ANALYTICAL REVIEW OF THE ASSOCIATION BETWEEN AMBULANCE REFERRAL NETWORK INTERVENTION AND MATERNAL HEALTH OUTCOMES WAJIR, KENYA

BY

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DECLARATION.

I, **Fatuma Ibrahim Adan**, do hereby declare that this thesis is my original work and has not been submitted for the award of a degree or diploma in any other University or college.

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DEDICATION

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ABSTRACT

Maternal health is a global public health concern. Every year more than half a million women die in childbirth, mainly from haemorrhage, infection, and complications of abortion worldwide with about 99% of these maternal mortalities occurring in Sub-Saharan African countries. Studies have linked the majority of these deaths to weak health systems substandard quality of care, and delays in accessing maternal health care. While the Ambulance Referral Network in certain regions of Kenya aims to minimize delays in obtaining maternal health care, its effectiveness has not been extensively assessed. This study sought to analytically review the association between ambulance referral network intervention and maternal health outcomes. Specifically, the study sought to determine the effect of demographic characteristics on maternal health outcomes, determine the Maternal clinical conditions on maternal ambulance referrals; assess the influence of the cost of ambulance on maternal health outcomes; analyze the effect of ambulance usage on maternal health outcomes; and to explore the effect of health facility condition on maternal health outcomes. This study was a longitudinally retro-prospective time series study and was specifically designed to assess both the cost and effectiveness of ambulance referral networks in influencing maternal health outcomes. The research involved the collection of secondary data from various sources, including ambulance logbooks, patient registers, logistics records, and maternal death surveillance records. A total of six hundred twenty-three (623) records of mothers who had utilized the Ambulance Referral Network during the referral process were used in sourcing data for the study. Data was analysed both descriptively and inferentially using SPSS version 23. Descriptive statistics used included percentages, frequencies, and means. The inferential statistics used were correlation and regression analyses. Results were presented in tables and figures. The correlation study results indicated that there was a statistically significant positive association between all the demographic characteristics, maternal clinical conditions, cost of ambulance; usage of ambulance, and health facility condition indicators with maternal health outcome in Wajir County. The regression results showed that demographic characteristics had explanatory power over maternal health outcomes, accounting for 23.6 percent of maternal health outcomes (R^2= .236) maternal Clinical conditions had significant power over maternal health outcome with a total of 619 mothers and 545 infants' lives were saved by the ambulance maternal referrals .while cost of the ambulance had explanatory power over maternal health outcomes accounting for 80.6 percent of maternal health outcomes (R^2 = .806). The results also indicated that ambulance usage had explanatory power over maternal health outcomes, accounting for 34.1 percent of maternal health outcomes (R^2 = .341), while health facility condition had explanatory power over maternal health outcome accounting for 46.5 percent of maternal health outcomes (R^2 =.465). The study concluded that demographic characteristics, maternal clinical condition, cost of ambulance, ambulance usage, and health facility condition all had a significant influence on maternal health outcomes. The study recommended that county governments should invest in and make more use of ambulance referral network interventions (Demographic characteristics, maternal clinical condition, cost of ambulance, ambulance usage, and health facility condition) since this study has found them to have statistically significant positive effect on maternal health outcomes.

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ABBREVIATIONS AND ACRONYMS

4WD	Four-wheel drive
ANC	Antenatal care
CIN	Cervical intraepithelial neoplasia
GDP	Growth domestic product
GSM	Global System for Mobile
HIV	Human Immunodeficiency virus
KDHS	Kenya Demographic Health Survey
KM	Kilometer
KNBS	Kenya National Bureau of Statistics
MINI	Mini International Neuropsychiatric Interview
mmHg	millimeters of mercury
MMR	Maternal mortality rate
MoH	Ministry of Health
NCPD	National Council for Population and Development
SDA	Step down allocation
TB	Tuberculosis
UNFPA	United Nations Population Fund
WHO	World Health Organization

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DEFINITION OF TERMS

Ambulance Referral Network: is a number of systematically interconnected medically equipped vehicles that transport patients/clients to treatment facilities, such as hospitals. In some instances, out-of-hospital medical care is provided to the patient.

Cost-effectiveness: -is the relationship between monetary inputs and the desired outcome

Demographic characteristics: These include description of the mother by age, location, referred by, Gestation age, ANC number indicated, and parity.

Health facility(ies): -A health facility is, in general, any location where healthcare is provided. Health facilities range from small clinics and doctor's offices to urgent care centres and specialized

Interventions: Activity or item brought in between can reduce exposure or control exposure

Maternal health: - The health of women during pregnancy, childbirth, and the postpartum period

Maternal health outcome: These are possibilities that occur during and after delivery

Organization conditions: These are other factors specific to a given health facility that might help in determining the possibility of a given maternal health outcome

Service/expert referral: The system of rotation and facilitation of healthcare providers' movement to reach patients in need of care, in situations where it may be more efficient and cost-effective. Expert referrals are used especially for non-emergency (scheduled) cases; this definition also includes out-reaches.

Referral system: A mechanism to enable clients' health needs to be comprehensively managed using resources beyond those available where they access care.

Women reproductive age: It's the age of a woman being capable of conceiving and giving birth to children during her lifetime. For this study, the age was between 15-49 years.

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CHAPTER ONE
INTRODUCTION

1.1 Background information

Globally, more than half a million women die from pregnancy-related causes each year and an estimated 10 million women experience injuries, infections, disease, or disability that can cause lifelong suffering *(*WHO, 2015*).* Almost 99% of maternal deaths occur in developing countries, with Sub-Saharan Africa contributing to more than 50% of global fatalities (WHO, 2015). An estimated 73% of these deaths result from direct obstetric causes, while 27.5% are attributed to indirect causes (Say *et al*., 2014). Despite the considerable attention given by experts to safe motherhood, the rate of women dying during childbirth has shown minimal improvement in the two decades following the 1987 Safe Motherhood Conference in Nairobi, Kenya. In Kenya, maternal mortality remains alarmingly high, with 488 maternal deaths per 100,000 live births reported (WHO, 2015). While this figure is below the Sub-Saharan average of 640 deaths per 100,000, the persistently high maternal mortality rate highlights a failure to ensure women's consistent access to equitable, high-quality healthcare, including reproductive health services.

The reasons for inaccessibility to maternal health care have been well documented and include difficult geographical terrain, costs of transport, lack of phones and vehicles, suboptimal distribution and location of health facilities, and poor decision-making of health professionals *(Gabrysch & Campbell, 2009; Thaddeus & Maine, 1994*), so interventions usually address these barriers. There is evidence that effective ambulance transport reduces maternal deaths by increasing maternal healthcare access (Kumbani *et al*., 2013). On the other hand, effective inter-facility ambulance referral service reduces maternal mortalities through prompt transport of pregnant to emergency comprehensive care referral hospitals (Tayler-Smith *et al*., 2013; Tayler-Smith *et al*., 2013).

Kenya experiences a very slow progression in maternal health. However, according to the Health Sector Referral Strategy (2013-2018), the Kenya Health Sector, through international declarations, is committed to ensuring all Kenyans have equitable access to high-quality health services is identified as a crucial approach to reversing the downward trend in health indicators. A comprehensive service delivery approach has been a key focus for guiding the delivery of the existing services. This has been based on the availability of adequate guidance

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for service standards, service inputs (human resource, infrastructure, equipment), and cross-linkages of services across the different levels of care in the country. These, together, provide a comprehensive strategic approach to guide the elaboration of management and referral guidelines, which are the bases for ensuring comprehensive, harmonized, and quantifiable healthcare services to the people in Kenya**.**

Through the Directorate of Health Standards, Quality Assurance, and Regulatory Services (DHSQARS), the Ministry of Health Kenya developed, completed, and piloted indicators for measuring 'general' aspects of quality of care. A core indicator of quality is that all facilities should have access to a fully equipped ambulance for referral of emergency cases within 30 minutes of the referral decision being made. Considerable investment in the referral system is required to achieve this standard.

In Kenya, the government is increasing its fleet of motor vehicle ambulances as well as providing financial incentives to health facilities to offer a free ambulance referral network (MOH, 2013*).* However, previous studies reported that ambulance referral networks in Kenya are poorly deployed and perform additional duties including courier and taxi services *(Broccoli, Calvello, et al., 2015; Wachira & Martin, 2011*), which is likely to increase operational/running costs of Ambulance Referral Network (*Robinson, et al., 2009),* making maternal health inaccessible for most mothers, especially in the rural and marginalized areas in Kenya.

Computer-based mathematical modeling estimated that referral and transport strategies contribute to as much as an 80% reduction in maternal mortality *(Goldie, et al., 2010)*, there is poor management and deployment of Ambulance Referral Networks in developing countries *(Kambala, et al., 2011).* Several studies have evaluated the performance of ambulance referral systems on maternal health care, with the view of providing alternatives that are unlikely to be misused for non-referral purposes or for improving their efficiency. For example, motorcycle ambulances are unlikely to be misused for non-referral purposes in rural areas with no roads accessible by motor vehicles, but their utility is influenced by weather conditions as well as women's socio-cultural, economic and obstetric conditions *(Bhopal et al, 2013; Hofman et al., 2008; Ssebunya & Ma 2016).* Effective Ambulance Referral Networks are associated with increased access to emergency obstetric care with concomitant reduction in maternal mortalities *(Tayler-Smith, et al., 2013; Tsegaye et al., 2016).*

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Kenya experiences a very slow progression in maternal health care, vindicated by the high maternal mortality approximated at 8,000 (uncertainty intervals: 5,400 to 12,000), and maternal deaths recorded in the year 2015 (*WHO, 2015).* Altogether, the high maternal mortalities associated with direct and indirect causes reflect inadequate progress toward providing essential maternal health care within Counties. In Kenya, Ambulance Referral Networks are inaccessible for maternal health care due to their scarcity, poor deployment, and inappropriate use *(*Broccoli *et al., 2015; MOH, 2013; Wachira & Martin, 2011).*

Improving maternal and child health remains a serious challenge for many developing countries. The proximity of a residence to the nearest health facility is believed to be a significant barrier hindering the utilization of suitable MCH services, particularly in Sub-Saharan African nations. Most research studies highlight the significance of research regarding factors that demographically, socioeconomically, or environmentally affect maternal healthcare levels. Maternal healthcare outcomes are affected by developments in all areas of society. According to *Karra, Fink, and Canning (2017),* many studies have shown that the maternal death rate is closely related to the mother's level of education, hygiene facilities, financial standards, the size of the related workforce, and the physical distance between mothers and healthcare facilities.

With the rural poor in Kenya, especially in the northern part region where the road network is poorly developed, the current study postulates that this aggravates poor maternal outcomes. Maternal mortality rates exhibit significant variation across different geographic regions in Kenya. Based on a 2009 analysis of census data, North Eastern Province recorded the highest maternal mortality rate at 2,014 per 100,000 live births, with Wajir County being the most affected. Following closely is Nyanza Province, reporting a maternal mortality rate of 546 per 100,000 live births, while Nairobi Province had the lowest rate at 212 per 100,000 live births (NCPD and UNFPA, 2013). Wajir County specifically contributes significantly to the overall high maternal mortality in Kenya, estimating over 1600 maternal deaths per 100,000 live births in the country (KNBS, 2012).

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Globally, Women succumb to complications arising from pregnancy and childbirth. The majority of these issues manifest during pregnancy and are largely preventable or treatable, as indicated by the World Health Organization (WHO, 2019). Moreover, pre-existing health complications may be exacerbated during pregnancy, particularly if not addressed as part of the woman's overall healthcare. Consequently, maternal mortality and morbidity have become a major global public concern.

The Kenyan government has undertaken substantial and intentional initiatives to enhance the well-being of women, particularly highlighted by the declaration in June 2013, making maternity services free of charge in all public health institutions nationwide. This strategic move aimed to enhance the accessibility and affordability of maternity services, with the overarching goal of reducing maternal and perinatal mortality. Despite these efforts, the country still experiences over 6000 maternal deaths and 35,000 stillbirths annually (Langát, et al., 2019). Furthermore, maternal mortality rates persistently range from 400 to 600 deaths per 100,000 live births over the past decade, indicating limited progress towards achieving Millennium Development Goal 5. The high financial burden associated with seeking maternity care has been identified as a contributing factor to maternal deaths. Directly related to the cause is the cost associated with transport. In these conditions, pregnant mothers with clinical conditions are less likely to get help on time.

In Kenya, approximately 6,300 women lose their lives each year during pregnancy and childbirth, highlighting a distressing lack of progress in delivering essential health services to all women. Maternal mortality rates exhibit significant disparities across different geographic regions in Kenya. For instance, based on a 2009 analysis of census data, North Eastern Province reported the highest maternal mortality at 2,014 per 100,000 live births, with Wajir County, among the top contributors, reporting 1,687 per 100,000 live births. Wajir County, following Mandera, has a substantial impact on Kenya's elevated maternal mortality, with a rate of 3,795 per 100,000 live births (NCPD, 2013). Furthermore, a recent University of Nairobi analysis revealed that 98 percent of these deaths are concentrated in just 15 of the country’s 47 counties (United Nations Population Fund [UNFPA], 2020).

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The current study postulated that the maternal health challenges facing Kenya can be resolved through well-coordinated efforts and additional investments. The actions must be taken on several fronts to improve maternal health, especially to increase access to care. This requires the county governments to provide quality, accessible, and affordable maternal health services, especially in counties with the highest burden of maternal deaths, and to provide adequate resources for the training of midwives, effective supervision, and logistics.

The government of Kenya is restructuring its referral services by increasing ambulance fleet numbers yet more is needed (*MOH, 2013).* In addition, financial incentives exist for levels 2 and 3 health facilities to offer an Ambulance Referral Network free of charge (*MOH, 2013*). However, ambulance referral networks are not immediately available due to poor deployment strategy, in most cases, ambulances function only as a taxi as well as hospital courier vehicles *(Broccoli et al., 2015; Wachira & Martin, 2011).* Increasing the number of tasks done by ambulance and poor deployment is associated with higher operational/running costs of the ambulance *(Robinson et al., 2009).* In addition, information on the cost-effectiveness of the ambulance referral system informs decisions on resource allocation in a country's health sector *(WHO, 2003).* However, there is no information on ambulance cost-effectiveness on maternal health outcomes in Kenya encouraging inefficient decisions to be made, a void that the current study sought to fill, by determining the cost-effectiveness of ambulance referral network on maternal health outcomes in Kenya.

For many women, giving birth is a dangerous endeavor (*Bhopal, 2013).* In rural areas, challenges hindering pregnant women's healthcare access encompass inadequate road infrastructure, weather conditions, and terrain; limited social support; reliance on others for decision-making; cultural factors; transportation-related issues such as cost, availability, and speed; absence of comfortable and secure positioning during transit; and considerable distance from critical life-saving care (Rajé, 2018).

Wajir County Maternal Newborn Health (MNH) Trends from 2013-2018

Wajir County, a semi-arid county, covers an area of 56,685.9Km2 and has a total population of 781,263 with 415,374 males and 365,840 females (*KNBS, 2019*). the county has 115 public health facilities, 29 private facilities, and two facilities run by NGOs/missions. There are 10 level-four hospitals, 26 level-three health centers, 79 level-two dispensaries, three private hospitals, one nursing home, and 27 clinics (County Government of Wajir, 2019). According

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to the *2015/2016 KIHBS*, only 0.2 % of the population has medical insurance coverage which is exceptionally low. 95.9% of the population must cover more than 5 km to access a health facility and only 4.1% access a health facility within less than 1 km.

Wajir County Maternal Newborn Health (MNH) Trends from 2013-2018

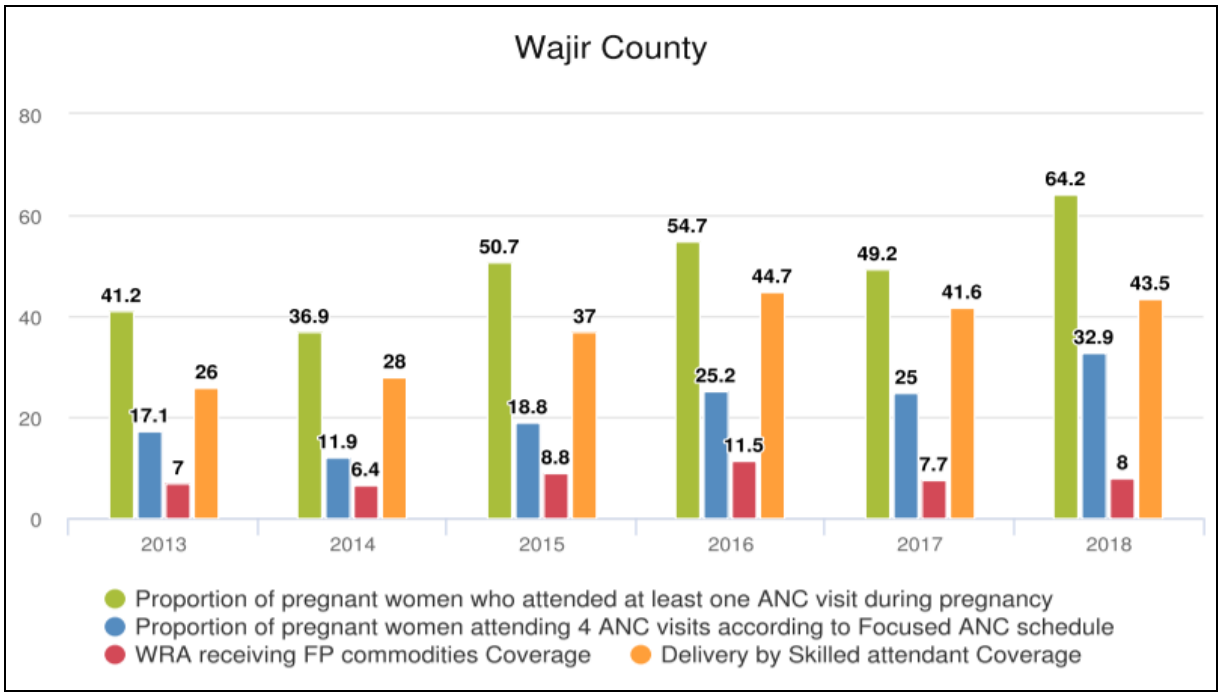

Figure 1.1 Wajir County Maternal Newborn Health (MNH) Trends from 2013-2018

The Contraceptive prevalence in Wajir County is the second lowest in the country with only 2% of married women using modern methods of FP. This low uptake of FP is attributed to cultural beliefs and practices in the community. This has led to high population growth and an increase in poverty due to poorly planned families, which strain the local resources. Total Fertility Rate (TFR) stands at 7.8% which is the highest in the country with the national average standing at 3.9%. (*County Government of Wajir, 2018).* Insecurity & sporadic clan clashes negating gains made in MNH, High technical staff turnover owing to the above bullet one Poor staff rationalization of more of the CHAs for services demand creation, Late disbursement of funds by the national treasury & partners, Inadequate knowledge and skills of HCPs on RMNH-new recruits-UHC, Poor community health-seeking behaviours hence low utilization of health services, as well as Weak community-facility linkage(County Government of Wajir 2019), are the major challenges affecting maternal In adequate social

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determinants of health in health facilities & communities including Lack of water, poor road access, low-income livelihood, low literacy level, harsh working environment all contribute to the outcome of maternal child health.

1.1.2 The Kenya Framework for Referral Service

According to the Kenya Health Sector Referral Strategy (*2013-2018*), the health care system is hierarchical and is organized around six levels of care. The first level starts at the community level and is mainly focused on promotive health and treatment of minor ailments. The second and third levels provide primary care services and include dispensaries and health centres that offer basic outpatient care, and maternity and minor surgical services. The fourth and fifth levels provide secondary care services and include county health facilities that offer a broad spectrum of treatment. The highest level of care forms the tertiary level, which offers specialized care besides training to health workers in Kenya (*KHSRS, 2018*).

There is also a lack of coordinated ambulance management systems and clear communication channels between facilities within a referral network. Most health facilities also lack new technology and infrastructure for e-referrals including telemedicine (*Kenya referral strategy, 2013-2018).* The Referral Strategy specifically deals with the management of four key movements. The initial aspect concerns client movement, denoting the physical transition of patients in search of the most suitable level of care to address their health needs. The second aspect pertains to expertise movement, encompassing the systematic rotation and facilitation of healthcare providers, enabling them to reach patients requiring care, particularly in scenarios where efficiency and cost-effectiveness are prioritized. (*Kenya Health Policy [KHP], 2012 – 2030*). The referral framework system and levels as shown **in Figure 1.2**

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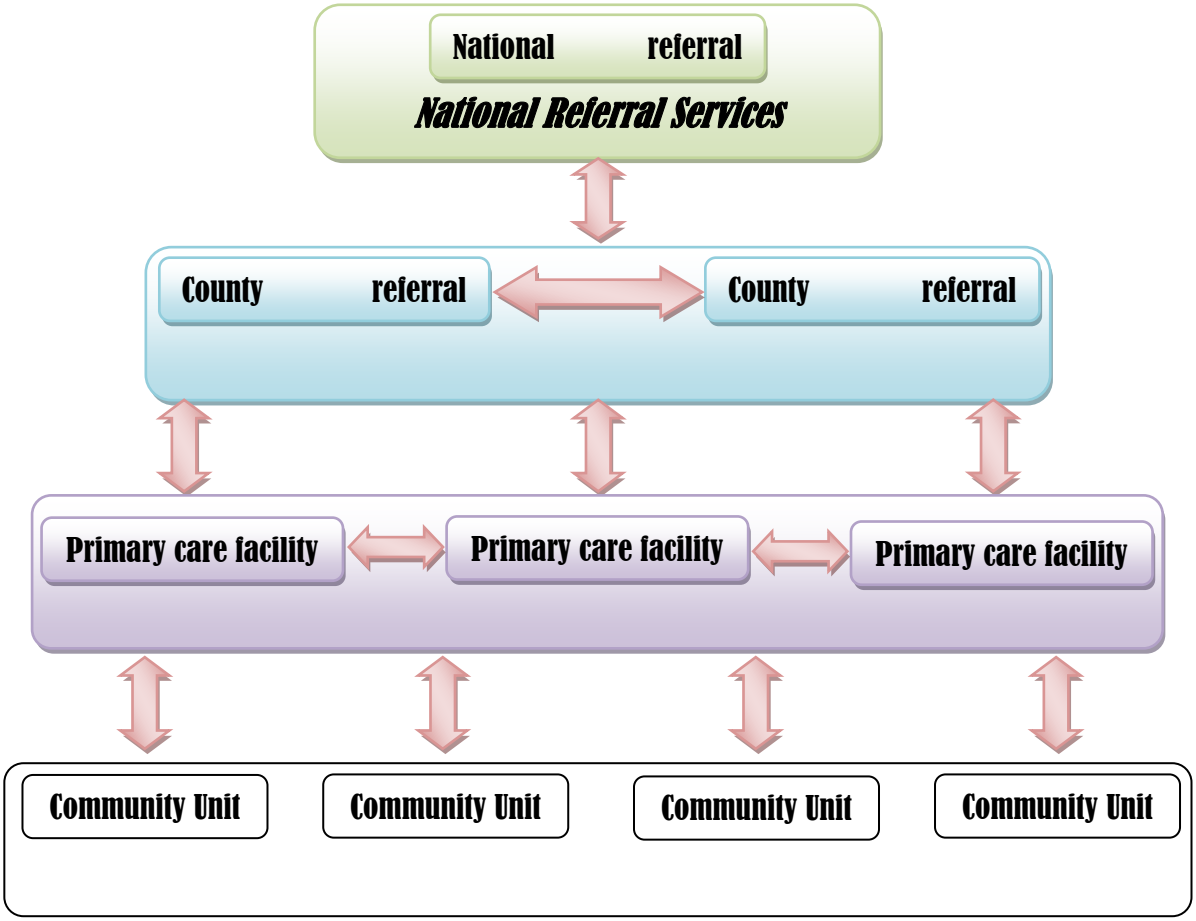

Figure 1.2: Kenya Referral Framework System and Levels

All referring and receiving facilities in the referral zone or network must have in place the referral data collection tools to effectively track the flow of referrals through the referral system and ensure safety and quality of care. The health staff and managers should be trained on the core referral system indicators, the methods of documentation, data retrieval, analysis, and presentation for decision-making.

