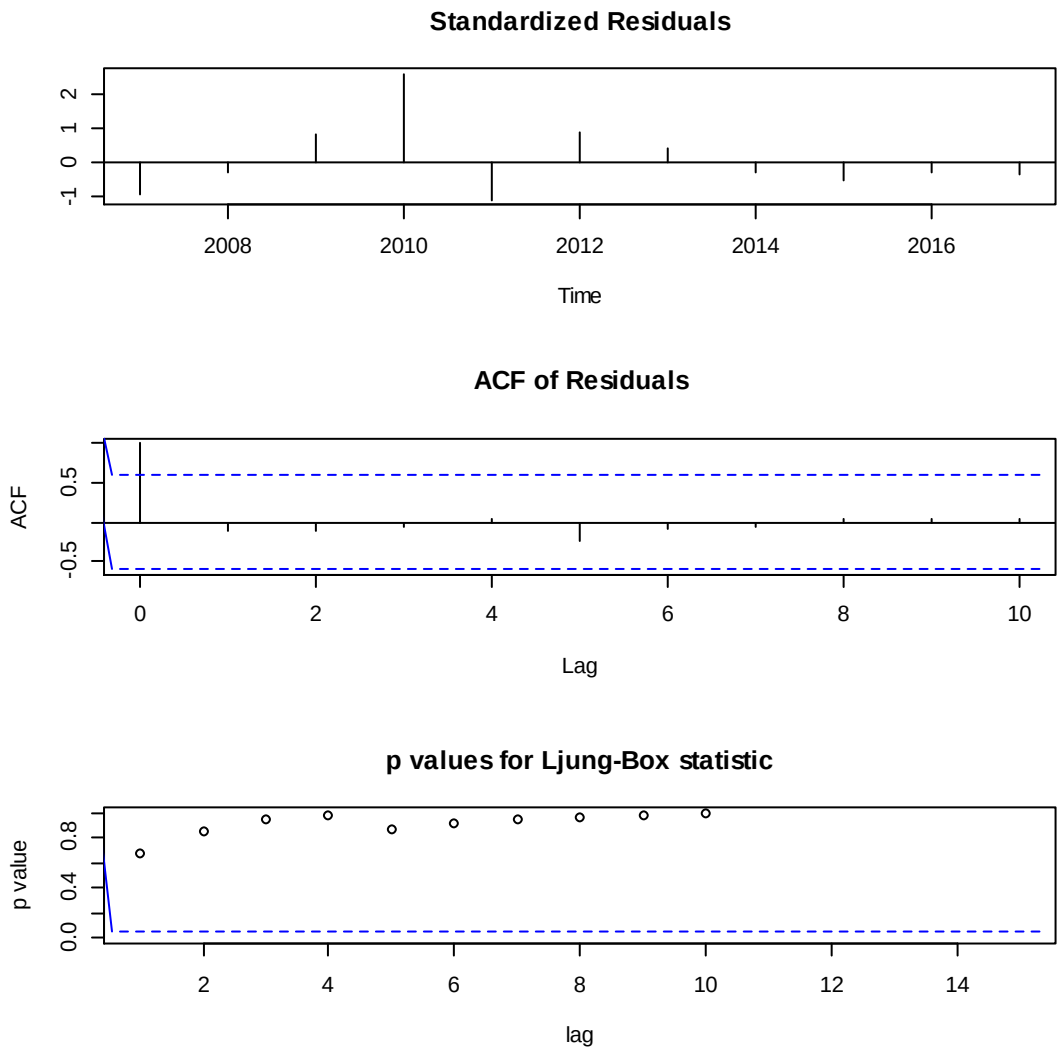


Figure 16: Diagnostic Plots of ARIMA (2, 1, 1) model for Residuals: HIV test Service

The fitted linear regression model for the series is provided in Table 6. The goodness of fit statistics for the model shows (Adjusted R-squared: 0.962) the model fits the data well. The regression coefficient for time variable shows significance at α=0.05 level. Positive value for coefficient of time (653) indicates that there is an increasing in number of family planning service utilizers during the intervention and post intervention period of HEP in Meket wereda.

Table 6: Summary of fitted Linear Trend Model for Maternal HIV Test Service

Coefficients	estimate	Std. Error	t value	p
Intercept	-1.310e+06	8.253e+04	-15.87	2.03e-08 ***
t	6.530e+02	4.103e+01	15.92	1.98e-08 ***

Residual standard error: 490.6 on 10 degrees of freedom, Multiple R-squared: 0.962, Adjusted R-squared: 0.9582 , F-statistic: 253.3 on 1 and 10 DF, p-value: 1.975e-08

ARIMA model for residuals of the trend model is provided below, the model was fitted following Box-Jenkins iterative approach for constructing time series models.