The levels of care in Kenya is classified based on the functions as proposed in the health policy and the tiers of the services in the system are defined as Community, Primary care, county referral services, and national referral services The *Community services* (Tier 1) comprise of all community-based demand creation activities, organized around the Comprehensive Community Strategy defined by the Health Sector. Community-based referral mechanisms shall exist, to facilitate linkage with primary care services.

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The *Primary care services (Tier 2)* comprise all dispensaries, health centres, and maternity homes for public and non-public providers. Their capacity will be upgraded, to ensure they can all provide appropriate demanded services. These shall manage referrals from communities, and also facilitate referrals to the nearest County Referral.

The *County referral services (Tier 3)* include all level 4 and level 5 facilities operating in, and managed by a given County including those managed by non-state actors. Together, all these facilities in a given County form its County Referral System, with specific services shared amongst the existing County Referral facilities to form a virtual network of comprehensive referral services. Referrals are received from: primary care facilities within its area of responsibility, community Units that are linked to the county referral facility and for whom the county referral facility provides primary care services, as well as from other county referral facilities in the county (horizontal referral).

The *National Referral Services* will include the facilities providing national referral services that provide specialized health care services, including hospitals, laboratories, blood banks, and research institutions. These shall operate with a defined level of autonomy. The scope of referral services expected of the Kenya health services includes; client, service, specimen, and client parameter movement, the below diagram the Framework for referral services in Kenya

1.2 Statement of Research Problem

Timely medical treatment is an important factor in preventing maternal mortality. Data from Nigeria estimates that the average interval between the onset of obstetric complication and death in the absence of medical intervention is two hours in the case of post-partum haemorrhage, 12 hours for an antepartum haemorrhage, and one day for a ruptured uterus (*Rajé, 2018*). Despite the evident link between maternal mortality outcomes and efficient ambulance transport, there is a lack of research on the nature of the relationship, the viability, and the effectiveness of interventions. Pregnant women continue to experience delays in accessing life-saving maternal healthcare services due to inefficient transport services, thus seriously affecting their conditions, and resulting in higher rates of mortality and morbidity (*Tsegaye et al., 2016*).in addition, barriers associated with delay in accessing healthcare services are inadequate, under-equipped, and understaffed healthcare facilities. According to *WHO (2015),* maternal mortality remains high at 488 maternal deaths per 100,000 live births in Kenya. While this is still below the Sub-Saharan average of 640 deaths per 100,000 live

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births, Kenya experiences a very slow progression in maternal health. This high maternal mortality indicates a failure to guarantee women lifelong access to equitable, quality health care, including reproductive health services more so in the rural poor.

Even though the Kenya health sector is committed to providing equitable access to quality health services to all Kenyans (*HSRS, 2013-2018), Pacagnella, et al., (2012*) acknowledge that high maternal mortality rates are attributed to among others delays in deciding to seek care; delay in reaching care in time and delay in receiving adequate treatment. To address this problem, ambulance transport has been provided by the government to improve maternal healthcare coverage in Kenya *(Broccoli et al., 2015*). However, of major concern has been the high cost of providing ambulance referral transport facilities in a low-income country like Kenya to reduce the risk associated with maternal health outcomes. Among facilities aimed at fulfilling the goal of improving access to and quality of reproductive health, *Shehu et al, (1997); Murray & Pearson, (2006); Hofman et al. (2008); Kongnyuy et al., (2008); Evjen-Olsen et al., (2009)* as well as Parkhurst & Ssengooba (2009) argue that ambulance services play a critical role, especially in remote settings, creating a network by linking different Health Centres and allows referral of urgent and complicated cases. However, the costs of such facilities are high, especially for a poor setting, which in turn raises the issue of its overall effectiveness. According to *WHO (1996*), ARN is initially supported and implemented by non-governmental organizations (NGO) related programs, but once the programs end, maintaining the service falls to the local health system. This highlights not only the importance of its cost-effectiveness but also raises the question of its affordability calling for proper allocation of the scarce resources in remote settings.

The need to clarify the effectiveness of ambulance service programs to improve quality access to reproductive health has however received little attention in the past (*Krasovec, 2004)*. Even though economic analyses have documented comprehensive interventions to improve reproductive health that are cost-effective (*Borghi et al., 2005; Goldie et al., 2010; Nizalova & Vyshnya, 2010),* only a few studies have specifically investigated the economic profile of the ambulance service (H*ofman et al., 2008*). This has contributed to the high maintenance costs and a county government may have concerns regarding its sustainability.

According to *Hofman, Dzimadzi, Lungu, Ratsma, and Hussein (2008),* community ambulance transport to a health facility reduces reaching care in time. However, a study by *UNFPA*

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(2015) determined that the overall coverage of functional ambulances across northern counties of Kenya is <3 per 100,000 populations. This is far way too low and to facilitate optimal referrals, increasing the number of ambulances is required. Previous studies reported that ambulance referral networks in Kenya are poorly deployed (Broccoli, Calvello, Skog, Wachira, & Wallis, 2015; Wachira & Martin, 2011), which is likely to increase operational or running costs of ARN (Robinson, Goel, Macdonald, & Manuel, 2009). While the County Governments of Wajir introduced a centralized coordination emergency and referral network program to strengthen its emergency and referral services, the County Department of Health however did not have a mechanism to establish the effectiveness of the intervention. This has continuously affected the ability to assess the cost invested, the usage of the intervention as well its effect in saving the lives of the mothers and their infants in the county, Therefore, this study sought to analytically review the association between ambulance referral network intervention and maternal health outcomes in Wajir Kenya.

Objectives of the study

1.3.1 General Objective

The main aim of this study was to analytically review the association between ambulance referral network intervention and maternal health outcomes in Kenya.

1.3.2 Specific Objectives

The study addressed five specific objectives outlined below:

1. To assess the effect of demographic characteristics on maternal health outcomes
2. To determine the effect of maternal clinical conditions on maternal health outcomes
3. To assess the influence of the cost of ambulance referral networks on maternal health outcomes
4. To analyze the effect of ambulance referral intervention usage on maternal health outcomes
5. To explore the effect of ambulance referral network interventions on maternal health outcome

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1.3 Research hypothesis

To achieve the above-stated study objectives, the study was guided by the following hypotheses stated in their null form and were tested at a 5% significance level.

H_{01}: There is no significant effect of demographic characteristics on maternal health outcomes

H_{02}: There is no association between maternal clinical conditions and maternal health outcomes

H_{03}: Cost of ambulance referral has no significant influence on maternal health outcomes

H_{04}: There is no significant effect of ambulance usage on maternal health outcomes

H_{05}: The association between ambulance referral network intervention on maternal health outcome

1.4 Purpose of the study.

Response rate of means of transport as well as cost effectiveness of the strategies used is a key driver to reducing maternal death. The current study sought to critically analyze the association between maternal health outcomes and ambulance referral network intervention. Specifically, the study was conducted in Wajir County to enable the county to monitor the demographic characteristics of the mothers, ambulance referral network costs, efficient use of ambulances, and maternal clinical conditions that are associated with maternal health outcomes so that they can reduce maternal and infant mortality rates and acknowledge the value of using ambulance as a key area of investment in improving maternal health outcomes, especially during delivery by mothers that need emergency care who are referred within the county of Wajir.

1.5 Justification of the study.

While ambulance referral networks are critical services and take up quite a portion of the health budget and investment of the Department of Health i.e. its initial capital investment and the operation costs) there is no information on the cost of the ambulance, its usage, effectiveness, and ambulance referral networks on maternal health outcomes in the country. This study contributes to the body of knowledge and adds to the existing literature on the constraints faced by expectant mothers, especially in the hard-to-reach areas, who have limited access to live-saving emergency obstetric care services, it similarly targets to inform

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policymakers at Wajir County government to operationalize and sustain a functional ambulance referral services for emergency obstetric complications as a tool for saving lives for hard to reach communities in accessing quality maternal health care.

The knowledge from this study is important to National and county governments and international development partners investing in the Kenya healthcare sector. To guide budgetary allocation, policy, and strategy review. The elucidation of ambulance referral network intervention on maternal health care outcome will provide information on the utilization of the services, and help maximize the potential benefits of ambulances in accessing and improving in quality of maternal health care services. but also inspire alternative options for maternal health care financing, such as health insurance and other schemes, Finally, the costing information is important to inform the public that their out-of-pocket fees at present only cover a percentage of the unit costs of the services.

1.6 Significant of the study

The study was carried out to understand the association between maternal health outcomes and ambulance referral network intervention in a remote centre. Understanding this association can enhance monitoring of these interventions by both the county and national governments but also by other stakeholders including the community, hence can contribute to the reduction of maternal mortality and infant mortality rates which is a major concern. The study also helps other interested persons to obtain literature when researching related studies. Specifically, the study shall be significant to policymakers, especially both national and county governments. The study findings shall direct their strategic policies geared towards reducing maternal death as well as improving the effectiveness of the ambulance service programs. The government will be able to address these issues according to the researcher‘s recommendations.

To the scholars, the study is value-added to the existing body of knowledge as it recommends ways to improve maternal health by leveraging ambulance referral networks. On the academic front, the study findings shall be documented for future referencing in academic journals, and hence will enable future academic researchers in the areas of community health and development disciplines to make inferences. The philosophical justification for the study is thus based on the researchers’ inclination, as community health expert, to contribute to filling

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this gap on how to best manage maternal health for better performance. Moreover; the study is likely to provide an important information database upon which other scholars can develop their studies.

1.7 Scope of the study

There are different types of costs, for this study, the costs were limited to only the operations (capital and running) cost of ambulances. These costs include the Ambulance Referral Network, the initial investment in the referral service, and the maintenance of fleets (review). The study analysed the effectiveness of the maternal emergency referral transport of pregnant women in the County and its outcome. The study used secondary data, collected retrospectively in Wajir County between the periods from 2016 to 2019.

The study focuses only on the maternal deliveries or the pregnancy outcomes referred using public ambulance services to the County referral hospital and the sub-county hospital. Moreover, the study was limited to Wajir County. The hospitals included in the study are those with comprehensive emergency obstetric care. The study was confined to extract ambulance referred maternal delivery data for Wajir County, Kenya from July 2016 to June 2019. All six sub-counties of Wajir County were involved in this study. Wajir has 16, 13, 12, 15, 16, and 5 static health facilities in Wajir South, Wajir East, Wajir West, Tarbaj, Wajir North, and Eldas sub-counties, respectively. Comprehensive emergency obstetric care is offered by 4 hospitals which include Wajir County Referral Hospital, Girftu sub-county Hospital, Bute sub-county Hospital and Habaswein Sub-county Hospital.

1.9 Limitation of the Study

The study used only secondary data which was already collected and hence it was not able to determine the reliability and validity of the research tool. Over-reliance on secondary data could not provide adequate information since its original intention of collecting data was not similar to this study. Besides, many records were not well organized and hence required some manipulation to suit the requirements of this study. The study faced various policy issues as most of the health documents that were to be perused through, had patient records, so patient confidentiality had to be maintained. This could have compromised the quality of the data collected.

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1.10 Assumptions

The study assumes that all data available was accurately collected and recorded in the preferred units by the Ministry of Health.

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CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter contains a review of the literature relevant to the study. The literature reviewed was arranged in the following sub-themes: theoretical framework, conceptual frameworks, and empirical review of study variables. The chapter covers an empirical review based on the hypothesis and theoretical framework based on the key indicators of this study. The existing literature was reviewed from books, past research papers, magazines, and information from the internet in an attempt to identify interrelationships existing between the study variables to guide the study.

2.1 Theoretical framework

A theory is a set of concepts, definitions, and propositions that explain or predict these events or situations by illustrating the relationships between variables, according to *Croyle, (2015).* The theory provides a road map for studying problems, crafting suitable interventions, and assessing their effectiveness. Consequently, theories equip planners with tools for moving beyond intuition to create and assess interventions in health behaviour and health promotion, all rooted in a comprehensive understanding of behaviour (Rajé, 2018).

If used correctly, *Rajé (2018*) argues that theory can help explain the dynamics of health behaviours, including processes for changing them, and the influences of the many forces that affect health behaviours, including social and physical environments. Likewise, the theoretical framework guided the researcher to avoid deviation from the confines of the accepted theories to make scholarly contributions. In this context, the Three Delays Model was used to anchor the whole study. In addition, the Social Cognitive Theory as well as Andersen Healthcare Utilization Model, were equally used to anchor the study. Their arguments and contributory roles are presented to show how county government planners can identify the most suitable target audiences, methods for fostering change, and outcomes for evaluation within the county.

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2.1.1 The Three Delays Model

Maternity Globally, an integrated approach is employed to tackle the various challenges women encounter in their efforts to access safe childbirth. Thaddeus and Maine's (1994) three-delay model of maternal mortality is well-recognized in the literature and consists of delay in seeking care, delay in arrival at a health facility, and delay in the provision of adequate care (*Rajé, 2018). Thaddeus and Maine* argued that maternal mortality required attention in research and policy. The researchers identified that, as one of the major avoidable causes of death for women of reproductive age, maternal mortality had received little attention from health professionals, policymakers, or politicians. Consequently, Thaddeus and Maine brought about the first shift in the approach to maternal mortality by emphasizing an apparent paradox in public health investments: there is no well-known primary prevention for most obstetric complications leading to death, nor is primary health care able to reduce maternal mortality (*Rodolfo et al, 2012).*

High maternal mortality rates are linked to the "3 delays": (1) a delay in deciding to seek care, (2) a delay in reaching care promptly, and (3) a delay in receiving sufficient treatment (Pacagnella, Cecatti, Osis, & Souza, 2012; Thaddeus & Maine, 1994). The initial delay lies with the mother, family, or community not recognizing a life-threatening condition. The second delay involves reaching a healthcare facility, influenced by factors such as road conditions, transportation availability, or the hospital's location. The third delay occurs at the healthcare facility upon arrival, where women may encounter inadequate care or inefficient treatment. It is essential to note that timely and adequate treatment plays a pivotal role in reducing high maternal mortality.

While many women with detectable risk factors may experience complications, it's crucial to note that the majority sharing these risk factors do not encounter severe issues. Furthermore, complications during pregnancy and labour can arise even in optimal conditions, and a significant portion of severe complications occurs among women without identifiable risk factors (Rodolfo et al., 2012). The time-lapse from the onset of a major obstetric complication to a death varies, ranging from 2–5.7 hours for post-partum haemorrhage to 3.4–6 days for sepsis. Hence, the swifter identification and treatment of a problem, the higher the likelihood of halting the progression of the condition.

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Thaddeus and Maine used the concept of "delays" to connect factors like distance, women's autonomy, and medical assistance with the onset of a complication, its adequate treatment, and its outcome. This framework offers a comprehensive approach to studying maternal deaths that goes beyond medical causes, integrating social and behavioural causal sequences related to households, communities, and health systems. This approach transcends mere clinical or demographic information, providing a clearer understanding of the multifaceted aspects influencing maternal mortality (Kalter, Salgado & Babille, 2015). Thaddeus and Maine reviewed the whole range of determinants and established the three delays framework (Thaddeus & Maine, 1994), while Say and Raine focussed on the influence of place of residence and socioeconomic status on maternal health care (*Say & Raine, 2007*). This study grouped these determinants of maternal health care into four themes in an adapted framework: (1) socio-cultural factors, (2) perceived benefit/need of skilled attendance, (3) economic accessibility, and (4) physical accessibility.

This study expanded Thaddeus and Maine's three-delay framework to conceptually distinguish emergency care-seeking and preventive care-seeking (Figure 2.1). Although similar factors are involved, their significance and impact can vary. For example, the cost of transportation might pose a more significant obstacle to preventive care seeking than to seeking emergency care. Physical accessibility may primarily influence the decision to seek preventive care, while, in the case of emergency care, the key challenge may be reaching the facility in time. Thaddeus and Maine's model effectively distinguishes between the direct impact of actual accessibility on reaching a facility (second delay) and the indirect impact of perceived accessibility on the decision to seek care (first delay). Correspondingly, it differentiates between the actual and perceived quality of care (third delay). In Figure 2.1, dashed arrows depict the effects of perceived factors.

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Delay Phases and factors affecting Use of delivery care and maternal mortality

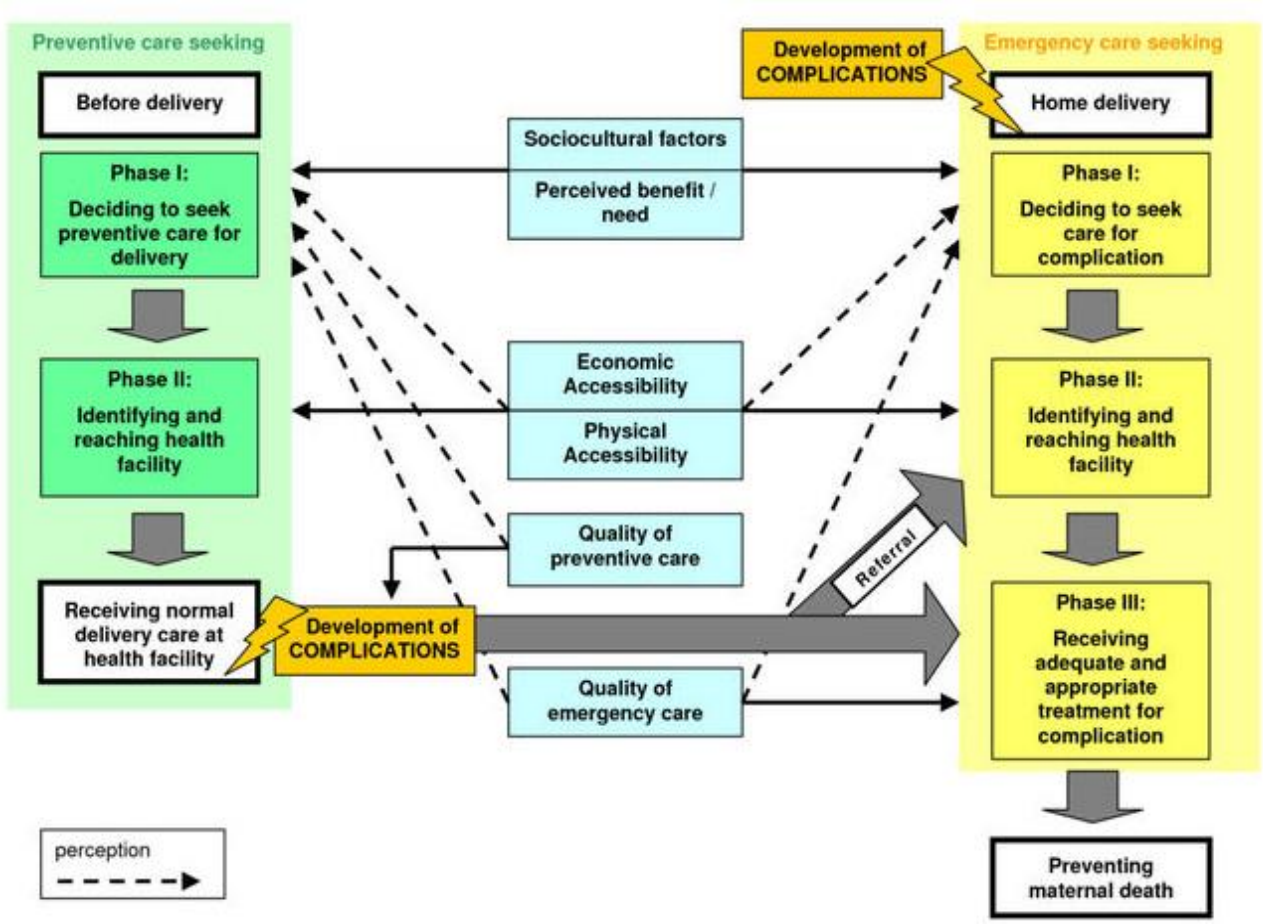

Figure 2.1: Delay phases and factors affecting the use of delivery care and maternal mortality

Adapted and modified from (Thaddeus & Maine, 1994).

Only the first and second phases are relevant for receiving normal preventive delivery care. If a woman undergoing preventive care at a health facility encounters complications, her survival hinges on timely and suitable treatment (third delay in emergency care seeking). Given her presence in a facility, skilled providers should promptly identify complications (no initial emergency delay), and if manageable at that location, there's no need for extensive travel (no subsequent emergency delay). However, for complications necessitating referral to a higher-level facility, she might need to travel, potentially with assistance from the initial facility (second emergency delay).

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The 2nd delay is reduced with community ambulance transport to a health facility (Hofman et al., 2008), and the 3rd delay is minimized through inter-facility ambulatory transfers to emergency obstetric care facilities (Tayler-Smith *et al*., 2013). Although many developing countries are restructuring ambulance emergency services, budget constraints are limiting (Hofman *et al*., 2008), underscoring the necessity for a cost-effective analysis of Ambulance Referral Networks. A study in a remote Ugandan setting illustrated that a motor vehicle ambulance referral network within a comprehensive intervention for reproductive health is highly cost-effective (Somigliana *et al*., 2011). In contrast, a study in rural Burundi found that, within the reproductive health framework, a motor vehicle ambulance service is cost-ineffective (Tayler-Smith *et al*., 2013).

Despite the evident link between maternal mortality outcomes and transport, there is a lack of research on the nature of the relationship and the viability and effectiveness of interventions. For example, *Rajé (2018)* argues that there is little empirical evidence to show effectiveness in reducing adverse outcomes associated with labour and delivery, although obstetric emergency transportation interventions are being implemented in low-income economies. Moreover, according to Bhopal (2013), the second delay, where transport infrastructure is crucial in facilitating a woman's access to care, has been an area of study that is relatively overlooked. Similarly, Fiagbe (2017) asserts that while it is increasingly acknowledged that inadequate access to transport may contribute to maternal deaths and conditions like fistula, there is a scarcity of research examining the accuracy of this claim and identifying effective interventions. There is limited discussion regarding the causes of maternal death and its association with transportation.

2.1.2 The Social Cognitive Theory

Social Cognitive Theory (SCT) describes the influence of individual experiences, the actions of others, and environmental factors on individual health behaviours. According to Bandura *(2014*), the SCT provides opportunities for social support through instilling expectations, and self-efficacy, and using observational learning and other reinforcements to achieve behaviour change. Merely expecting that an individual will change their behaviour when presented with a certain scenario, such as the threat of illness or disease, is limited and naive. Clients are not

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consistent in the way they approach their health and, therefore, there is a need to be aware of the many variations that may take place within any health encounter (*Whitehead, 2014*). Moreover, health professionals also are inconsistent in the way that they view a client's health status and how it should be managed and improved. Accordingly, the social cognition models, in themselves, are designed to observe and examine the predictors and precursors of health-related behaviour.

The understanding and active adoption of social cognitive theories in nursing practice are invaluable in planning timely and appropriate interventions, as well as helping to provide valuable insight into client behaviour. In addition, *Whitehead (2014)* argues that strategies that employ multiple-level interventions, such as psychosocial factors and process models (social cognition models) of persuasion, are of the utmost importance. This is in line with the current study that explored various strategies that the county government of Wajir employs to better the health standards in the region, and as such, practitioners are to move away from a simplistic, limited, and singular focus on health-related activities.

The strength of the social cognitive theory, according to *DeAmicis (2017*), lies in its ability to highlight an individual's reasons for considering and possibly adopting any health-related behavioural change, for example, their belief, knowledge, attitude, value, drive, motivation, and self-effacing systems. They seek to consider the complex relationships between health behaviours and the factors that determine social norms as a framework for how a client is most likely to behave under any given circumstances. Therefore, any health intervention adopted by the county government is far more likely to have a successful outcome. This makes the theory appropriate to the current study since within the framework of a behavioural model, attitudes can be measured before the programme planning stage and anticipated behavioural changes can be predicted and monitored (*Gott & O'Brien, 2019).*

In implementing behavioural change strategies, there is usually a call for a significant departure from a client's normal pattern of behaviour and therefore the challenge lies in identifying when and how these changes might occur (*McQueen, 2016).* In this case, the model suggests that clients need a strong incentive to change a behaviour that threatens or already affects their health status. In this respect, the County government of Wajir has the

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obligation of offering varied incentives to enable the clients not only to swiftly seek medical attention when in need, but also to seem affordable and of quality. Ordinarily, most clients feel threatened not so much by any looming ill-health state of the county, but by the health change itself, and often maintain a healthy ambivalence towards this prospect (*Baird, 2018).* Usually, client's actions are often based on a rational choice of valuing some aspects of their life above their health.

Bearing in mind the multifaceted factors that underpin behavioural change of individuals, the county health workers need to be aware that, despite their own health beliefs (which may be faulty in themselves), the client's beliefs may not always be based on the weight of objective evidence, since they can also be practically based on inaccurate yet emotive personal estimations (McQueen, 2016). While social cognitive theory assumes that clients are rational beings, their behaviour is often guided by rationalities other than one might expect (*Bennett & Murphy,2017).* Moreover, the theory is cognisant of the fact that the intention to change behaviours does not necessarily represent a desire or ability to change especially in unfamiliar and stressful settings like hospitals or clinics.

As a word of caution, Gott and O'Brien *(2019)* argue that effective planning is an essential part of the overall process for any health system to succeed. That is, the more encompassing and structured the planning, the better the chances of success overall. However, the SCT can be used to understand the influence of social determinants of health and a person's past experiences on behaviour change (Bandura, 2014).

2.1.3 Andersen Healthcare Utilization Model (1968)

Andersen's Healthcare Model has been used extensively in studies investigating the use of health services. The studies identified for this review showed that the model has been used in several areas of the healthcare system and relation to very different diseases (*Babitsch, Gohl & Lengerke, 2012).* Healthcare utilization is the point in health systems where patients' needs meet the professional system. It is well known that apart from need-related factors, healthcare utilization is also supply-induced and thus strongly dependent on the structures of the healthcare system. Furthermore, many study findings have shown differences in healthcare utilization based on patients' social characteristics.

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Andersen's healthcare utilization model by Andersen 1968, aims at demonstrating the factors that lead to the use of health services. The model is a multilevel model that incorporates both individual and contextual determinants of health services use. In doing so, it divides the major components of contextual characteristics in the same way as individual characteristics have traditionally been divided into those that predispose those that, enable or suggest the need for individual use of health services (*Babitsch, et al., 2012).* This includes: Predisposing factors, Enabling factors, and Need (*Andersen, Davidson, & Baumeister, 2016)*. Accordingly, Individual predisposing factors include the demographic characteristics of age and sex as "biological imperatives", social factors such as education, occupation, ethnicity, and social relationships (e.g., family status), and mental factors in terms of health beliefs (for example, attitudes, values, and knowledge related to health and health services). Contextual factors predisposing individuals to the use of health services include the demographic and social composition of communities, collective and organizational values, cultural norms, and political perspectives.

Enabling factors are both financing and organizational factors which are considered to serve as conditions enabling service utilization. Individual financing factors involve the income and wealth at an individual's disposal to pay for health services and the effective price of health care which is determined by the individual's health insurance status and cost-sharing requirements. The financial factors relate to the cost and affordability of the services by the clients. Organizational factors entail whether an individual has a regular source of care and the nature of that source. As Aday and A*ndersen (197*4) affirm, they also include means of transportation, travel time to and waiting time for health care. At the contextual level, financing encompasses the resources available within the community for health services, such as per capita community income, affluence, the rate of health insurance coverage, the relative price of goods and services, methods of compensating providers, and health care expenditures. Organization at this level refers to the amount, variety, locations, structures, and distribution of health services facilities and personnel. It also involves physician and hospital density, office hours, provider mix, quality management oversight, and outreach and education programs. Health policies also fall into the category of contextual enabling factors.

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The need factors represent both perceived and actual need for health care services *(Aday & Andersen, 1974).* At the individual level, *Andersen et al. (2016)* differentiate between perceived need for health services (how people view and experience their own general health, functional state, and illness symptoms) and evaluated need (professional assessments and objective measurements of patients' health status and need for medical care). At the contextual level, they make a distinction between environmental need characteristics and population health indices. Environmental need reflects the health-related conditions of the environment (occupational and traffic and crime-related injury and death rates). Population health indices are overall measures of community health, including epidemiological indicators of mortality, morbidity, and disability.

In theory, health-care utilization should correlate highly with the need, however defined, for services. However, some services are needed and not obtained, and others are utilized but not clearly indicated, *(McLaughlin & Kaluzny, 1994).* Figure 2.2 shows a modified Andersen's behavioral model indicating the framework of interrelationships amongst Predisposing, Enabling, and Need factors.

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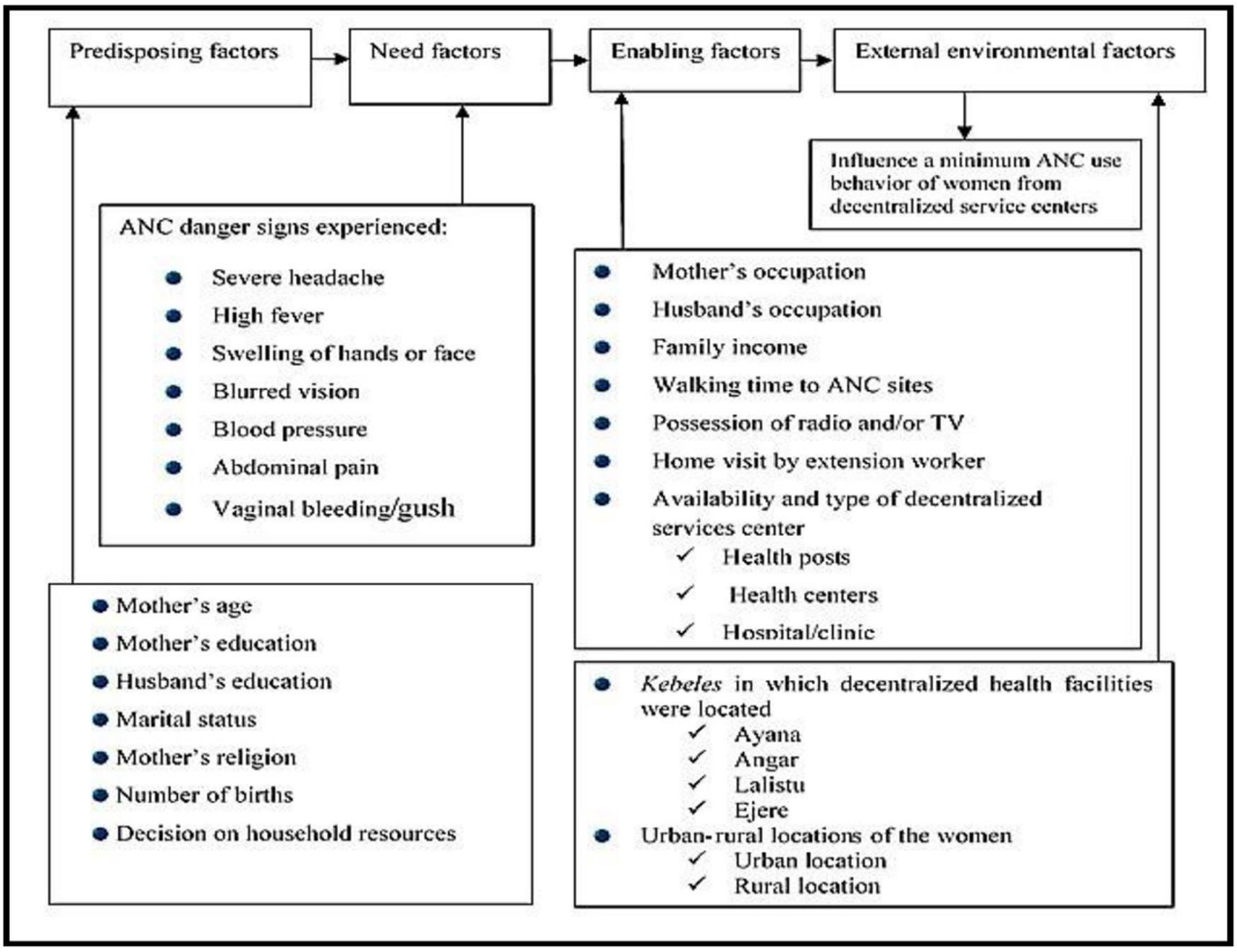

Figure 2.3: Relationship between Predisposing, Enabling, and Need factors framework: ***Modified from Andersen's behavioural model.***

Although the problems identified in the diagram (Figure 2.2) are presented as distinct from each other, it is likely that they are interlinked, so one intervention might affect more than one problem area or lead to several consequences. For example, if a mobile health clinic was placed nearer to women's homes to improve the distribution of services, it is possible that access to an ambulance might also be improved. On the other hand, ambulance transport provision of effective ambulance transport will reduce response and travel times as well as improve access to emergency obstetric care. The mobile health facility and ambulance may lead to positive consequences (such as decreased travel time or increased utilization of the service, which may result in improved maternal health care), but may also have negative or unintended effects (for example, if the health provider in the facility is overworked and does not effectively carry out triage of cases, s/he may cause delays in referring the most urgent cases). Thus the conceptual framework of this study is illustrated in Figure 2.2. It explains the relationship between the independent variables and the dependent variable.

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However, according to *Thode, Bergmann, and Kamtsiuris (2004*), the Andersen Healthcare Utilization Model has frequently been used in studies, mainly those conducted in Europe and the United States of America. It was to be utilized in a growing economy like Kenya, which has experienced numerous health challenges, more so in the marginalized regions like northern counties of Kenya.

2.2. Conceptual Framework

A conceptual framework is a logical structure that provides a picture or visual display of how ideas in a study relate to one another which the researcher believes can best explain the natural progression of the phenomenon to be studied (*Adom, 2018).* It is the researcher's own construct showing the interrelationship among study variables, thus it assists the researcher in identifying and constructing his/her worldview on the phenomenon to be investigated (*Grant & Osanloo, 2014).* It is the way through which a researcher presents his/her asserted remedies to the problem s/he has defined.

In this study, there are five sets of variables depicted in the conceptual framework: (1) demographic characteristics, (2) Ambulance referrals, (3) Cost (4) effectiveness, and (5) maternal health outcomes. Figure 2.3 shows the interrelationships among the study variables. The current study hypothesized that ambulance referral network interventions (Independent Variable) linearly and directly influence maternal health outcomes (Dependent Variable).

2.2. Conceptual Framework

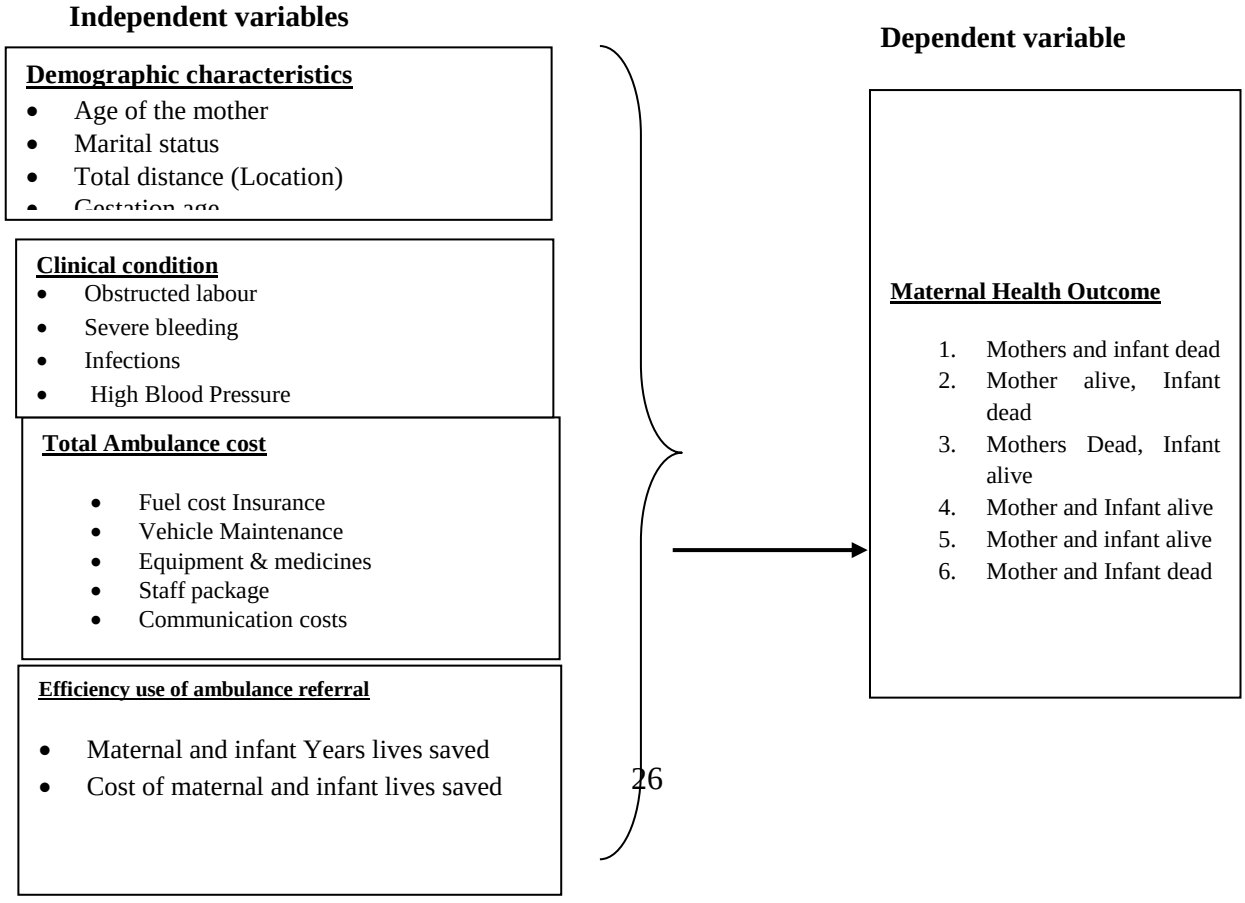

Figure 2.4: Conceptual frame work depicting interrelationships of study variables

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2.3 Empirical Review of Study Variables

The main objective of this study was to analytically review the association between ambulance referral network intervention and maternal health outcomes. To achieve this, the study identified specific variables which formed study objectives and were reviewed as follows:

2.3.1 Effect of Demographic Characteristics on Maternal Health Outcomes

The demographic characteristics are the personal factors of the mother that can determine the possible maternal health outcome *(WHO, 2014).* According to *MOH (2015),* the characteristics include age, education, marital status, location, gestation age, referred by, parity, and ANC number attended. Women who are educated are likely to utilize institutional delivery services preferably in a private health facility compared to a public hospital facility, suggesting that education influences the choice of maternal health care (Caulfield *et al*., 2016; Kitui *et al*, 2013; Tebekaw *et al*, 2015). Women who are working and earning money may be able to save and decide to spend it on facility delivery (*Exavery et al., 2014).*

Early age at childbirth is variously defined in studies of its effect on maternal and infant health. Approximately 11 percent of births worldwide are to women 15–19 years old, and 95 percent of these are in low- and middle-income countries *World Health Organization, (2011).* There are a large number of studies evaluating obstetric and neonatal outcomes over the full range of reproductive maternal ages, especially with a focus on the youngest and the oldest mothers. According to *Malabarey (2012),* young mothers are exposed to an increased risk of anemia, low birth weight, fetal death, eclampsia, and preterm birth although, at the same time, they were more likely to have a spontaneous normal vaginal birth and the risk of preeclampsia and postpartum haemorrhage (PPH) were significantly decreased. Just like the current study, the study by *Malabarey (2012)* evaluated outcomes in low-income countries. It is of interest that the current study results shall comparatively determine similarities, if there were any, to these studies performed in other low-income countries on teenage pregnancies given the divergent economic capabilities.

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Moreover, complications during pregnancy and birth at an advanced maternal age (either defined as 35 years and older or 40 years or older) have also been evaluated in high-income countries. For instance, advanced maternal age at birth has been found to be associated with gestational diabetes, preeclampsia, placenta previa, cesarean section (CS), placental abruption, preterm delivery, low birth weight, intrauterine fetal death, and increased perinatal mortality (*Cleary-Goldman et al.,2015*). The difference in obstetric and neonatal outcomes between teenagers and women at advanced age seemed to be lower risks for several unwanted and threatening outcomes in the teenage group; thus, the study showed that there were no obvious advantages concerning obstetric and neonatal outcomes at advanced maternal ages. However, theories propose that advanced maternal ages complicate the birth process. Moreover, published studies concerning the impact of maternal age on perinatal outcomes differ in many aspects methodologically as well as in the sociodemographic characteristics of the populations and healthcare systems. All these factors make the interpretation of comparisons between data sets difficult. It is these methodological differences that the current study hopes to fill.

Out-of-wedlock status has long been recognized as a demographic risk factor associated with infant mortality and low birth weight. However, the relationship between marital status and birth outcomes varies by maternal race and age. According to *Bennett (2012)*, high infant mortality rates for married teen mothers challenge the assumption that marriage necessarily provides a protective environment for childbearing. According to the author, inconsistencies in the effect of marital status indicate variations in both economic and social resources. Purely behavioral explanations for escalated risks to unmarried mothers are not justified by research findings of the reviewed literature. Hence there is a need for greater societal involvement in maternal health care created in part by changes in family structure.

A study by *Norhasmah, Wah-Yun, and Sajaratulnisah (2015),* evaluated the impact of maternal marital status on birth outcomes among young Malaysian women. The participants were interviewed using a structured questionnaire at pregnancy diagnosis and shortly after childbirth. From a total of 229 unmarried and 213 married women who participated, marital status was significantly associated with preterm birth (odds ratio [OR], 1.66; 95% confidence interval [CI], 1.05-2.61) and low birth weight (OR, 3.61; 95% CI, 1.98-6.57). Promoting

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access to prenatal care and social support programs for unmarried mothers may be important to reduce adverse pregnancy outcomes. However, the current study focuses on the Muslim dominant family structure, which overlooks the family support system especially male-related during childbirth. The proposition that close family ties help improve maternal health is yet to be tested and verified.