Coefficients of ARIMA (2,1,1):

	ar1	ar2	ma1
	0.1007	0.6659	0.0130
s.e.	0.2446	0.1872	0.3593

sigma^2 estimated as 230428: log likelihood = -84.16, aic = 176.31

4.3. Discussions

Overall, our findings indicated a positive association of the health extension program with the utilization of selected maternal health care services namely the antenatal care, HIV testing, postnatal care, safe delivery care and family planning service. The total number of consultations for this increased constantly, particularly after the late-intervention period. The positive trend was also present in ANC, PNC, DC and HIV testing services in the district. Short term forecasts also done to see future trends of the five indicators based on fitted ARIMA time series models indicating that an increasing trend in following years.

Findings from this paper are in line with a study conducted in Tigray, Ethiopia which shows that HEP have contributed substantially to the improvement in women's utilization of selected maternal health care services (Medhanyie *et al.,* 2012), keeping that, we include two additional maternal health issues in this paper i.e. family planning and HIV testing services. However, we are aware that this may not necessarily detect the causal determinants of that impact. Explanation for changes could not be due to the HEP only, but to other external factors that also happened during those years such as: increase in per capita income, building roads and infrastructure, strengthening micro and small scale enterprises which reduce the trend of unemployment, expansion of agricultural programs and increased access to education. Because of unavailability of data, the external factors influencing the outcomes are not controlled. Due to the fact that our sample was taken from only one woreda, the issue of generalizability needs to be carefully handled.

CHAPTER FIVE

Conclusion and Recommendations

This chapter summarizes the study by highlighting the research conducted on Trends in Maternal Health Service Utilization in Pre and Post-Intervention of Health Extension Program (HEP) in Meket Woreda of Amhara Region. The conclusions given were drawn from the outcomes of the empirical study and analysis of data using time series models. Moreover, recommendations were based on the findings and conclusion of the study.

5.1. Conclusion

The aim of this study is to measure level and trends in selected maternal health services during pre and post-intervention period of the Health Extension Program in Meket Woreda, Amhara Region. Findings revealed that there has been an overall increase in trends of ANC, HIV, DC, FP, and PNC service utilization after the introduction of the health extension program.

From results of analysis based on trend model indicates significant positive increase in ANC, PNC and FP service utilizations. While slow positive trend was obtained for HIV testing, DC service utilization as compared with other indicators. However figures for DC and HIV are low and more needs to be done in order to increase the access to the health care system, as well as the demand for these services by the population.

The future forecasts based on specified ARIMA models shows moderately increasing trend for ANC and HIV test services while slower positive trend for DC, FP and PNC services. Although forecasts did not consider total target population of woreda, forecasted values indicates that additional efforts should be made to strengthen the HEP program in order to maintain past achievements as well as improve low achievement maternal health service utilization indicators.

We understand that other factors that we could not control for, might be explaining the increasing trend in the services. As literacy and socio-economic status of the population improve, the demand for quality and comprehensive services also increases. Besides, changes in demographic trends, epidemiology, and urbanization require more comprehensive services covering a wide range of quality health services. So research may include those variables and can be done by widening the scope of the study.

5.2. Recommendations

- The government needs to address the challenges for poor performance areas of the HEWs in maternal health service utilization.
- It is most important for the government to strengthen the local health institutions and the referral system to undertake clean and safe delivery that the HEWs are incapable of doing.

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APPENDICES

APPENDIX A: Dataset Used for Trend analysis of the Five Maternal Health Services

YEAR	ANC		HIV		DC		PNC		FP	
	Targeted	Achieved	Targeted	Achieved	Targeted	Achieved	Targeted	Achieved	Targeted	Achieved
2001	5732	317			5732	129	5732	363	28345	3874
2002	5998	551			5998	217	5998	221	30320	5982
2003	7161	624			7161	311	7161	593	34245	6914
2004	7797	658			7797	471	7797	561	33311	9841
2005	7983	1121			7983	626	7983	673	37562	11997
2006	8016	2347	8016	624	8016	1227	8016	1027	45321	21511
2007	8241	3723	8241	658	8241	1874	8241	1772	45423	27183
2008	9976	8090	9976	1121	9976	2315	9976	2679	48392	36414
2009	9467	7745	9467	1774	9467	4982	9467	5102	49237	47949
2010	8948	7664	8948	3419	8948	3463	8948	7464	48125	44978
2011	8998	7168	8998	3573	8998	4653	8998	4188	48396	47410
2012	6768	6058	6768	5075	6768	4170	6768	4402	51465	39717
2013	8008	8937	8008	5213	8008	8950	8008	8826	51001	52443
2014	8177	8062	8177	6024	8177	8274	8177	6914	49621	50640
2015	8349	9323	8349	6278	8349	8324	8349	8362	49940	51323
2016	8397	9572	8397	6623	8397	8517	8397	8041	51143	50971
2017	8482	9610	8482	6883	8482	6354	8482	6883	50919	50497