Women are disproportionately affected by adverse pregnancy outcomes, with recent study findings highlighting a lack of attention to the role of the father in pregnancy *(Alio, Kornosky, & Salihu, 2015).* The contribution and role that fathers may play in families may be different from one household to another, or from one region to another, as many fathers face unique, yet highly interconnected, barriers to involvement including joblessness, low educational attainment, and declining marriage rates. Few studies have considered the nature of the mother-father relationship (e.g. unmarried, but cohabiting or unmarried and non-cohabitating) for pregnancy outcomes with mixed results. For instance, unmarried women have a higher proportion of low birth weight infants than their married counterparts in studies not considering race or ethnicity as a contextual factor that might influence this association (*Ventura, 2015).*

The current state of research on the marital status disparities in birth outcomes highlights the need to explore factors that may be more salient to experiences within diverse families in an effort to reduce these disparities. Moreover, the involvement of fathers in the pregnancy experience may be a promising direction because of previous research suggesting an indirect influence of fathers on mothers' health behaviors. How fathers may influence pregnancy outcomes and maternal health behaviors is still unclear, especially because of the interconnections and support behaviors between members of extended family systems, regions, as well as faith-based beliefs.

Improving maternal and child health remains a serious challenge for many developing countries. Geographical accessibility from a residence to the nearest health facility is suspected to be an important obstacle hampering the use of appropriate services for MCH especially in Sub-Saharan African countries. Most research studies highlight the significance of research regarding factors that demographically, socioeconomically, or environmentally

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affect maternal healthcare levels. Maternal healthcare outcomes are affected by developments in all areas of society. According to *Karra, Fink, and Canning (2017),* many studies have shown that the maternal death rate is closely related to the mother's level of education, hygiene facilities, financial standards, the size of the related workforce, and the physical distance between mothers and healthcare facilities.

With the rural poor in Kenya, especially in the northern part region where the road network is poorly developed, the current study postulates that this aggravates poor maternal outcomes. Maternal deaths vary markedly among geographic regions in Kenya. According to a 2009 analysis of census data, the highest maternal mortality was reported in North Eastern Province (2,014 per 100,000 live births) with Wajir County leading, followed by Nyanza Province (546 per 100,000 live births) while the lowest was in Nairobi Province (212 per 100,000 live births *(NCPD & UNFPA, 2013*). Wajir County contributes to high maternal mortality in Kenya with an estimated maternal mortality to be over 1600 maternal deaths per 100,000 live births in the country (*KNBS, 2012).*

By gender and age, associations' studies have demonstrated between gender/sex and utilization of health care services. An analysis of gender/sex as a single variable reported that women were more likely to visit a physician than men. These studies included samples of young Australian adults. Another study analyzing the variables age and gender/sex in combination found that younger age (19 to 39 years) and male gender were risk factors for not visiting a physician during the previous year (*Andersen, et al., 2002*).

In several settings women complain about culturally inappropriate care, for example in the Hoima district in the Karamojong region of Uganda Tradition requires that the umbilical cord of a baby girl be cut with a knife (the one used by women to prepare food), while the one of a baby boy is to be cut with an arrow (the one typically used by a man/warrior), but this could not be done in the health unit. *(Wilunda et al., 2014).* In countries as diverse as Nigeria, Ethiopia, and Ghana, studies show that women do not decide on their own to seek care: the decision belongs to a spouse, mother-in-law, or senior members of the family (*Abimbola et al., 2016;* Ganle *et al*., 2015; Roro *et al*., 2014). Ethnicity, as a factor influencing health service utilization, was also looked at in combination with health insurance status. A study

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including a sample of lower-income adults in the US showed that among those insured, African Americans and American Indians/Alaska Natives were more likely than non-Latino whites to have a usual source of care. Furthermore, among the uninsured, having a usual source of care was more prevalent in Latinos than in non-Latino whites. However, the study found that Latinos, predominantly Mexican-origin Latinos, did worse (in terms of not having a usual source of care) in areas with a large low-income population (*Andersen et al., 2002).*

Women's mobility is limited in certain areas because they need permission to travel hence thwarting timely efforts to seek care. In the Samburu community of Kenya, "no matter how obvious the need for hospital management becomes for the woman who develops labour, she will continue to do household duties and it's the husband to decide when and where to seek care" *(Caulfield et al., 2016).* On the other hand, a study in Nigeria reported that women who were involved in decision-making on their health were likely to seek timely maternal health care *(Fawole & Adeoye, 2015)*. There is evidence that utilization of medical services increases with increasing levels of women's education. There is a positive association between a mother's education and the use of maternal health services in Nigeria (*Fawole & Adeoye, 2015*). A longitudinal study in Nepal indicated that women who were educated especially with secondary education and above were likely to deliver in a hospital (*Karkee, Binns, & Lee, 2013)* suggesting that increasing level of education increases knowledge and awareness of obstetric danger signs (Hailu & Berhe, 2014). In addition, the proportion of private health facility deliveries is positively linked to maternal education (Das *et al*., 2016) while a lower level of maternal education is associated with high morbidity and mortality *(Karlsen et al., 2011; Tuncalp et al., 2014)* indicating that education influences the choice of quality health care. Therefore, education may affect individuals by increasing access to healthcare information.

Long distances are a hindrance to reaching a health facility, and the effect of distance is worsened by lack of transportation and poor roads. The highest proportion of users are located close to the health facility and the proportion of users declines as the radius increases (*Asseffa, Bukola, & Ayodele, 2016).* In addition, the adverse birth outcome in pregnant women is associated with long-distance travel suggesting that the longer distance travelled acts as a disincentive thus delaying the caretakers' decisions to seek care until complications of the

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initial disease develop *(Asundep et al., 2013).* Therefore, distance acts as a disincentive and actual obstacle in seeking health care.

The uneven distribution of health facilities has implications for travel distances between women and even the closest facility as well as specialist referral hospitals. Health care access is therefore an acute problem for rural inhabitants in developing countries. Pregnant women from a rural farming area in Ethiopia had to walk for 10km to reach the nearest health facility when bicycles were not available *(Kumbani et al., 2013).* In both Laikipia and Samburu counties, the majority of women and men said that distance to the health facilities contributed to the continuing practice of home births (Tanya Caulfield *et al.*, 2016). In Congo, the highest proportion of antenatal care users is located within a radius of <15km compared to those who are beyond 15km or 3-hour walk *(Nsibu et al., 2016*). In Ethiopia, pregnant women cannot walk to the hospital due to insecurity on the long-distance roads *(Wilunda et al., 2014).*

The physical distance between mothers' residences and the closest medical facility has been considered an important factor, because receiving special treatment immediately after childbirth prevents complications and consequently improves maternal mortality rates (*Janssen et al., 2012).* A study by Won and Yeon (2019) found a direct proportional relationship between the distance to the closest health center and travel time ($r = 0.331$, $p < 0.001$), travel time during rainy seasons ($r = 0.252$, $p < 0.001$), transportation expenses ($r = 0.461$, $p < 0.001$), and trouble finding transportation methods ($r = 0.163$, $p < 0.001$), with an explanatory power of 27% ($R^2 = 0.274$). Based on these findings, the study recommended that improving accessibility to effective maternal and child healthcare services reduces maternal and child mortality.

Moreover, a study by *Tanou & Yusuke (2019*) used a demographic and health survey (DHS) 2010 dataset, with a sample of 10,364 mothers aged 15–49 years. The multivariate logistic regressions were conducted to estimate the effects of distance on maternal healthcare utilization. The regression results revealed that the longer the distance to the closest health centre, the less likely it is that a woman will receive appropriate maternal healthcare services. The estimates showed that one Kilometres increase in distance to the closest health centre reduces the odds that a woman will receive four or more antenatal care by 0.05 and reduces by 0.267 the odds that she will deliver her baby with the assistance of a skilled birth attendant.

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Cultural norms and traditional health beliefs or behavior have equally been identified in some studies as predisposing factors for the utilization of health care services. A community-based participatory study on Puerto Rican Latinas living in the Capital District of New York State identified women preferring to be seen by a Latino doctor, and those using alternative medicine as being significantly more likely to delay care *(Insaf et al, 2010).* Traditional male role norms around the disclosure of vulnerability were found to have a negative impact on African-American men's routine health examination receipt. One study, which examined the impact of culture on the use of Western health services by older South Asian Canadians, found that having fewer cultural barriers and a lower level of agreement with South Asian health beliefs, but a stronger South Asian ethnic identity was related to using more types of Western health services. This study originally considered cultural factors as a separate category.

According to *Boyle et al. (2012*), very preterm infants, born before 32 weeks of gestation, have high rates of neonatal morbidity and mortality and have therefore been the centre of most research into outcomes following preterm birth. The available data indicate a moderate (32-33 weeks) and late (34-36 weeks) preterm infants represent 6-7% of all births and around 75% of preterm births annually in the United Kingdom. Studies have consistently shown higher mortality, increased neonatal morbidity, and worse neurodevelopmental and educational outcomes in these infants compared with those of at least 37 weeks gestation, although on average their problems are less severe than those of very preterm infants. Moreover, a study results by *Boyle et al. (2012)* revealed that general health, hospital admissions, and longstanding illness showed a gradient of increasing risk of poorer outcomes with decreasing gestation. These results suggest that health outcomes of moderate/late preterm and early-term babies are worse than those of full-term babies.

2.3.2 Maternal Clinical Conditions on Referrals and Maternal Health Outcome

Globally, women die as a result of complications during and following pregnancy and childbirth. Most of these complications develop during pregnancy and most are preventable or treatable *(WHO, 2019).* In addition, other health complications may exist before pregnancy but are worsened during pregnancy, especially if not managed as part of the woman’s care.

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Consequently, maternal mortality and morbidities have become a major global public concern. According to *WHO (2019*), the major clinical complications that account for nearly 75% of all maternal deaths are: severe bleeding (mostly bleeding after childbirth), infections (usually after childbirth), high blood pressure during pregnancy (pre-eclampsia and eclampsia), complications from delivery, and unsafe abortion.

Poor women in remote areas are the least likely to receive adequate health care on time. This is particularly true for marginalized regions of the country. The highest maternal mortality rates are in Africa, with a lifetime risk of 1 in 16; the lowest rates are in Western nations (1:2800), with a global ratio of 400 maternal deaths per 100,000 live births *(Tsegaye et al., 2016).* Of these deaths, the developing economies accounted for approximately 99% (302,000) of the global maternal deaths in 2015, with sub-Saharan Africa alone accounting for roughly 66% (201,000) *(WHO, 2015).* About 71.5% of maternal deaths in sub-Saharan Africa were due to direct causes while 28.6% were due to indirect causes *(Say et al., 2014).*

Manisha et al. (2017) subdivides maternal deaths into direct obstetric deaths (i.e, deaths resulting from the obstetric complications of pregnancy, interventions, omissions, incorrect treatment, or a chain of events resulting from any of the above) and indirect obstetric deaths (i.e, deaths resulting from a previous existing disease, or disease that developed during pregnancy that was not due to direct obstetric causes, but was aggravated by physiological effects of pregnancy). Particularly, haemorrhage was the leading direct cause accounting for 24.5% of deaths in sub-Saharan Africa with 8.4%, 0.9%, and 15.2% of the reported haemorrhage classified as antepartum, intra-partum, and post-partum *(Say et al., 2014).* In addition, 9.6%, 2.1%, 16.0%, and 10.3%, of all maternal deaths were due to abortion, embolism, hypertension, and sepsis, respectively, while other direct causes accounted for 9.0% of sub-Saharan Africa maternal deaths *(Say et al., 2014*). Sub-Saharan Africa maternal deaths due to indirect causes showed that more than 28.5% of deaths are from pre-existing medical conditions aggravated by pregnancy, with HIV alone accounting for 6.4% of maternal deaths in Sub-Saharan Africa *(Say et al., 2014).* These existing data reveal the dire need to have an efficient and more responsive referral system to arrest maternal deaths as a result. Even though data by *UNICEF (2019),* show that the number of women and girls who died each year from complications of pregnancy and childbirth declined from 451,000 in 2000

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to 295,000 in 2017, these improvements did not directly link this improvement to the referral system of the country. Still, information is vague as to the impact of a country's referral network within the medical sector.

The Kenyan government has made significant and purposeful efforts geared towards improving the lives of women over the years and more recently, in June of 2013, Kenya declared maternity services free of charge, in all public health institutions across the country, a move to make maternity services accessible and affordable, and to reduce maternal and perinatal mortality. However, this still saw more than 6000 maternal deaths, and 35,000 stillbirths occur each year *(Langát, et al., 2019*). In addition, maternal mortality has remained high, at 400-600 deaths per 100,000 live births over the past decade, resulting in little or no progress being made towards achieving *MDG 5.* High cost of seeking maternity care has been associated with maternal deaths. Directly related to the cause is the cost associated with transport. In these conditions, the pregnant mothers with clinical conditions are less likely to get help on time.

In Kenya, an estimated 6,300 women die each year during pregnancy and childbirth, a tragic number that reflects inadequate progress toward providing essential health services to all women. Maternal deaths vary markedly among geographic regions in Kenya. For example, according to a 2009 analysis of census data, the highest maternal mortality was reported in North Eastern Province (2,014 per 100,000 live births) with Wajir County, being among the leading two, accounting for 1,687 per 1,00,000 live births. Wajir County is one of the counties that is contributing to the high maternal mortality in Kenya after Mandera 3,795 per 100,000 live births. *(NCPD, 2013).* Moreover, a recent analysis by the University of Nairobi showed that 98 per cent of these deaths are concentrated in just 15 of the country's 47 counties (*United Nation Population Fund [UNFPA 2020).*

The maternal health challenges facing Kenya can be resolved through a well-coordinated efforts and additional investments. The actions must be taken on several fronts to improve maternal health, especially to increase access to care. This requires the county governments to provide quality, accessible, and affordable maternal health services, especially in counties

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with the highest burden of maternal deaths, and to provide adequate resources for training of midwives, effective supervision, and logistics.

As at 2015, maternal deaths was estimated to be 303,000 globally *(WHO, 2015).* Nearly 73% of all maternal deaths were due to direct obstetric causes whereas 27.5% were linked to indirect causes *(Say et al., 2014).* Globally, haemorrhage was the leading direct cause of maternal death representing 27.1% of maternal deaths with 6.5%, 0.9% and 19.7% of reported haemorrhage classified as ante-partum, intra-partum, and post-partum (*Say et al., 2014).* Hypertension was the second most common direct cause maternal death worldwide (14.0%), while sepsis (10.7%), abortion (7.9%) and embolism and other direct causes accounted for their remaining (12.8%) of global deaths (*Say et al., 2014).* Deaths due to indirect causes suggest that more than 70% of indirect causes are from pre-existing disorders exacerbated by pregnancy with HIV alone accounting for 5.5% of global maternal deaths*(Say et al., 2014).*

Developing regions accounted for approximately 99% (302,000) of the global maternal deaths in 2015, with sub-Saharan Africa alone accounting for roughly 66% (201,000) *(WHO, 2015).* About 71.5% of maternal deaths in sub-Saharan Africa were due to direct causes while 28.6% were due to indirect causes (*Say et al., 2014).* Haemorrhage was the leading direct cause accounting for 24.5% of deaths in sub-Saharan Africa with 8.4%, 0.9%, and 15.2% of the reported haemorrhage classified as ante-partum, intra-partum and post-partum (Say *et al.*, 2014). In addition, 9.6%, 2.1%, 16.0%, and 10.3%, of all maternal deaths were due to abortion, embolism, hypertension, and sepsis, respectively, while other direct causes accounted for 9.0% of sub-Saharan Africa maternal deaths (*Say et al., 2014).* Sub-Saharan Africa maternal deaths due to indirect causes showed that more than 28.5% of deaths are from pre-existing medical conditions aggravated by pregnancy, with HIV alone accounting for 6.4% of maternal deaths in Sub-Saharan Africa(*Say et al., 2014).*

Kenya experiences a very slow progression in maternal health care vindicated by the high maternal mortality approximated at 8,000 (uncertainty intervals: 5,400 to 12,000) maternal deaths recorded in the year 2015 (*WHO, 2015).* Maternal deaths due to direct causes were 44% for haemorrhage, 34% for obstructed labour, 13% for eclampsia, 6% for sepsis and 3% for raptured uterus (NCPD & *UNFPA.*, 2015). Indirect causes of maternal deaths included HIV and AIDS, malaria, anaemia, and cardiovascular causes*(NCPD & UNFPA., 2015).*

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Altogether, the high maternal mortalities associated with direct and indirect causes reflect inadequate progress toward providing essential maternal health care.

Maternal deaths vary markedly among geographic regions in Kenya. According to a 2009 analysis of census data, the highest maternal mortality was reported in North Eastern Province (2,014 per 100,000 live births) with Wajir County, being among the leading two, accounting for 1,687 per 1,00,000 live births. Wajir County is one of the counties that is contributing to the high maternal mortality in Kenya after Mandera 3,795 per 100,000 live births (*NCPD, 2013).*

2.3.3 Effect of Ambulance Costs on Maternal Health Outcome

The total ambulance costs include both direct and indirect costs. These costs include staff salaries, referral allowances, fuel costs, vehicle maintenance costs, insurance costs, equipment, drugs and stationeries, and communication costs (*MOH, 2015).* These determines maternal health outcomes of the mother and the child. The government of Kenya is restructuring her referral services by increasing ambulance fleet number yet more is needed (*MOH, 2013).* In addition, financial incentives exist to levels 2 and 3 health facilities to offer Ambulance Referral Network free of charge *(MOH,2013*). However, ambulance referral network are not immediately available due to poor deployment strategy, in most cases, ambulances function only as a taxi as well as hospital courier vehicle *(Broccoli et al., 2015; Wachira & Martin, 2011).* Increasing the number of tasks done by ambulance and poor deployment is associated with higher operational/running cost of ambulance *(Robinson et al., 2009).* In addition, information on the cost-effectiveness of ambulance referral system informs decision on resource allocation in a country's health sector (*WHO, 2003).* However, there is no information on ambulance cost-effectiveness on maternal health outcomes in Kenya encouraging inefficient decisions to be made. This study was to determine the cost effective of ambulance referral network on maternal health outcomes in Kenya.

A systematic review of interventions to reduce maternal mortality in developing countries, Wilson (2013) reports that in many low-income countries, it is estimated that less than one percent of the population has access to conventional emergency transport, such as an ambulance. Motorised vehicle ownership is rare in low income countries, with the vehicle to person ratio as low as 30: 100,000 people. Such shortage of vehicles means that very few

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people have access to transport for work, social or health purposes, even though transport systems were recognised as a fundamental human need over three decades ago. For many, access to transport services is not within easy reach; in Ethiopia, approximately half of all rural households had to travel distances over 15km to access public transport. However, even where vehicles were available in many of these low-income countries, road systems are insufficient, and often unsafe. Most births in low- and middle-income countries occur outside of health facilities, and as most obstetric complications are unpredictable, access to emergency care in a timely manner is essential to reduce preventable deaths *(Gott & O'Brien's, 2019; Rajé, 2018).*

Following Thaddeus and Maine's three delay model of maternal mortality, the Kenya government has focused on delay 3 and abolished user fees in all public health facilities *(Presidency,2013),* with the aim of promoting health facility delivery service utilisation especially among vulnerable groups *(McKinnon, Harper, Kaufman,2015).* The cost of ambulance referral in Kenya has been highly inhibitive, more so in the rural poor. While eliminating delivery fees is a commendable intervention, pregnancy-related mortality due to the following "three delays" remains a concern: delays in deciding to seek skilled delivery services, delays in arriving at health facilities and delays in receiving adequate treatment and referral (*McCarthy & Maine, 2019*). Car ambulances, private cars and taxis would be the most effective method of transferring women, but the problem is availability and affordability. According to *Tayler-Smith and Zachariah (2013),* the total annual cost of the referral system (comprising 1.6 ambulances linked with nine maternity units) was € 85 586 (€ 61/obstetric case transferred or € 0.43/capita/year) in Kenya.

While the importance of improved transport and roads to reducing maternal and child mortality rates is recognised, a study by B*abinard and Roberts (2016)* established that the role of emergency transport associated with maternal deaths in India. Moreover, a study by H*anson (2017)* in Tanzania established that the policy of sending ambulances for emergency maternal health admissions was constrained by a lack of funds at the district level to pay for fuel, maintenance and repairs to keep ambulances on the road.

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There is evidence that cost-effective analysis informs decision on the choice of referral transport. For example, a cost effective analysis study in Zambia revealed that use of bicycle ambulance for maternal health was not associated with cost compared to ox-cart and motor vehicle ambulance (Simfukwe *et al.,* 2009). In Malawi, the cost effectiveness of bicycle ambulance was nearly 200 times costlier than traditional methods such as homemade stretcher or hiring ordinary bicycle for accessing maternal health delivery (*Lungu et al., 2001).* In Malawi, annual operating costs of motorcycle ambulance was almost 24 times cheaper than for a car ambulance, and they are useful means of referral for emergency obstetric care and a relatively cheap option for the rural health centres *(Hofman et al., 2008).*In Scandinavia, the hourly cost of running the medical emergency motorcycle was two times cheaper compared to a car ambulance and the actual cost benefit is smaller since the weather conditions make it impossible to run a medical emergency motorcycle in wintertime *(Nakstad, Bjelland, & Sandberg, 2009).* In Uganda, annual operating costs of motorcycle ambulance is almost ten times lower than a 4WD motor vehicle ambulance and that motorcycle ambulance can easily be moved to remote places on roads inaccessible by vehicle ambulances *(Mohanty, 2013).* Taken together, a combination of both motor cycle and motor vehicle ambulance approaches might be cost effective, depending on distance, geographic terrain and weather conditions.

According to *Hussein and Webber (2012),* delays in the decision to seek care usually occur at the household level and include problems related to recognition of the complication and its nature as a life-threatening condition or an emergency. The distances involved in reaching care, the costs of care and perceptions regarding the quality of care available, are also known to be key factors that affect women's decision making.

Kenya has a population of about 44.9 million of which 39.1% are unemployed while 48.3% are females of the reproductive age of 15-49 years with total fertility rate of 3.9 live births per woman *(KNBS, 2009; WorldBank, 2016*). The Gross Domestic Product (GDP) per Capita in Kenya is$1,420, equivalent to 9 percent of the world's average(*MOH, 2015a).*Despite low per capita income in Kenya ($1,420), the government has conventionally provided funding for personnel and operating costs at public hospitals. Kenya's total health expenditure in the fiscal year 2012/13 accounted for 6.8% of gross domestic product (GDP) while government

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health expenditure as a proportion of total health expenditure was recorded at 33.5% in the same timeframe*(MOH, 2015a).* Following the adoption of the 2010 constitution, the Government of Kenya (GOK) devolved its health system resulting in a 57% increase in county health budget allocation from fiscal years 2013/14 to 2014/15 (MOH, 2014a, 2015a).Out-of-pocket expenditures as a proportion of total health expenditure was approximated at 29.9%forfiscal year 2012/13*(MOH, 2014a) hence* Kenya suffers catastrophic health expenditure (*WHO, 2005).*

In the years 2011 to 2013, a cross-sectional survey reported that nearly 50% of households in Kenya borrow money outside families and from money lenders or even selling household property to pay for maternity care (*MOH, 2014b).* In the view of catastrophic health expenditure, the government of Kenya abolished all user fees in public dispensaries and health centres, and provided nearly US$7million for compensation to lower-level facilities in 2013 *(MOH, 2015a*). In addition, the government of Kenya implemented a free maternity care policy, committing approximately US$38 and US$40 million for free maternal health services in fiscal year 2013/14 and 2014/15, respectively *(MOH, 2015a).*Despite increased domestic and government contributions to health, Kenya is still dependent on donors, with 57% of the fiscal year 2014/15 development health budget estimated to be funded by development partners*(MOH, 2015*).

The cost of care-seeking includes costs of transportation, medications and supplies, official and unofficial provider fees as well as the opportunity costs of travel time and waiting time lost from productive activities. Traditional birth attendants (TBAs) are usually considered affordable for poor families since their payment is negotiable in terms of amount and timing and can be in kind (*Mason et al., 2015).* On the other hand, a drastic increase in hospital births' was observed after introduction of delivery care user fee exemption *(Leone et al, 2016).* Costs discourage poor women from using health facility delivery services, while they play a lesser role in case of complications *(Kabali et al., 2011).*

In Tanzania, women with better economic status were three times more likely than the poorest woman to have institutional delivery (*Exavery et al., 2014).* Therefore, cost influences decision in seeking care but severity of complication overrides cost as a barrier in accessing

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health care. Reports from Norther Uganda indicate that women tend to use low-cost remedies to treat minor conditions and then move to more expensive resources if the illness progressed *(Nyeko et al., 2016)* indicating that indicate that the perceived severity of the condition may well be an overriding factor in the decision to seek appropriate care. Economic status of women influences their ability to access maternal care. Socio-economic status in women was significantly associated with institutional delivery despite the existence of delivery user fee exemptions *(Exavery et al., 2014; Fawole & Adeoye, 2015).* A study in Ethiopia showed that women residents of slums are likely to deliver in public hospitals compared to non-slum residents suggesting that poverty limits access to quality care *(Tebekaw et al., 2015).* Women with low economic status are associated with non-institutional (home) delivery (*Mazalale et al., 2015).* Maternal near miss is associated with poor socio-economic conditions of woman *(Rosendo & Roncalli, 2016)* suggesting that poverty exceedingly expose women to hard and heavy workloads associated with adverse pregnancy outcome *(Izugbara & Ngilangwa, 2010). High* maternal mortality and morbidity occurs in women living in poor remote regions with limited health facilities *(WHO, 2015).* Taken together, poverty limits access to quality maternal care.

In addition to travel distance, the scarcity of transportation in developing countries is also a harsh reality. In Malawi, pregnant women lack money to fuel ambulance and there is no prompt ambulance response even after calling resulting in maternal deaths due to inappropriate use of ambulance by corrupt health workers resulting in deaths due to inappropriate use of ambulance by corrupt health workers *(Kambala et al., 2011).* As a result, inhabitants of rural areas commonly have to walk or improvise means of transportation to reach a health care facility. For example, in Laikipia and Samburu counties of Kenya, the cost of transport is high depending on the distance between the group ranch and the facility which is prohibitive making the expectant women to walk to the nearest facility which is more than two hours away (Caulfield *et al.*, 2016). In rural Ethiopia and Nepal, men carry pregnant women on locally made bamboo stretchers to health facilities (*Khatri, 2017; Roro et al., 2014).* Maternal medical emergencies occur everywhere, specifically in low- and –middle income countries consuming resources every day regardless of whether there are systems capable of achieving good outcomes *(Kobusingye et al., 2005*). Most of the developing countries are restructuring ambulance emergency services but they are limited with budget

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(Hofman et al., 2008), justifying the need for cost effective analysis of maternal health Ambulance Referral Network.

Due to the cost of running a public sec-tor ambulance service in rural areas, women and their families have to depend on private transport using either their own funds or financing schemes. *Holmes and Kennedy (2010*) presented a detailed description of the initiatives in a wide variety of developing country settings and concluded that community-based schemes have demonstrated some potential to overcome financial barriers to reaching EmOC. These included emergency loan funds, insurance and pre-payment schemes *Hussein et al, (2015).* However, local challenges included the generation and access of sufficient funds, particularly in small communities, and sustainability. The government programmes have been introduced, sometimes in partnership with non-governmental organizations or the private sector, cost-sharing initiatives: vouchers and entitlement cards, and cash transfers and reimbursements. Attention to effective management, transparency, and regulations to ensure rationalization has been elusive hindering the initiative success.

2.3.4 Ambulance Use and Maternal Health Outcome

According to Committee on Monitoring Access to Medical Care, efficient access to health care is refers to timely use of personal health services to achieve the best possible health outcomes. In addition, efficiency concerns about cost containment combined with concerns about improving health outcomes (*Andersen et al, 2016).* It measures the impact of potential access (enabling resources like health insurance) and realized access (health services utilization) on outcomes (health status, quality of life, and satisfaction. Thus, different combinations of enabling resources and services can be compared as to the cost of producing one unit of outcome. Lower cost equals greater efficiency. This implies that efficiency in using ambulance by the patients relates to high outcome impact at affordable cost.

Cost effectiveness analysis can be used to determine the cost of providing ambulance referral network guiding budgetary resource allocation in a country. By examples, in Sierra Leone, the motorbike ambulances cost approximately US $4,410 per year and that capital and ongoing costs of a motorbike ambulance are low, and implementation of such a system is possible in a short time (*Bhopal et al., 2013).* In Ethiopia, the cost of running a free car ambulance service dedicated to emergency obstetric care was US$18.47 per referred patient (*Tsegaye et al.,*

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2016). In Cambodia, the running cost Ambulance Referral Network specifically for emergency obstetric care was US $34.4 per collected emergency case *(Jacobs, et al., 2016*). In India, cost of operating publicly financed and privately delivered ambulance service was US $ 22.7) per patient transported or US $ 0.35 per km travelled (Prinja *et al*., 2014) while that of publicly financed and publicly delivered is INR 15.5 per km travelled *(Prinja et al., 2013).* In Uganda, the overall cost of the ambulance service for obstetrical referrals was estimated to be US $ 9,675 for three months (US $ 3,225 per month) *(Somigliana et al., 2011).* In Burundi, the cost of providing ambulance service was estimated to be € 61 per obstetric case transferred (Tayler-Smith et al., 2013). In Nigeria, the mean cost of transport of emergency obstetric cases was US $5.89 per patient (*Shehu, Ikeh, & Kuna, 1997).*

Taken together, population size and economic and poverty levels of the community affects the running cost of an ambulance referral network. Inefficient use of the ambulance can cause the maternal delay which can cause death of the mother or the child. These maternal delays follow a "Three Delays" model suggesting that pregnancy-related deaths is tremendously due to (1) delay the decision to seek care; (2) delay arrival at a health facility; and (3) delay the provision of adequate care *(Pacagnella et al., 2012) (Thaddeus & Maine, 1994).*The first delay is on the part of the mother, family, or community not recognizing a life-threatening condition (*Gabrysch & Campbell, 2009; Pacagnella et al., 2012; Thaddeus & Maine, 1994).* Because most deaths occur during labor or in the first 24 hours postpartum, recognizing an emergency is not easy *(Gabrysch & Campbell, 2009; Thaddeus & Maine, 1994*). Most births occur at home with unskilled attendants, and it takes skill to predict or prevent bad outcomes and medical knowledge to diagnose and immediately act on complications (Gabrysch & Campbell, 2009; Pacagnella *et al*., 2012; *Thaddeus & Maine, 1994).* By the time, the lay midwife or family realizes there is a problem, it is too late.

Following the three – days model, the second delay is in reaching a health-care facility, and may be due to road conditions, lack of transportation, or location *(Gabrysch & Campbell, 2009; Thaddeus & Maine, 1994).* Many villages do not have access to paved roads and many families do not have access to vehicles *(Gabrysch & Campbell, 2009; Pacagnella et al., 2012; Thaddeus & Maine, 1994).* Public transportation (or animals) may be the main transportation method. This means it may take hours or days to reach a health-care facility. Women with life-threatening conditions often do not make it to the facility in time.

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The third delay occurs at the healthcare facility *(Gabrysch & Campbell, 2009; Thaddeus & Maine, 1994). Up*on arrival, women receive inadequate care or inefficient treatment *(Gabrysch & Campbell, 2009; Thaddeus & Maine, 1994)*. Resource-poor nations with fragile health-care facilities may not have the technology or services necessary to provide critical care to haemorrhaging, infected, or seizing patients *(Gabrysch & Campbell, 2009; Thaddeus & Maine, 1994)*. Omissions in treatment, incorrect treatment, and a lack of supplies contribute to maternal mortality *(Gabrysch & Campbell, 2009; Thaddeus & Maine, 1994).* In addition, data on Sub-Saharan Africa maternal deaths due to indirect causes showed that more than 28.5% of deaths are from pre-existing medical conditions aggravated by pregnancy, with HIV alone accounting for 6.4% of maternal deaths in Sub-Saharan Africa (*Say et al., 2014).*

Effective prevention and management of conditions in late pregnancy, childbirth and the early new born period are likely to reduce the numbers of maternal deaths, antepartum and intrapartum-related stillbirths and early neonatal deaths significantly. Therefore, improvement of the quality of preventive and curative care during this critical period could have the greatest impact on maternal, foetal and new born survival (*WHO, 2016).* Quality of health care is a critical aspect of the unfinished maternal and new-born health agenda, mainly with respect to care around labour and delivery and in the immediate postnatal period (Maxwell, 2018). It is recognized that high coverage alone is not enough to reduce mortality. To reduce maternal and neonatal mortality substantially and move towards elimination of preventable causes of maternal and new-born death, increased coverage should be accompanied by improved quality throughout the continuum of care (*Ovretveit, et al., 2012*).

The WHO (2016) Multicounty Survey on Maternal and New-born Health sampled more than 300,000 women attending 359 health care facilities in 29 countries. The study results showed a poor correlation between coverage of "essential interventions" (the proportion of the population who had received an indicated intervention, such as women with eclampsia who received magnesium sulfate) and maternal mortality in health facilities. Studies also show that high-quality care requires appropriate use of the available infrastructure, staff and commodities to ensure effective case management (*Roemer & Montoya-Aguilar, 2018).* In addition, high-quality health care requires appropriate use of evidence-based clinical practices

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and non-clinical interventions, strengthened health infrastructure and optimum skills and a positive attitude of health providers.

The significance of ambulance referral in an obstetric emergency is related to the unpredictability of pregnancy complications, which can be severe, and life threatening. For instance, about 73% of maternal deaths are due to direct obstetric causes whereas 27% are linked to indirect causes *(Say et al., 2014).* These deaths are avoidable through timely referral to an emergency obstetric care health facility (*Tayler-Smith, et al., 2013).* However, prompt, effective and efficient ambulance inter-facility referral services is a problem in low- and middle-income countries *(Wilson et al., 2013) delineating* the need to determine the effect of Ambulance Referral Network on maternal health care.

Ambulance is one of the facilities aimed at improving access to maternal health care in low- and middle-income countries *(Hussein et al, 2012).* A computer-based mathematical modelling estimated that referral and transport strategies, could contribute to as much as an 80% reduction in maternal mortality*(Goldie et al., 2010)* yet there is poor medical emergency response associated with poor management and deployment of ambulance in sub-Saharan Africa *(Kambala et al., 2011).* Therefore, several studies have evaluated the performance of ambulance referral systems on maternal health care with the view of providing alternatives that are unlikely to be misused for non-referral purpose or improving their efficiency. For instance, a study in a study in Malawi demonstrated the effectiveness of bicycle ambulances to strengthen an obstetric referral system in but found that that cultural beliefs deterred pregnant women from using bicycle ambulances *(Lungu et al., 2001).* In Zambia, a study showed that bicycle ambulance was easily accessible and faster means of transportation in accessing access maternal health care by pregnant women in labour (*Simfukwe et al., 2009).*A study in Malawi reported that motorcycle ambulance are unlikely to be misused for non-referral purposes and they effective and efficient in obstetric referrals in rural areas compared to motor vehicle ambulance (*Hofman et al., 2008).*

It is in the rural areas that transport interventions are crucial. The range of physical transport options includes: pick-up trucks; taxis; buses; reconditioned vehicles; tractors; motorcycles; tricycles; bicycles; bicycles/tractors/tricycles with trailers; motor-boats; canoes;

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wheelbarrows; animal-drawn carts; home-made stretchers; rickshaws; and air-craft. Non-motorized options do not have the potential to transport a woman needing emergency care in good time (*Hussein et al., 2015)*. However, according to *Hussein et al. (2015),* there are very few reports on non-motorized means of transport, but there have been publications on bicycles and tricycles. This is probably because some of these transport options have not become more widely used because of their limitations, since there is a limit to the distance that a rider can carry.

In the view of motorcycle ambulance efficiency in maternal referral, several studies have examined factors associated with use of motorcycle ambulance. For example, in Sierra Leone a study reported that motorbike ambulance is an acceptable and accessible transport of patients with obstetric cases to a health care facility in remote areas with poor roads inaccessible to motor vehicles (Bhopal *et al*., 2013). However, in Malawi, motorcycle ambulances have been tried in a few settings (Hussein *et al*., 2015). The study results revealed that the median referral delay in the centres using the motor-cycle ambulances was reduced by 2–4.5 h (35–76%). The purchase price of a motorcycle was 19 times cheaper than a car ambulance and annual operating costs 24 times cheaper. Currently, on land the motorcycle ambulance is the only way that large numbers of women can be moved at a relatively affordable cost from primary facilities to district hospitals.

In Malawi, ambulance use was associated with non-health related misuse and faster response time(2-4 times) faster in responding to emergency obstetric care than motor vehicle ambulances (*Hofman et al., 2008)*. In Cambodia, motor cycle Ambulance Referral Network were mainly used by the poor women to access emergency obstetric care *(Jacobs et al., 2016).* In Mbale district of Uganda, utilization of motorcycle ambulances among pregnant women was associated with older age of the mother, male involvement in the birth preparedness of a pregnant woman and consultations with traditional birth attendants *(Ssebunya & Matovu, 2016).* Another study in Uganda, showed that women on labour as well as those women with major direct obstetric complications in an area with no roads and inaccessible by 4WD motor vehicle ambulance were likely to use motor cycle ambulance *(Mohanty, 2013).* Taken together, motorcycle cannot serve as a replacement but as a back-up to motor vehicle ambulance.

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Previous studies of obstetric emergency transport in sub-Saharan Africa measured the effect of motor vehicle ambulance on maternal mortality. For example, the effect of introducing emergency obstetric motor vehicle ambulance transport across the Tigray region of Ethiopia reduced institutional maternal mortality rate (MMR) from 401 per 100 000 live-births to 266 per 100 000 (*Godefay, Kinsman, Admasu, & Byass, 2013).* In Free state province, South Africa, effective and prompt inter-facility ambulance referrals to appropriate emergency obstetric care (EmONC) facility resulted in significant decrease in maternal deaths from 279 per 100 000 live births to 152 per 100 000 live births and this was due to shorter response time and increased number of ambulance dispatches *(Schoon, 2013).* In Sierra Leone, investment in an efficient communication and ambulance referral vehicle system led to a 50% reduction in case fatalities *(Samai & Sengeh, 1997).* In Burundi, provision of and access to quality emergency obstetric care through a transport system averted 74% (range 55-99%) of maternal deaths *(Tayler-Smith et al., 2013).* A study in the Gambia found that there had been no maternal deaths for eight years in a group of small villages where resident midwifery services and immediate access to referral transport had been made freely available, when otherwise 16 maternal deaths might have been expected *(Lamb, Foord, Lamb, & Whitehead, 1984).*Taken together, ambulance inter-facility referral networks alleviate maternal deaths.

Studies in sub–Saharan countries have considered and evaluated the provision of ambulances to facilitate access to obstetric care even in emergencies. For example, a free ambulance transport to emergency EmONC facility was used to save lives of 46.9% patients diagnosed with major direct obstetric complications in Ethiopia (Tsegaye *et al*., 2016). In Uganda, a study reported that ambulance backed up by normal vehicle effectively saved lives of 12% of the 92 obstetric cases referred to an emergency obstetric care (*Somigliana et al., 2011).* In Burundi, a study demonstrated that it is possible to implement an effective communication and ambulance transport system linked to EmONC is associated with reduce response time thus improves coverage of complicated obstetric cases and caesarean sections was estimated to be 80% and 92%, respectively, *(Tayler-Smith et al., 2013).*

In Nigeria, for example, an emergency obstetric transport system transferred 29 women to higher levels of care over a period of two years, of which only one died (*Shehu et al., 1997).*

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In Uganda, there was a two fold increase in the rate of caesarean and hospital deliveries increased by 50% after introduction of a free-of-charge 24-hour ambulance and communication services *(Mucunguzi, Wamani, Lochoro, & Tylleskar, 2014*). Another study in Eastern cape, south Africa, reported that about 50%of women non-institutional (home) deliveries are associated with longer ambulance response time (*Susuman, 2015).* In Uganda, a study showed that trained traditional birth attendants are in need of ambulance with established communication system to facilitate prompt referral of complicated obstetric cases to facilities offering EmONC*(Chalo, Salihu, Nabukera, & Zirabamuzaale, 2005).*In Sierra Leone, investment in ambulance referral vehicle and an improved communication system led to a doubling of the utilization of emergency obstetric services (Samai & Sengeh, 1997). Taken together, ambulance inter-facility referral backed-up with basic and emergency obstetric care positively increases institutional deliveries

According to Global Burden of Disease Health Financing Collaborator Network report (*Dieleman et al., 2017),* health care policy change could lead to increased health spending but for the poorest countries external support might remain constant suggesting that limiting health care expenditure is not only a requirement of the government but for donors also. Therefore, cost evaluation of health care delivery services is important.

The cost-effectiveness analysis could be conducted by comparing the cost of providing health care service informing decision on effectiveness and efficiency of clinics. For example, a study in South Africa showed that the cost of providing Reproductive and Primary Health Care per patient was $46.09 and $76.03 in two separate mobile clinics, Thabo Mofutsanyana and Central Karoo clinics respectively, suggesting that population size influences cost of provision of health services *(Schnippel et al., 2015). In* India, an evaluation of cost of services in tsunami affected area of India showed that cost of public care was nearly one-eighth the price of private care and mobile clinics were reported at approximately half the cost of public care suggesting that mobile clinics were an accessible source of health care in disaster *(Rassekh, et al., 2014).*

A study in USA showed that costs per visit in mobile clinic providing primary care to rural veterans was twice as high as those of the fixed clinics *(Menke & Wray, 1999)* suggesting that mobile clinics may not be always a cost effective strategy. In North India, the cost of

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providing curative care was Rs. 107.74 per outpatient visit, 66.14 per immunization for immunization services and 388.78 per antenatal/postnatal care visit in a mobile clinic suggesting variation in the utilization of various primary health care services in mobile health clinics *(Prabhakaran, et al., 2014).* Taken together, information gained from cost effectiveness analysis can be used for management purposes hence optimizing both the use of resources and the quality of service provided at local health facility.

Cost-effectiveness analysis studies are extensively conducted with an aim of selection between alternative methods for the delivery of healthcare services by comparing the cost effectiveness between the alternative methods of delivery. For example, in the Kalahari desert of Botswana, comparative cost-effectiveness of the three types of clinics, a fixed clinic, a mobile vehicle, and an aircraft used for providing healthcare services showed that the cost of mobile clinics (air craft and motor vehicle) per-likely effective patient contact was much higher (8 to 14 times greater) than the fixed permanently staffed clinics and that vehicles were cheaper for more accessible areas, while for far distant visits the cost of vehicle was similar to aircraft cost *(Walker & Gish, 1977).* A study assessing the costs and effectiveness of mobile HIV voluntary counselling testing and wellness service delivery in Namibia showed that cost per person tested for HIV in mobile clinics reduced by 3.9% compared to static clinics (d*e Beer et al., 2015*). Cost effectiveness studies of family planning (FP) services in Egypt showed that mobile clinic program is able to offer additional family planning coverage that only costs $4.46 per CYP compared to static clinics *(Al-Attar et al, 2017*).In Kenya, the cost of HIV counselling and testing was $14.91 per client tested and $16.58 per previously untested client compared to $26.75 per client tested and $43.69 per previously untested for static clinics *(Grabbe et al., 2010*) demonstrating the superiority of mobile clinics in reaching the underserved community.

One of the important aspects of selecting a health intervention is to assess their relative health gain in monetary value against the amount of money invested on them. In Boston, a cost-benefit analysis of a mobile health clinic serving the medically disenfranchised people for 16 years showed that has that investing $ 1 on a mobile clinic will give $36 benefits in terms of the value of emergency visits avoided and life years saved *(Oriol et al., 2009).* In New Mexico a cost benefit analysis of mobile health clinic providing biometric and retinal

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screening showed that that investing $ 1 on a mobile clinic will give $15 benefits in terms of life years saved *(Brown-Connolly, et al., 2014).* In Massachusetts, USA, a cost benefit analysis showed that investing $1 on mobile clinic will give $ 3 benefits in lowering blood pressure and emergency department use *(Song et al., 2013).* In California, the return on investment on a mobile program for underserved children was $6.73 per dollar invested in terms of improved patient quality-adjusted life years saved and reduced costs attributed to preventable emergency department visits *(Morphew et al., 2013).* Taken together, mobile health clinics may be a cost-effective strategy to deliver medical care to underserved populations.

Mobile clinic may not be efficient in providing health care. For example, cross-sectional survey in New Delhi, India, found out that about 82% of the respondents were aware of the mobile health clinic of which 54.9% had ever utilized the services while more than two-thirds (70.5%) of patients preferred static private practitioners/private hospitals compared to mobile health clinic (12.9%) (*Patro, Kumar, Goswami, Nongkynrih, & Pandav, 2008).* In Indonesia, a study reported that 11.5% of children aged 1-5 years seeking primary health care in a mobile clinic care after tsunami tragedy compared to 88.5% for static health *facility (Rassekh et al., 2014).* In Egypt, the proportion of women seeking family planning services in a mobile health clinic reduced by 16.4% compared to static clinic (*Al-Attar et al., 2017).* Taken together, under-utilization of mobile health clinic services is due to lack of privacy provided, inconvenient timing of the mobile health clinic, long queues, unavailability of all drugs, and investigations and lack of continuity in care (Pe*ters, et al., 2014*).

In Kenya, although ambulance referral services are free in the Public Health Sector by policy (MOH, 2013), in most cases the ambulances are not available or are inaccessible to the mothers due to their scarcity and lack of a well-connected, reliable central dispatch system*(Broccoli et al., 2015; Wachira & Martin, 2011).* Most importantly, the few available ambulances function only as a taxi, as very few have either trained attendants or necessary equipment (*Wachira & Martin, 2011).* Since delay in accessing well-equipped ambulance transport to health facility is associated with increased non-institutional (home) delivery and higher risk of obstetric complications as well as maternal death (*Tayler-Smith et al., 2013),* it is possible that ambulance inter-facility referral in Kenya is failing to reduce the phase II and phase III delays in maternal health care as well as providing pre-hospital care while

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transporting patient to appropriate facility. However, there is no information on the effect of ambulance referral network on maternal health outcomes in Kenya. This study therefore, will determine the effect of ambulance referral on maternal health outcomes in Wajir County, Kenya.

2.3.5 Effect of Health Facility Conditions on Maternal Health Outcome

Quality of care is key in the decision to seek care. The two elements via which quality of care affects decision to seek care are satisfaction or dissatisfaction with the health care outcome including staff friendliness, availability of supplies and waiting times *(Kabali et al., 2011).* In Uganda, government health facility offers free health services and it was accessible by foot yet the pregnant women did not utilize maternal care because the facility was understaffed and underequipped and thus unable to provide quality care *(Wilunda et al., 2015).* Women have complained about inappropriate care, for example in Chiradzulu district of Malawi, women complained of waiting at the antenatal clinic when it was opened late *(Kumbani, Bjune, Chirwa, Malata, & Odland, 2013).* They also disliked poor staff attitude, including rudeness and shouting unnecessarily when they were being attended to at the antenatal clinic (Kumbani et al., 2013).Women report better quality of care in private health facilities, but cost deters them from using those private health facilities (*Kiguli et al., 2009; Rahmani & Brekke, 2013).*Many women report dissatisfaction with rude, arrogant and neglectful behaviour at health facilities and prefer the care of a traditional birth attendant (*Mason et al., 2015).*

For many women, giving birth is a dangerous endeavour (*Bhopal, 2013).* Barriers to access to healthcare for pregnant women in rural areas include poor road networks, meteorological conditions and terrain (e.g. footpaths which are only passable outside of the rainy season, and the need to carry women when streams cut off the road); support (family, community, and professional); dependence on others for decision-making; cultural issues (preference for traditional health workers, embarrassment and beliefs); cost, availability and speed of transport; lack of comfortable and safe positioning during transport, and distance from life-saving care (Rajé, 2018).

Insufficient medical and nursing personnel at a facility automatically lead to delays in patients' receiving the care they need. For example a cross sectional qualitative survey of

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health workers in Malawi revealed inadequacy nursing care and that one night nurse in maternity covering postnatal ward, nursery, labour ward, ante-natal ward, and theatre when there is a caesarean section (Bradley *et al*., 2015). Shortcomings in personal care at facilities are often coupled with shortcomings in hygiene and medical care. Women criticise dirty toilet facilities, lack of water and aseptic practices as well as lack of necessary drugs or too early Caesarean sections *(Jayanthi et al, 2015; Kiguli et al., 2009; Okonofua et al., 2017).* These factors will act as inhibitors of future health utilization hence affecting the decision to seek care and hence influence the maternal health outcome.

There is a general shortage of medical care institutions in the developing world. In addition, existing facilities are more often than not concentrated in and around urban areas *(Mazalale et al. 2015).*Urban residents are more likely to receive skilled antenatal and delivery care compared to rural residents (*Fawole & Adeoye, 2015)* indicating inequality and inequity in health care utilization and distribution, respectively (Phiri & Ataguba, 2014). For instance, a survey of private health facilities in Uganda revealed that compared to urban, only 47 (19.5 %) were in rural areas, and they more likely to be drug shops, unregistered, manned by untrained clinicians, and lacked zinc tablets (*Rutebemberwa et al., 2016).*It has been reported that deaths due to direct causes of maternal mortality were strongly related to distance, with mortality increasing from 111 per 100, 000 live births among women who lived within 5 km to 422 deaths per 100,000 live births among those who lived more than 35km from a hospital *(Hanson et al., 2015*). This is unsafe for the patients, because emergencies can occur in all wards at once. This shortage is often not only a matter of staff numbers; it is also a matter of competence. For instance, a cross sectional assessment of health facilities in Ghana revealed that 28% of doctors and midwives are incompetent in management of obstetric emergencies hence limiting provision of health care in certain health facilities *(Lohela et al., 2016).* Staff incompetence also leads to poor assessment of pregnant women resulting in poor maternal care. For example, as reviewed by *(Fyfe et al., 2014).*

A lack of equipment and supplies health facilities perpetuated by poor management and organization of the available resources plagues most regions of the developing world. Difficulty in obtaining blood for transfusion delays the provision of adequate care therefore driving maternal deaths *(Tort, Rozenberg, Traore, Fournier, & Dumont, 2015).* For example,

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as reviewed by (*Bates, et al.,=2008)* blood shortages were implicated in 16% of hospital maternal deaths in Tanzania, 28% in the Gambia, 71%% in Malawi, and 24% in Nigeria. Inadequate supplies of essential drugs and equipment such as antibiotics and ergometrine, contribute to phase 3 delays. Such shortages occur at all levels of the health system *(Ameh et al., 2012).*

A retrospective review of hospital records at Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER) in India revealed that the 106 maternal deaths among 73,935 live births were due to lack of facilities to perform a caesarean section, no cardiotocography, facilities for blood transfusion and most of these deaths would have been prevented (Dasari, 2015). In the Gambia, a pregnant woman was referred to an emergency obstetric care referral facility one day late after decision to seek higher care was made by a nurse using a vehicle from the department of Agriculture because the only one ambulance for these health centre was not functioning due to engine failure (*Cham et al, 2005*).

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CHAPTER THREE
METHODOLOGY

3.0 Introduction

Research methodology is a systematic way to solve a problem. According to *Goundar (2012),* it is a science of studying how rresearch is to be carried out. Essentially, the research methodology entails the procedures by which the researcher used in describing, explaining and predicting the dependent variable under study. In addition, various steps that were generally adopted in studying the research problem along with the logic behind them were considered.

The section describes the methods that were applied to investigate the research problem and the rationale for application including the specific procedures used to identify, select, process and analyse data to aid in understanding the problem of the study and the critical evaluation of the study's overall validity and reliability. In particular, the section outlines research philosophy, study design, target population, sampling and sampling technique, data collection instruments, data collection procedure, piloting of data instruments, data analysis, logical and ethical considerations to be applies in the study.

3.1 Research philosophy

Research philosophy is the belief in the way data should be gathered (*Lehaney & Vinten, 1994).* Research question is the determinant of research philosophy. Research philosophy assumes four paradigms: pragmatism, positivism, and realism or *(Saunders et al., 2009).* Positivism and realism are the two extreme and mutually exclusive paradigms about the nature and sources of knowledge (Saunders *et al.*, 2009). With positivism the observer is independent, facts are gained through observation, to understand phenomena reality must be measured and supported by evidence explanation demonstrates causality, progresses through hypothesis, concepts are operationalized, sample required is large but requires random selection. Interpretivism the observer is part of the observed, reality is accessed through language, shared meaning, consciousness, allows to research things that can't be observed-thoughts, values, feelings, views and perspectives *(Ramanathan, 2009).*

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Drawing from their different characteristics, the current study on the influence of ambulance intervention on maternal health outcome adopted realism view. Realism, also known as post – positivism, emphasizes objectivity and assumes that reality is imperfect, and that human intelligence is flawed, and situations may not be easily manipulated (Lee, 2006). The methodology was used to assess process – oriented and is more concerned with underlying causal tendencies. In addition, the methodology was found appropriate due to the need for large quantitative data that was expected to satisfy the stated study objectives. Moreover, the methodology was equally appropriate for the current study since it allowed situational information to be collected from their natural settings in the maternal health records at the emergency referral unit and the health facilities (Eldas, Tarbaj, Wajir East, Wajir North, Wajir South, and Wajir West) in the county of Wajir, with an objective of analysing the effect of ambulance intervention in maternal health outcome for the study period of 2016 to 2019 in Wajir Kenya.

3.2 Study Design

A study design shows how the investigation was undertaken and solved (*Orodho & Kombo, 2003).* In order to achieve the set objectives, the study adopted a retrospective analytical multiple cross sectional design adopting both quantitative and qualitative techniques to demonstrate the effect of Ambulance Referral Network on maternal health outcome from July 2016 to June 2019 in Wajir County. In a retrospective study, in contrast to a prospective study, the outcome of interest has already occurred at the time the study is initiated *(Salkind, 2010).* The study design allowed the researcher to formulate hypotheses about possible associations between ambulance referral network interventions and maternal health outcomes. This study design was appropriate since it allowed the researcher to use administrative databases existing from medical records, or interviews with health managers at the referral facility (Eldas, Tarbaj, Wajir East, Wajir North, Wajir South, and Wajir West.). The study reviewed maternal health records from referral hospitals in Wajir for four years starting 2016 to 2019. All records for the mothers who were referred and used ambulance services during the period 2016 to 2019 were targeted for review in Wajir County.

3.3 Target Population

Several authors have defined study population differently. Whereas *Orodho & Kombo (2003)* define population as a group of individuals, objects or items from which samples are drawn

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for measurement, Kothari (2010) however, views it as the researcher's 'universe'. For a specific study, Kothari (2010) describes population as a collection of all elements under consideration, from which a researcher intends to make inferences. Going by these divers' definitions, the target population for this study.

Table 3.1: Hospital deliveries in Wajir County during the June 2016 to July, 2019

Sub-county	**Year**				
Health Facility	**2016**	**2017**	**2018**	**2019**	**Total**
Eldas	5	3	2	2	12
Tarbaj	0	5	4	6	15
Wajir East	140	114	182	103	540
Wajir North	5	3	9	5	22
Wajir South	6	8	3	2	19
Wajir West	1	6	9	0	15
Total	**157**	**139**	**209**	**118**	**623**

3.4 Sample and Sampling Techniques

A sample is a collection of units chosen from the population to represent it (*Orodho & Kombo (2003).* All the women who delivered between July 2016 and June 2019 in Wajir County and used public ambulances during delivery were studied. The records of these women were available to the research assistant in each health facility. A total of six hundred twenty-three (623) pregnant women records were used to provide data for this study. The women records were picked from all the six sub-counties in Wajir County. The hospital deliveries for these records were distributed across the facilities (Eldas, Tarbaj, Wajir East, Wajir North, Wajir South, and Wajir West) and year (2016-2019) as reflected in Table 3. 1. For the study, the unit of analysis were women of Reproductive age (WRA) referred and delivered in Wajir County between July 2016 and June 2019, while unit of observation were maternal health records and the facilities.

3.5 Inclusion and Exclusion Criteria

Based on the study objectives, the study reviewed, Records of pregnant women referred for delivery in the County from July 2016 to June 2019, who used public ambulances and were within the reproductive age were included in the study. Records of women who were not

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within the reproductive age (15-49) years, and those who received service and did not use ambulances referral services were excluded in the study.

3.6 Data Collection Method and Instruments

Nine quantitative data collection checklists were developed. It focused on checking the values of the indicators to measure the effect of the independent variables (demographic characteristics, total ambulance cost, efficient use of ambulance and organizational determinants) on the dependent variable (maternal health outcomes) in Wajir County, Kenya. The check list covered all the variables on the specific objectives using simple, clear and precise language that was understandable to research assistants.

A qualitative notebook with details for coding with measurements for the variables was kept for easy identification. This method implies the collection of information by way of investigator's own observation, without interviewing the respondents. The information obtained relates to what is currently happening and is not complicated by either the past behavior or future intentions or attitudes of respondents(*Kothari, 2008*). Moreover, Frels, Bipin and Anthony (2011) intone that a qualitative note book represents a series of assessments which a researcher uses to collect, to analyse, and to interpret data, and ultimately use the information so collected to write up formally the findings and interpretations. For instance, maternal health outcomes answers were coded as 1 to 6 as outlined in Table 3.2. The research team numbered, checked for completeness and accuracy at the end of extracting data for each delivery in the records provided. Data was then converted into numerical codes representing measurement of the variables. From the check list record, data was captured in to excel and exported in R Software and Gretel software for storing and analysis.

3.7 Data Collection Procedure

Research team consisting of six health workers; employees of health facilities within the six Sub-Counties of Wajir underwent training to understand and familiarize themselves with the data extraction check list and the documents required from the hospital to provide information for this study. This was done to ensure that every item in the questionnaire was well understood to boost their confidence when extracting data from the available document in their respective health facility.

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3.8 Data Analysis and Presentation

Data analysis relates to how gathered data is managed to achieve the objective of the research study. According to Kombo and Tromp (2007), data analysis involves scrutinizing the acquired information and making inferences. This study collected secondary data. Data relating to the independent and dependent variables was extracted from nine check list documents for the period July 2016 to June 2019 in Wajir County. Upon data collection, the data was cleaned for completeness. Here, any given variable had a specified set of answer choices and codes to match each answer choice. For example, the variable education had three answer choices and codes for each: 1 for primary, 2 for secondary and 3 for tertiary level of education. The collected data was processed and analyzed using IBM's SPSS version 23 and, while Microsoft Excel 2010 was used to generate various means to facilitate generation of statistics inferentially.

The study collected both quantitative and quantitative data Descriptive data was analysed using frequency, mean and percentages were used to summarize the indicators for independent variables. The effect of ambulances referral network intervention on maternal health outcomes was analysed using multinomial regression and chi – square tests at 95% confidence level of interval. Multinomial regression analysis was used to determine the effect between the independent (demographic characteristics) and dependent (maternal health outcomes) variables. Chi-square was used to test the significance of the effect between the independent and dependent variables and the results were presented in tables and graphs.

3.9 Ethical Consideration

Ethical Review Committee (ERC) is a research member committee established by Universities to approve research proposals. The research proposal for this study was submitted to Great Lakes University of Kisumu (GLUK) ERC, which then requested Masinde Muliro University of Science and Technology (MUST) ERC to reviewed and clear the research. Permit from NACOSTI was then sought. The MOH Kenya through the Wajir County department of health cleared and approved the study. Health facility managers were required be given informed consent at the beginning of data extraction process. The Managers Consent Form (Appendix 2) was used to explain the purpose and objectives of the study to

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managers, this was then required to be signed on voluntary basis. Confidentiality, privacy and dignity were assured. Participation was voluntary without coursing or enticement.

A team of research assistants in the hospitals with the facility manager were used to compile the data from the health facilities in Wajir County. The records were under custody of the facility manager and incase of any clarification, the research assistant would enquire from manager. The research assistant captured data based on the checklist provided to enable picking information relevant to this study. This exercise was conducted in November and December, 2019. Six research assistants (Health workers within the facility) were used to extract data from records provided by the facility manager. The six were distributed in all the six sub-county hospitals (Eldas, Tarbaj, Wajir East, Wajir North, Wajir South, and Wajir West) of Wajir County. The research assistant had a training of one day to understand the check lists required and how to capture relevant data for this study. They were also trained on the key variables of this study and how to extract data from the available records.

This study specifically looked at maternal health outcomes, demographic characteristics of the Mothers who had delivered, maternal clinical condition at referral, total cost of using ambulance services, and efficiency of using ambulance services. Potential confounders anticipated was variation caused by difference in level of education and skills for Ambulance referral network employees. The study assumed that ambulance was available and there was established referral coordinating units within the County.

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Table 3.2: Data Analysis Framework by objectives

Objective	Hypothesis	Independent Variable	Dependent Variable	Statistical tools
To establish the effect demographic characteristics on maternal health outcomes	H_{01}: Demographic characteristics have no significant effect on maternal health outcomes	1.Age of the mother 2.Total distance covered to pick mother (Location) 3. Referred by. Gestation age 4.ANC number indicated 5.Parity	**Maternal health outcome:** 1. Mothers and infant dead (1) 2. Mother alive, Infant dead (2) 3. Mothers Dead, Infant alive (3) 4. Mother and Infant alive (4) 5. Mother and infant tweens alive (5) 6. Mother and Infant tweens dead (6)	1. Frequency 2. Mean 3. Percentages 4. Chi-square 5. Multinomial Regression 6. Tables 7. Graphs
To determine the clinical conditions of the maternal ambulance referrals in Wajir County, Kenya.	H02: There is no association between maternal clinical conditions and the maternal ambulance referrals in Wajir County, Kenya.	**Clinical conditions** 1. Prolonged Labour 2. Obstructed Labour 3. Postpartum Haemorrhage 4. Pre-eclampsia	**Maternal health outcome:** **1.M**others and infant dead (1) 2.Mother alive, Infant dead (2) 3. Mothers Dead, Infant alive (3) 4. Mother and Infant alive (4) 5.Mother and infant tweens alive (5) 6.Mother and Infant tweens dead (6	1. Frequency 2. Mean 3. Percentages 4. Chi-square 5. Multinomial Regression 6. Tables 7. Graphs

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Objective	Hypothesis	Independent Variable	Dependent Variable	Statistical tools
To investigate the effect ambulance costs on maternal health outcomes	H_{03}: Total ambulance costs have no significant effect on maternal health outcome	1. Fuel cost 2. Insurance 3. Vehicle Maintenance Cost 4. Equipment, drugs & Stationaries 5. Gross salary . 6. Referral allowances 7. Communication costs	**Maternal health outcome:** 1. Mothers and infant dead (1) 2. Mother alive, Infant dead (2) 3. Mothers Dead, Infant alive (3) 4. Mother and Infant alive (4) 5. Mother and infant tweens alive(5) 6. Mother and Infant tweens dead(6)	1. Frequency 2. Mean 3. Percentages 4. Chi-square 5. Multinomial Regression 6. Tables 7. Graphs
To investigate the effect of ambulance usage on maternal health outcomes	**H_{04}:** Efficient use of ambulance have no significant effect on maternal health outcome	1. Number of maternal referral	**Maternal health outcome:** 1. Mothers and infant dead (1) 2. Mother alive, Infant dead (2) 3. Mothers Dead, Infant alive (3) 4. Mother and Infant alive (4) 5. Mother and infant tweens alive (5) 6. Mother and Infant tweens dead (6)	1.Frequency 2.Mean 3.Percentages 4.Chi-square 5.Multinomial Regression 6Tables 7.Graph.s

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Objective	Hypothesis	Independent Variable	Dependent Variable	Statistical tools
To determine the effect of ambulance referral on maternal and infant live years	H_{05}: ambulance referral has no significant effect on maternal and infant live years	1. Maternal and infant live years saved 2. Cost of live years saved 3. Dedicated functional delivery facilities	**Maternal health outcome:** 1. Mothers and infant dead (1) 2. Mother alive, Infant dead (2) 3. Mothers Dead, Infant alive (3) 4. Mother and Infant alive (4) 5. Mother and infant tweens alive (5) 6. Mother and Infant tweens dead (6)	1.Frequency 2.Mean 3.Percentages 4.Chi-square 5. Multinomial Regression 6.Tables 7.Graphs

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CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.0 Introduction

This chapter presents the results of the study and interpretation of analysed results. The analysis was conducted based on the sections of the variable used to collect data. Further analysis for descriptive and inferential statistics was based on the objectives. This chapter was guided based on detailed analysis and presented under the following subsections: Demographic characteristics, maternal clinical condition, cost of ambulance; ambulance usage and health facility condition in Wajir County. Multiple linear regression analysis was performed and the results were presented using bar-charts, frequency and percentage tables. This chapter also presents the results of the study and interpretation of analysed results. The analysis was conducted based on the sections of the variable used to collect data. Further analysis for descriptive and inferential statistics was based on the objectives and the hypotheses testing are also presented in this chapter.

4.1 Diagnostic Tests

To test the hypothesis and determine the type of inferential statistics to be used for hypothesis and testing the influence of demographic characteristics, maternal clinical condition, ambulance cost, efficiency and organizational determinants on maternal health outcomes, a number of tests were conducted. Majorly, normality test was conducted to decide if we use parametric or non-parametric tests to perform inferential statistics. Since the influence of explanatory variables were to be established based on the dependent variable, them multinomial regression was used and correlation analysis. Thus, collinearity and multicollinearity were also required to be tested. The data used was secondary and hence reliability and validity of the study tool was not to be conducted to prepare the collection of data. These tests were conducted and the interpretation was stated as shown in the subsections.

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4.1.1 Normality Test

The targeted respondents from the records were greater than 30 and hence the study assumed use of large sample size during analysis. Thus, normality was tested by Shapiro-Wilk test. The normality for each variable to eliminate biasness during inclusion of respondents in the targeted response was carried out and the results were displayed as shown in the Table 4.1.

Table 4.1: Normality Test of Variables

Variable	Shapiro-Wilk	P-value
Demographic characteristics	0.954753	0.6680
Maternal Clinical conditions	0.77837	0.7958
Cost of ambulance	0.93484	0.5760
Ambulance usage	0.802075	0.87290
Health facility condition	0.858591	0.6714
Maternal health outcomes	0.8369	0.5412

From Table 4.1, above based on the Shapiro-Wilk tests, the significance value for all the variables used to measure the effects between maternal health outcomes and ambulance referral network intervention in Wajir County, Kenya was not significant since p-value > 0.05 for Shapiro-Wilk tests. This indicates probability values greater than 0.05 for inclusion of respondent in the sample size to enhance objectivity of data collection and hence this means the data collected on this variable is normal. Thus, the indicators that measured demographic characteristics, maternal clinical condition. Ambulance cost, ambulance response rate, ambulance staff experience and maternal health outcomes were normally distributed, and therefore parametric tests can be used on the data.

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4.1.2 Multicollinearity

These tests were performed to ascertain the linearity of variables. Variance Inflation Factors (VIF) was used to interpreted results. The results were presented in Table 4.1.2.

Table 4.2: Multicollinearity test

Variable	Variance Inflation Factors (VIF)
Demographic characteristics	1.389
Maternal Clinical conditions	1.784
Cost of ambulance referral	2.041
Ambulance response rate	1.563
Ambulance staff experience	1.112
Maternal health outcomes	2.452

From Table 4.1.2, the indicators of the explanatory variable had all had a VIF<10 which indicates that there was no problem of multicollinearity among the variables in the data set. Also, the VIF of maternal health outcome was <3 which indicates that there is no problem of multicollinearity. Thus, the use of multinomial regression analysis will yield independent coefficients to measure the maternal health outcomes based on demographic characteristics, Maternal clinical condition cost of ambulance, ambulance response rate and ambulance staff experience.

4.2 Demographic characteristics of the antenatal mother

The demographic Characteristics of the mothers was analysed in terms of their ages, period of deliveries (both past and current), and their education background. Results are as presented in the subsequent sections.

From Table 4.2.1 below, the result shows that the Mean ± SD age of the respondents was 25.86±6.64 supported by the categorized age groups which shows the majority of the respondents fall between the ages of 20-24, that is 171 (27.45%) of the total respondents followed by ages 25-29, 142 (22.79%); 30-34, 113 (18.14%); 15-19, 112 (17.98%); 35-39, 57 (9.15%) and the largest age group 28 (4.49%). 116 (27.68%) had previously had 2-3 deliveries; 107 (25.54%) had 4-5 deliveries; 73 (17.42%) had 1 delivery; 72 (17.18%) had 6-7

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deliveries; 35 (8.35%) had 8-9 deliveries; 9 (2.15%) had 0 deliveries; 7 (1.67%) had >=10 deliveries.

Table 4.3 Demographic Characteristics of the mothers

Characteristics (n=623)	n (%)
Age category	
15-19	112 (17.98)
20-24	171 (27.45)
25-29	142 (22.79)
30-34	113 (18.14)
35-39	57 (9.15)
40-45	28 (4.49)
Mean Age (Mean±SD)	25.86±6.64
No. of previous deliveries	
0	9 (2.15)
1	73 (17.42)
2-3	116 (27.68)
4-5	107 (25.54)
6-7	72 (17.18)
8-9	35 (8.35)
>=10	7 (1.67)
Missing	210 (33.1)
Level of education	
Primary	580 (93.1)
Secondary	1 (6.7)
Missing	42 (0.2)

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4.2.2 Education of the mothers.

Education level of the mothers whose records were involved in this study was also collected and the results were processed and presented in the Table 4.4

Table 4.4 Education of the mothers

Level	Frequency	Percentage
Primary	389	62.62
Secondary	26	4.15
Tertiary College	204	32.59
Tertiary University	1	0.16
Not Indicated	3	0.48
Total	**623**	**100**

From Table 4.4 on education level, majority of the mothers had completed primary school and these was about 62.62% of the records for the participants. About 32.59% of the participants had tertiary college level of education. This was followed by 4.15% of the participants had completed secondary schools. Only 0.16% had tertiary university level of education and 0.48% of the participants did not indicate their level of education which was missing in their records when data was being collected.

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4.2.3 Gestation Period in Weeks

The records indicate the gestation period in weeks when the mother used public ambulance to be referred to a special hospital within the county. The results were processed and displayed in Table 4.5

Table 4.5 Pregnancy Gestation in weeks

Weeks	Frequency	Percentage (%)
20	1	0.16
22	1	0.16
24	1	0.16
26	3	0.48
27	2	0.32
28	11	1.76
29	2	0.32
30	1	0.16
31	3	0.48
32	11	1.76
33	4	0.64
34	15	2.40
35	10	1.60
36	105	16.77
37	26	4.15
38	323	52.88
39	77	12.30
40	15	2.40
41	1	0.16
42	2	0.32
Not Indicated	4	0.64
Total	**623**	**100**

From Table 4.5, Majority of the mothers who used the Ambulance Referral Network had gestation age of 38 weeks, these accounted for 52.88%. 39 weeks gestation was about 12.3% and the rest were less than 10%. Only 0.64% of the mothers did not indicate their gestation period.

4.2.4 Parity of mothers

This is number of previous births of children by the mother. It includes both children who are dead and alive and have been born by the mother. The results were processed and displayed in Table 4.6

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Table 4.6: Mothers Parity

Parity	Frequency	Percentage
0	9	1.44
1	110	18.85
2	87	13.90
3	68	10.86
4	72	11.50
5	99	15.81
6	62	9.90
7	53	8.47
8	27	4.31
9	19	3.04
10	4	0.64
11	5	0.80
Not Indicated	3	0.48
Total	**623**	**100%**

From Table 4.6, Majority of the mothers had previously given birth to one child which accounted for 18.85% of the records for the mothers that were referred to deliver within the county from 2016 to 2019. Those who had given birth to two children accounted for 13.90%, those with five children were 15.81%. Those with three and four children accounted to 10.86% and 11.5% respectively. The rest, less than 10%, had more than 5 children with only 1.44% who had never given birth previously and 0.48% did not indicate their previous number of births. About 0.80% had previously given birth to eleven children.

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4.3 Cost of ambulance on maternal health outcome

Table 4.7: Cost of ambulance

Expense	Cost per referral ($)
Cost of fuel	39.34
Referral allowances	14.04
Communication costs	0.17
Vehicle cost	1,406.64
Vehicle maintenance cost	82.65
Insurance costs	70.33
Gross salary crew members	259.11
Equipment and stationaries	4.48
Total ambulance cost	1,876.76

As illustrated in the Table 4.7 above, the average total cost per referral was $1,876.76 broken down into the cost of fuel $39.34, referral allowances $14.05, communication costs $0.17, vehicle cost $1,406.64, vehicle maintenance cost $82.65, insurance cost $70.33, gross salary for the crew members $259.11 and equipment and stationaries $4.48.

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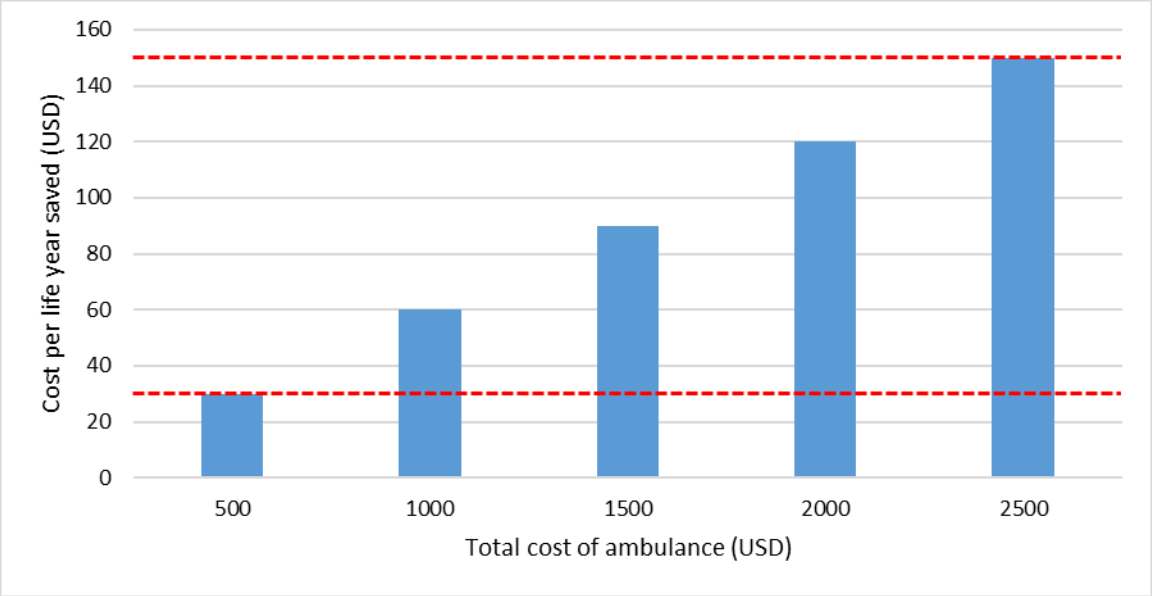

Figure 4.1 Total cost of ambulance referral

In addition, the sensitivity analysis as illustrated in figure 4.1. The two broken lines indicate the attractiveness cut-offs with <150 USD (attractive) and <30 USD (very attractive).

The total ambulance cost of $2,500 is reached with the attractive upper ceiling of $150 while the very attractive lower cut-off of $30 is reached with the total cost of $500.

Table 4.8 Cost of ambulance referral and lives years saved by referral per sub county in Ksh

Wajir County	Total maternal ambulance referral cost (Kshs.)	Total maternal ambulance referral cost (USD)	Total maternal and infant life saved in years	Total cost per life saved (Ksh.)	Total cost per life saved (USD.)
Eldas sub county	15,351,895.33	143,475.66	4843.40115	3169.652	29.62291
Tarbaj sub county	14,352,844.88	134,138.74	6282.86015	2284.444	21.34995
Wajir Eas sub county	19,104,138.30	178,543.35	7066.9151	2703.321	25.26468
Wajir North sub county	8,947,515.41	83,621.64	2892.83645	3092.99	28.90645
Wajir South sub county	20,724,580.83	193,687.67	7778.1991	2664.445	24.90135

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Wajir West subcounty	38,441,650.42	359,267.76	11912.47085	3227.009	30.15896
Total	**116,922,625.17**	**1,092,734.81**	**40,776.6828**	**17,142**	**26.7**

As reflected in Table 4.8, the total cost of the ambulance referral for Wajir County during the study period was Ksh. 116,922,625.17. (1,092,734.81 USD) the total life years saved was estimated at 4,0776.6828 years. The average cost per year life saved was 26.7 thus less than between less than 30 US dollars which is below the three benchmarks of (550, 150 and 30 US dollars) and fulfils the criterion to be defined as very cost effective and attractive ambulance referral services and therefore worth the investment.The cost of ambulance was also summarized as shown in the table 4.9 based on the years saved

Table 4.9: Life Years saved

	Numbers (n)	**Total Life Years Saved**	**Discounted 3% Total Life Years saved**	**Discounted 3% Total Cost Life Years Saved (US$)**
Mothers	618	24,850.01	16,525.26	45,578.53
Infants	552	36,468.31	24,251.43	22,651.63
Total	1170	61,318.32	40,776.69	68,230.16

4.4 Maternal Clinical Condition at referrals and maternal health outcome in Wajir County

The table of maternal clinical conditions at referrals and maternal health outcomes in Wajir County was displayed as I n table below

Table 4.10 : Maternal Clinical Conditions at referral

Conditions	**n (%)**
Prolonged labor	237 (38.3)
Obstructed labor, no caesarean section	43 (6.9)
Postpartum hemorrhage, foetal distress	38 (6.1)
Foetal distress	36 (5.8)
Preeclampsia, fetus dead	32 (5.2)
Antepartum mild vaginal bleeding, no emergency treatments	29 (4.7)
PPH, non-severe bleeding	25 (4.0)
Obstructed labor, immediate caesarean section	23 (3.7)
Severe malaria	21 (3.4)
Previous caesarean section in labor	19 (3.1)

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Mal presentation/Transverse lie, fetus dead	17 (2.7)
Twin delivery	14 (2.3)
Eclampsia, foetus dead	11 (1.8)
Mal-presentation/Transverse lie, fetus alive	11 (1.8)
Premature rupture of membranes, fetus dead	10 (1.6)
Retained placenta, manual removal, non-severe bleeding	9 (1.5)
Obstructive labor, SVD, baby alive	8 (1.3)
SVD, baby dead	8 (1.3)
Premature rupture of membranes, fetus alive	7 (1.1)
Peuperal sepsis	6 (1.0)
Incomplete abortion	4 (0.6)
Obstructive labor, delayed CS, baby alive	3 (0.5)
Urinary tract infection in pregnancy	3 (0.5)
Labour in women with previous VVF repair (CS)	2 (0.3)
Cervical tear	2 (0.3)
Maternal death due to DIC of unknown origin	1 (0.2)
Missing	4 (0.6)

Table 4.10 above indicates that most of the referrals were as a result of prolonged labour 237 (38.3%) followed by Obstructed labor 43 (6.9%), caesarean section 43 (6.9%), Postpartum hemorrhage 6.1% (38), foetal distress 36 (5.8%), Pre-eclampsia, fetus dead 32 (5.2%), Antepartum mild vaginal bleeding, no emergency treatments 29 (47%), PPH, non-severe bleeding 25 (4%), Obstructed labor, immediate caesarean section 23 (3.7%), Severe malaria 21 (3.4%), Previous caesarean section in labor 19 (3.1%), Mal presentation/Transverse lie, fetus dead 17 (2.7%), Twin delivery 14 (2.3%), Eclampsia, foetus dead 11 (1.8%), Mal-presentation/Transverse lie, fetus alive 11 (1.8%) and Premature rupture of membranes, fetus dead 10 (1.6%). However, there were few cases of retained placenta, manual removal, non-severe bleeding 9 (1.5%); Obstructive labor, SVD, baby alive 8 (1.3%); SVD, baby dead 8 (1.3%); Premature rupture of membranes, fetus alive 7 (1.1%); Peuperal sepsis 6 (1%); Obstructive labor, delayed CS, baby alive and urinary tract infection in pregnancy all at 3 (0.5%); labor in women with previous VVF repair (CS) and cervical tear 2 (0.3%); maternal death due to DIC of unknown origin 1 (0.2%).

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4.5: Effect of ambulance usage on maternal health outcome

The study sought to assess the effect of Ambulance referral network usage on maternal outcome. The dependent of variable of for the study was maternal outcome in Wajir county. The descriptive analyses for the variable is as shown in table 4.5.1, 532 (85.39%) of the outcome of the cases were successful i.e. both mother and the baby were alive for single birth; 82 (13.16%) of the mothers made it alive with the infants dead; 3 (0.48%) cases of only mothers dying were recorded. 6 cases of twin births were recorded with 4 (0.64%), Mother alive, twin infants alive and Mother alive one infant alive 2 (0.32%). Cumulatively, a total of the referred cases was successful 536 (86.03%) and 87 (13.96%) Not successful.

Table 4.11 Maternal health outcomes

Maternal outcome (n=623)	**n (%)**
Successful outcome	
Both alive	532 (85.39)
Mother alive twin infants alive	4 (0.64)
Total	**536 (86.03)**
Not successful outcome	
Infant alive (mother dead)	3 (0.48)
Mother alive (infant dead)	82 (13.16)
Mother alive one infant alive	2 (0.32)
Total	**87 (13.96)**

From table 4.12, the cumulatively a total of 618 mothers and 552 infants' lives were saved by the use of ambulance maternal referrals between July 2016 and June 2019 as indicated in the table 4.12 a bove . Total life years saved was about 40,776.6828; Costs per life in years saved at 3% discounted was $26.7.

4.5.2: **Ambulance Usage distribution per year**

The study analysed the ambulance usage of the mothers by years, by age, by gestation period as well as by parity. The results are as presented in the table below..

The participants whose records were used in this study were women within Wajir County who had delivered and used public ambulance to be referred in different hospitals within the County. These were distributed as shown in the figure Table 4.5

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Table 4.13: Ambulance referral usage by Year

Year	Frequency	Percentage
2016	62	10%
2017	168	27%
2018	255	41%
2019	133	22%
Total	**623**	**100%**

From Table 4.13, Majority, about (41%.) of the participants whose records were reviewed used the ambulance referral service in 2018. In the year 2017, 27% used ambulance while in 2019, 23 %, and 2016 had the least with about 10%. These records reviewed were used to carry out the analytical review of the association between maternal health outcomes and ambulance referral network intervention in Wajir County, Kenya.

4.5,3 Ambulance Usage by Reproductive Age

In addition, the age of mothers seeking ambulance age was equally analysed. The reproductive age of the antenatal mothers during the time they were seeking for the Ambulance Referral Network within Wajir County between 2016 and 2019.The results were displayed in the frequency Table 4.14 below

Table 4..14 : Ambulance by Reproductive age

Age	Frequency	Percentage
15-19	112	18%
20-24	171	27%
25-29	140	23%
30-34	113	18%
35-39	57	9%
40-44	25	4%
45-49	5	1%
Total	**623**	**100%**

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From Table 4.13, majority (27%) of the records used were for women between the ages of 20-24 years old. About 23% were between 25-29 years of age, 18% were between 15-19 years. This was followed by 9% of age between 35-39 years old, while 4% who were of age between 40-44 years and lastly 1% of were between 45-49 years of age.

4.5.4 Ambulance usage and maternal Outcomes per sub county

Pregnancy outcomes were captured for each sub County in wajir and is distributed as shown in Table 4.14

Sub county Ambulance Station	Pregnancy outcome per referral					outcomes
	2	3	4	5	6	
Eldas	10	0	**65**	0	0	75(11.6%
Tarbaj	10	1	**80**	2	0	93(15%)
Wajir East	5	0	**96**	1	0	102(16.3%)
Wajir North	3	0	**40**	0	0	43(6.9%)
Wajir South	12	1	**103**	1	1	118(19%)
Wajir West	33	1	**157**	0	1	192(30.8%
Total	73	3	**541**	4	2	623(100%)

From table 4.14**,**Wajir West sub county had the highest maternal ambulance referrals and highest successful pregnancy outcomes of 192(30%) and 152 of both mother and infant alive, this was followed with Wajir South sub county which had 118(19%) ambulance referral and 103 mothers and alive respectively, Wajir East sub county had with 102(16.2%) referral and 96 mothers and babies being saved, Tarbaj sub county had 93(15%) referral and a pregnancy success rate of 80 followed by Eldas sub county with 75(11. 6%) referral of which 60 were successful and lastly Wajir North had 43(6.3%) referrals with 40 mother having had a successful pregnancy outcome

4.6 Inferential Analysis

Based on normality test, parametric test were employed to process data as inferential statistics. The data was found to be normal and also the data was quantitative in nature hence it can be subjected into further statistical test which include the correlation and regression analysis. The following sections presents the correlation analsis of the data guided by the study objectives. Multinomial regression analysis was carried out to determine the inflence of

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explanatory variables on dependent variables. The objectives of this study were to determine the effect of demographic characteristics on maternal health outcomes in Wajir County; to assess the influence of cost of ambulance on maternal health outcomes in Wajir County; to analyze the effect of use of ambulance on maternal health outcomes in Wajir County and to explore the effect of health facility condition on maternal health outcomes in Wajir County.

4.6.1 Correlation Analysis

The objectives of this study were to determine the effect of demographic characteristics on maternal health outcomes; to assess the influence of cost of ambulance on maternal health outcomes; to analyze the effect of use of ambulance on maternal health outcomes, to explore the effect of health facility condition on maternal health outcomes in, and to determine the clinical conditions of maternal ambulance referrals on maternal health in Wajir County, Kenya. The study used Pearson correlation coefficient in order to establish the relationship between the study variables guided by the study objectives.

4.6.2 Correlation of Demographich Characteristics and Maternal Health Outcomes

Association between demographich characteristics and maternal health outcomes was established using of Pearson product moment correlation. The correlation analysis was done using the mean scores of measures of demographic characteristics and results are presented in Tables 4.15 below.

Table 4.15.: Correlation between Demographich Characteristics and Maternal Health Outcomes

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Maternal oealth outcomes	1							
2. Total distance covered per referral	.649*	1						
3. Mothers age	.732*	.239*	1					
4. Referred by	.221*	.482**	.421*	1				
5. Level of education	.335*	.049*	.128*	.243*	1			
6. Number of previous deliveries	.312*	.213*	.201*	.580**	.439*	1		
7. ANC number indicated	.127*	.251*	.287*	.436**	.522*	.463*	1	
8. Gestation age	.862*	.231*	.437*	.214*	.247*	.236*	.258*	1

*. Correlation is significant at the 0.05 level (2-tailed).

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**. Correlation is significant at the 0.01 level (2-tailed).

The study results indicated that the highest statistically important positive association was reported between the maternal health outcomes and gestation age ($r = .862$, $p < .05$). This has the implication that the gestation age and maternal health outcomes have a strong positive linear relationship such that as gestation age increases, the maternal health. This depends on how the coding was done in spss. If you started with worse outcomes moving to better outcomes, then as the gestation age increases, maternal health outcomes become better or they become worse you started from better to worse outcomes in the spss coding) relations. The second highest association was reported by the mothers age and maternal health outcomes ($r = .732$, $p < .05$) and was followed by the Total distance covered per referral and maternal health outcomes ($r = .649$, $p<.05$). The lowest association was reported between the ANC number indicated and maternal health outcomes ($r = .127$, $p < .05$). It is important to note that all the demographic characteristics indicators had positive and significant association with maternal health outcomes in Wajir County. The association between the demographic characteristics indicators was found to positive and statistically significant.

4.6.3 Correlation of Ambulance Cost and Maternal Health Outcomes

The association between ambulance cost and maternal health outcomes was determined using Pearson product moment correlation. Correlation analysis was conducted using mean scores of variables between the measures of ambulance cost and maternal health outcomes and the results presented in below Tables 4.16.

Table 4.16 Correlations between Ambulance Cost and Maternal Health Outcomes

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Maternal health outcomes	1								
2. Cost of fuel per referral	.843*	1							
3. Referral allowances	.538**	.549*	1						
4. Communication costs per	.542**	.481**	.546*	1					
5. Vehicle cost	.635*	.549*	.228*	.347	1				
6. Maintenance cost	.531*	.613*	.321	.580**	.679*	1			

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7. Insurance cost	.573*	.425	.387*	.463**	.526*	.431*	1		
8. Gross salary	.513*	.531*	.452*	.238*	.456*	.324*	.432*	1	
9. Equipment and stationeries	.586*	.464*	.396*	.263*	.428*	.254*	.376*	.234	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The study outcomes indicated that the cost of fuel per referral had the highest statistically important positive association with maternal health outcomes ($r = .843$, $p < .05$). This has the implication that the cost of fuel per referral and maternal health outcomes association was very strong meaning the outcomes are highly dependent on each other. Vehicle cost had the second highest association with the maternal health outcomes which was also statistically significant ($r = .635$, $p < .05$) and was followed by the insurance cost and maternal health outcomes ($r = .573$, $p<.05$). The lowest association was reported between the ANC number indicated and maternal health outcomes ($r = .127$, $p< .05$). All the ambulance cost indicators had positive and significant association with maternal health outcomes in Wajir County. The association between the ambulance cost indicators was found to positive and statistically significant.

4.6.4 Association between Ambulance Usage on Maternal Health Outcomes

Correlation analysis amongst ambulance usage on maternal health outcomes was evaluated by the use of constructs mean scores of ambulance usage and maternal health outcomes and results presented in Tables 4.6.4 below.

Table 4.17: Correlations between Ambulance Usages on Maternal Health Outcomes

	1	**2**	**3**
1. Maternal health outcomes	1		
2. Discounted saved life in years	.786*	1	
3. Discounted saved amount in Ksh.	.603**	.752*	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

As revealed in Table 4.6.4, the correlation between all the measures of ambulance usage was statistically significant. The strongest association was between the discounted saved life in

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years and maternal health outcomes which was statistically significant (r = .786, p< .05). The study results showed a positive correlation between the discounted saved amount in Ksh. and maternal health outcomes in Wajir County which was also statically significant (r= .603, p< .01). The association between discounted saved life in years and discounted saved amount in Ksh. was also statistically positive.

4.6.5 Ambulance Referral Network Interventions and Maternal Health Outcomes

The general objective of the study was to explore the association between the maternal health outcomes and ambulance referral network interventions implemented by Wajir County, Kenya. In order to explore the association, Pearson correlation analysis was carried out on the data where ambulance referral network interventions (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) were correlated with maternal health outcomes in Wajir County and the results presented in Table 4.6.5. below

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Table 4.18: Ambulance Referral Network Interventions and Maternal Health Outcomes

	Maternal health outcomes	Demographic characteristics	Cost of ambulance	Ambulance usage	Clinical condition	Health facility condition
Maternal health outcomes	1					
Demographic characteristics	.324*	1				
Cost of ambulance	.849**	.642*	1			
Ambulance usage	.652*	.526**	.786*	1		
Clinical condition	.714*	.657*	.425*	.354*	1	
Health facility condition	.682*	.602*	.532*	.512*	.628*	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation study results indicated that all measures of between ambulance referral network interventions and maternal health outcomes in Wajir County was a statistically significant and positive ($p < .05$). The correlation between cost of ambulance and maternal health outcomes in Wajir County was the highest, positive and statistically significant ($r = .849$, $p < .01$) followed by the correlation between health facility condition and maternal health outcomes in Wajir County ($r= .682$, $p < .01$). Correlation between ambulance usage, demographic characteristics with maternal health outcomes in Wajir County was positive and statistically significant ($r = .652$, $p < .05$) and ($r = .324$, $p < .05$) respectively. All the measures of ambulance referral network interventions (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) had statistically significant positive correlation between them. This implies that the ambulance referral network interventions (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) all had important role of association with maternal health outcomes in Wajir County.

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4.7 Regression Analysis and Hypotheses Testing

The study had the suggestion that ambulance referral network interventions (independent variable) had a significant influence on maternal health outcomes in Wajir County (dependent variable). The study had four objectives which were later turned into null hypotheses and tested at 95 percent confidence level ($\alpha = .05$). The aggregate mean scores were computed for the independent and dependent variables and used in regression runs and results used to test corresponding hypotheses. The value of R^2 showed the level of variation in maternal health outcomes in Wajir County which is being explained by each of ambulance referral network interventions. The subsequent segment presents regression analysis and hypotheses testing guided by the four study objectives.

4.7.1 Effect of Demographic Characteristics on Maternal Health Outcomes

The study's first objective was to determine the effect of demographic characteristics on maternal health outcomes in Wajir County. The objective was later written in null hypothesis as stated below;

H_{01}: *There is no significant effect of demographic characteristics on maternal health Outcomes In Wajir County*

The mean score of maternal health outcomes indicators (dependent variable) were regressed on the aggregate mean score of demographic characteristics and the relevant research findings presented in Tables 4.7.1 below

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Table 4.19: Demographic Characteristics on Maternal Health Outcomes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.486[a]	.236	.231	.04570

Predictors: (Constant), Demographic characteristics

ANOVAa

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5423	1	5423	88.042	.000[b]
	Residual	38251	621	61.595		
	Total	43674	622			

a. Dependent Variable: Maternal Health Outcome

b. Predictors: (Constant), Demographic characteristics

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	4.352	.486		8.954	.000
Cost of Ambulance	.658	.528	.486	1.246	.000

Dependent Variable: Maternal Health Outcomes

Model summary or goodness of fit model results also indicated that demographic characteristics had a positive association with maternal health outcomes in Wajir County (R = .486). Demographic characteristics had explanatory power over maternal health outcomes in Wajir County since it accounts for 23.6 percent of maternal health outcomes in Wajir County change (R square = .236). This implies that 66.4 percent of change in maternal health

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outcomes in Wajir County can be accounted for by other factors other than demographic characteristics (1-.236=.664). This shows that the contribution of demographic characteristics to maternal health outcomes in Wajir County was statistically significant. Analysis of variance results show that F-ratio was greater than one (F = 88.042). Based on the outcome of the F – ratio in ANOVA table, the prediction capacity of model contribution of the demographic characteristics to maternal health outcomes in Wajir County was significant since the p-value was less than 0.05. This means that this model can significantly predict the change in maternal health outcomes in Wajir County.

The coefficient results showed that demographic characteristics is an important contributor to coefficient model of maternal health outcomes in Wajir County (t = 8.954, $\rho < .05$). The study coefficients results exposed a statistically significant positive influence of demographic characteristics on maternal health outcomes in Wajir County (β = .658, p-value = .000). This is a demonstration that demographic characteristics had an individual statistically significant and positive influence on maternal health outcomes in Wajir County. The influence was found to be significant since p-value was less than .05 (p – value = .000). The hypotheses testing criteria was that reject hypothesis one if p-value is less than .05 and $\beta \neq 0$ or else don't reject H_{01} in case p-value > .05. Based on the study results, $\beta \neq 0$ and p-value < .05, the study rejected hypothesis one and states that demographic characteristics had an influence on maternal health outcomes in Wajir County.

From the regression results, the resultant simple regression equation that can be used to predict level of maternal health outcomes in Wajir County for a one standard deviation improvement in demographic characteristics can be expressed as:

$MHO = 4.352 + .658DC + \varepsilon$.

Where:

MHO =		Maternal health outcomes
3.735	is	the y-intercept; constant
.452	is	the beta or the slope coefficient
DC	is	the demographic characteristics
ε =		Error term

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The unstandardized beta coefficient .658 represents the expected improvement in maternal health outcomes for a unit standard deviation improvement in demographic characteristics. This means that, holding other factors constant, 1 standard deviance improvement in demographic characteristics would raise level of maternal health outcomes by a factor of approximately .658 of a standard deviation.

4.7.2 Influence of Cost of Ambulance on Maternal Health Outcomes

The study's second objective was to assess influence of cost of ambulance on maternal health outcomes in Wajir County. The objective was later written in null hypothesis as stated below;

***H_{02}**: Cost of ambulance has no significant influence on maternal health outcomes in Wajir County*

The mean score of maternal health outcomes indicators (dependent variable) were regressed on the aggregate mean score of cost of ambulance and the relevant research findings presented in Tables 4.7.2 below.

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Table 4.20: Cost of Ambulance on Maternal Health Outcomes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.898[a]	.806	.796	.08470

Predictors: (Constant), Cost of Ambulance

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5202	1	5202	8.768	.003[b]
	Residual	36825	621	593		
	Total	373455	622			

a. Dependent Variable: Maternal Health Outcome

b. Predictors: (Constant), Cost of Ambulance

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	3.735	.486		7.685	.000
Cost of Ambulance	.452	.358	.898	1.263	.003

Dependent Variable: Maternal Health Outcomes

Model summary results demonstrated that cost of ambulance had a positive association with maternal health outcomes in Wajir County (R = .898). Cost of ambulance had explanatory power over maternal health outcomes in Wajir County because it accounts for 80.6 percent of maternal health outcomes in Wajir County change (R square = .806).

The ANOVA results showed that the influence of cost of ambulance on maternal health outcomes in Wajir County was statistically significant p-value < .05 (p – value = .003). The regression results revealed that there was statistically significant positive linear influence of cost of ambulance measures on maternal health outcomes in Wajir County (β = .898, p-value

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= .003). An F statistic of 8.767 indicated that the overall model was significant and it was supported by a p-value = .037 since its p-value was < .05. This model implied that it can significantly predict the change in maternal health outcomes in Wajir County.

The study coefficients results revealed a statistically significant positive influence of cost of ambulance on maternal health outcomes in Wajir County (β = .452, p-value = .003). This is a demonstration that cost of ambulance had an overall statistically significant and positive influence on maternal health outcomes in Wajir County. The influence was found to be significant since p-value was less than .05 (p – value = .003). The hypothesis criteria were that reject Hypothesis two if p-value is less than .05 and $\beta \neq 0$ or else don't reject H_{02} in case p-value > .05. Based on the study results, $\beta \neq 0$ and p-value < .05, the study rejected H_{02} and states that cost of ambulance had an influence on maternal health outcomes in Wajir County.

From the study results, the resultant simple regression equation which may be used to prediction maternal health outcomes in Wajir County given the level of cost of ambulance may be stated as:

MHO = 3.735+ .452DC+ ε.

Where:

MHO =	Maternal health outcomes
3.735 is	the y-intercept; constant
.452 is	the beta or the slope coefficient
DC is	the cost of ambulance
ε =	Error term

4.7.3 Effect of Ambulance Usage on Maternal Health Outcomes

The third objective was to analyze the effect of ambulance usage on maternal health outcomes in Wajir County. The study had assumed that effect of ambulance usage on maternal health outcomes in Wajir County was not statistically significant. In order to be able to examine extent to which effect of ambulance usage on maternal health outcomes the study had set the following null hypothesis:

H_{03}: The effect of ambulance usage on maternal health outcomes in Wajir County is not

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Significant

In testing the null hypothesis three (H_{03}) aggregate mean scores of maternal health outcomes in Wajir County were regressed on those of ambulance usage and the relevant research outcome recorded in Table 4.21 below.

Table 4.21: Ambulance Usage on Maternal Health Outcomes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.584[a]	.341	.338	.08309

Predictors: (Constant), Ambulance usage

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6522	1	6522	591	.000[b]
	Residual	6852	621	11.034		
	Total	373455	622			

a. Dependent Variable: Maternal Health Outcome

b. Predictors: (Constant), Ambulance usage

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	4.352	.682		6.381	.000
Cost of Ambulance	.523	.385	.584	1.358	.000

Dependent Variable: Maternal Health Outcomes

Goodness of fit model (Table 4.21 results also exposed that ambulance usage had a positive relationship on maternal health outcomes in Wajir County (R = .584). The study found out that ambulance usage had explanatory power over maternal health outcomes in Wajir County because it accounts for 34.1 percent of maternal health outcomes in Wajir County change (R square = .341). The ANOVA results indicated an F statistic of 591 indicated that the overall

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model was significant and it was supported by a p-value = .000 since its p-value was < .05. Based on the outcome of the F – ratio in the ANOVA table; the results show the prediction capacity of the model contribution of the ambulance usage to maternal health outcomes in Wajir was significant.

The coefficients results revealed that there was statistically significant and positive association of ambulance usage and maternal health outcomes in Wajir ($\beta = .523$, p-value = .000). The hypothesis criterion was that reject hypothesis if p-value is less than .05 and $\beta \neq 0$ or else don't reject H_{03} in case p-value > .05. Based on the study results, $\beta \neq 0$ and p-value < .05, the study rejected H_{03} and states that ambulance usage had an effect on maternal health outcomes in Wajir. Arising from the results, the resulting single regression equation that can be used to predict the level of maternal health outcomes in Wajir for a one standard deviation improvement in ambulance usage can be expressed as:

MHO = 4.352+ .523AU+ ε.

Where:

MHO =	Maternal health outcomes
4.352 is	the y-intercept; constant
.523 is	the beta or the slope coefficient
AU is	the ambulance usage
ε =	Error term

4.7.4 Effect of Health Facility Condition on Maternal Health Outcomes

The fourth objective was to explore the effect of health facility condition on maternal health outcomes in Wajir County; the study formulated the following null hypothesis;

H_{04}: The association between health facility condition and maternal health referrals outcomes in Wajir County is not significant.

The mean score of maternal health outcomes indicators (dependent variable) were regressed on the aggregate mean score of health facility condition and the relevant research findings presented in Tables 4.7.4 below .

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Table 4.22 : Health Facility Condition and Maternal Health Outcomes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.682[a]	.465	.423	.40572

Predictors: (Constant), Health Facility Condition

ANOVAa

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	6432	1	6432	13.438	.000[b]
	Residual	8245	621	61.595		
	Total	14677	622			

a. Dependent Variable: Maternal Health Outcome

b. Predictors: (Constant), Health Facility Condition

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	3.524	.628		5.611	.000
Cost of Ambulance	.687	.582	.682	1.077	.000

Dependent Variable: Maternal Health Outcomes

The study results in the model summary indicated that health facility condition had a positive association with maternal health outcomes in Wajir County (R = .682). Health facility condition had explanatory power over maternal health outcomes in Wajir County since it accounts for 46.5 percent of maternal health outcomes in Wajir County change (R square = .465). This had the implication that 53.5 percent of change in maternal health outcomes in Wajir County can be accounted for by other factors other than health facility condition (1-.465=.535). This shows that the contribution of health facility condition to maternal health outcomes in Wajir County was statistically significant.

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Analysis of variance (ANOVA) results show that F-ratio was greater than one (F = 13.438). Based on the outcome of the F – ratio in ANOVA table, the prediction capacity of model contribution of the health facility condition to maternal health outcomes in Wajir County was significant since the p-value was less than 0.05. This means that this model can significantly predict the change in maternal health outcomes in Wajir County.

The coefficient results showed that health facility condition is an important contributor to coefficient model of maternal health outcomes in Wajir County (t = 5.611, $\rho < .05$). The study coefficients results exposed a statistically significant positive influence of health facility condition on maternal health outcomes in Wajir County ($\beta = .658$, p-value = .000). This is a demonstration that health facility condition had an individual statistically significant and positive influence on maternal health outcomes in Wajir County. The influence was found to be significant since p-value was less than .05 (p – value = .000). The hypotheses testing criteria was that reject hypothesis one if p-value is less than .05 and $\beta \neq 0$ or else don't reject H_{01} in case p-value > .05. Based on the study results, $\beta \neq 0$ and p-value < .05, the study rejected hypothesis four and states that the association between health facility condition and maternal health outcomes in Wajir County was statistically significant.

From the regression results, the resultant simple regression equation that can be used to predict level of maternal health outcomes in Wajir County for a one standard deviation improvement in health facility condition can be expressed as:

MHO = 3.524+ .687HFC+ ε.

Where:

MHO =	Maternal health outcomes
3.524 is	the y-intercept; constant
.687 is	the beta or the slope coefficient
HFC is	the health facility condition
ε =	Error term

The unstandardized beta coefficient .687 represents the expected improvement in maternal health outcomes for a unit standard deviation improvement in health facility condition. This means that, holding other factors constant, 1 standard deviance improvement in health facility

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condition would raise level of maternal health outcomes by a factor of approximately .687 of a standard deviation.

4.7.5 Ambulance Referral Network Interventions and Maternal Health Outcomes

The aim of the study was to explore the association between ambulance referral network interventions (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) and maternal health outcomes in Wajir County, Kenya. In an effort to explore the association between ambulance referral network interventions, the individual ambulance referral network interventions were regressed against aggregate mean scores of maternal health outcomes in Wajir County and the relevant results recorded in Table 4.23 below

Table 4.23: Ambulance Referral Network Interventions and Maternal Health Outcomes

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.869	.755	.689	.40185

Predictors: (Constant), Demographic characteristics Cost of ambulance, Ambulance usage. Health facility condition

ANOVA

	Sum of Squares	df	Mean Square	F	Sign. (p-value)
Regression	13.813	4	3.453	164.428	.008
Residual	12.230	618	.021		
Total	26.043	622			

Predictors: (Constant), Demographic characteristics, Cost of ambulance, Ambulance usage. Health facility condition

Dependent Variable: Maternal health outcomes

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	Beta	Std. Error	B	T	Sign. (p-value)
(Constant)	10.347	.929		11.138	.042
Demographic characteristics	.438	.267	.364	1.640	.037
Cost of ambulance	.862	.249	.783	3.461	.028
Ambulance usage	.642	.283	.569	2.268	.000
Health facility condition	.547	.325	.486	1.683	.000

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Dependent Variable: Maternal health outcomes

Model summary results revealed that there was an association between ambulance referral network interventions and maternal health outcomes which was positive (R = .869). The results also indicated that ambulance referral network interventions had explanatory power over maternal health outcomes in Wajir County because it accounted for 75.5 percent of organizations' competitiveness of sugar firms' change (R square = .755).

The ANOVA results revealed that ambulance referral network interventions (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) and maternal health outcomes in Wajir County, overall effect on maternal health outcomes in Wajir County was statistically significant (p-value = 0.008). An F statistic of 164.428 indicated that the overall model was significant and it was supported by a p-value = .000 since its p-value was < .05. An F statistic of 164.428 indicated that the overall model was significant and it was supported by a p-value = .000 since its p-value was < .05.

The ANOVA results show that the F-ratio was more than one (F = 164.428) shows the prediction capacity of the model contribution of ambulance referral network interventions (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) to maternal health outcomes in Wajir County. This means that this model can significantly predict the change in maternal health outcomes in Wajir County. At individual level, ANOVA results showed that the overall influence of ambulance referral network interventions measures on maternal health outcomes in Wajir County was significant in that p-value was < .05 (p – value = .008).

The coefficient results indicated that ambulance referral network interventions measures (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) all had important contribution to the coefficient model of maternal health outcomes (t = 11.138, $\rho < .05$). The model parameters had the indication that when cost of ambulance is used as a predictor, its effect to model is significantly higher than other measures (t (1.96) = 3.461, $\rho < .05$). The second predictive strength was of ambulance usage contribution in the coefficient model was similarly significant (t (1.96) = 2.268, $\rho < .05$. On the other hand, when health facility condition is used as a predictor, its contribution to the model is significantly

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important (t (1.96) = 1.683, ρ < .05) while the contribution to the model of demographic characteristics was the lowest but equally significant (t (1.96) = 1.640, ρ < .05).

At the individual level, coefficients results showed that all the ambulance referral network interventions (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) measures had positive and significant influence on maternal health outcomes in Wajir County as follows; cost of ambulance had positively influenced maternal health outcomes in Wajir County (β = .862 and p-value = .028) while ambulance usage also positively influenced maternal health outcomes in Wajir County (β = .642, p-value = .000). Health facility condition on the other hand had a positive influence on maternal health outcomes in Wajir County (β = .547, p-value = .000) while demographic characteristics also positively influenced maternal health outcomes in Wajir County (β = .437, p-value = .037).

Arising from the study results, the resultant multiple regression equation that can be used to predict the level of maternal health outcomes in Wajir County for a one standard deviation improvement in ambulance referral network interventions can be expressed as:

MHO = 10.347+ .438DC + .862CA + .642AU +. 547HCF+ ε.

Where:

MHO =	Maternal health outcomes
10.347 =	y-intercept; constant
.438, .862, .642, .547 =	the slope coefficients
DC =	the demographic characteristics
CA =	the cost of ambulance
AU =	the ambulance usage
HFC is	the health facility condition
ε =	Error term

4.8 Summary of Hypotheses Testing Results

Below is a summary of hypotheses testing which were carried out as per the study objectives as presented in Table 4.24 below.

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Table 4.24: Summary of Hypotheses Testing Results

Hypotheses	Test Criteria	Findings
H_{01}: There is no significant effect of demographic characteristics on maternal health outcomes in Wajir County.	$H_{01}: \beta \neq 0$ p-value $\leq .05$	P-value = .000, β = .486; Rejected H_{01}: Hence; There was a significant effect of demographic characteristics on maternal health outcomes in Wajir County
H_{02}: There is no significant effect of maternal clinical condition at referral on maternal health outcomes in Wajir County.	$H_{01}: \beta \neq 0$ p-value $\leq .05$	P-value = .000, β = .682; Rejected H_{01}: Hence; There was a significant effect of maternal clinical condition at referral on maternal health outcomes in Wajir County
H_{03}: Cost of ambulance has no significant influence on maternal health outcomes in Wajir County	$H_{02}: \beta \neq 0$ p-value $\leq .05$	P-value = .003, β = 898; Rejected H_{02}: Hence, cost of ambulance had a significant influence on maternal health outcomes in Wajir County
H_{04}: The effect of ambulance usage on maternal health outcomes in Wajir County is not significant.	$H_{03}: \beta \neq 0$ p-value $\leq .05$	P-value = .000, β = 584; Rejected H_{03}: Hence, effect of ambulance usage on maternal health outcomes in Wajir County was significant.
H_{05}: The association between health facility condition and maternal health referrals outcomes in Wajir County is not significant.	$H_{04}: \beta \neq 0$ p-value $\leq .05$	P-value = .000, β = 682; Rejected H_{04}: Hence; the association between health facility condition and maternal health referrals outcomes in Wajir County was significant.

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CHAPTER FIVE

DISCUSSION OF FINDINGS

5.0 Introduction

This chapter presents the discussions of the study findings as per the research objectives. It aims at discussing the results of the study and compares them with the work already published by other researchers as per the literature review of this study.

5.1 Study Findings Discussion

The following sub-section presents the discussion of the discussions of the study findings as per the research objectives.

5.1.1 Effect of Demographic Characteristics on Maternal Health Outcomes

The correlation study results indicated that there was statistically significant positive association was reported between all the demographic characteristics indicators with maternal health outcomes in Wajir County. This has the implication that they were all moving in the same direction. The association between the demographic characteristics indicators was found to positive and statistically significant. The highest correlation was reported between the maternal health outcomes and gestation age ($r = .862$, $p < .05$). This has the implication that the gestation age and maternal health outcomes have a lot of relations. The lowest association was reported between the ANC number indicated and maternal health outcomes ($r = .127$, $p < .05$).

The regression results also indicated that demographic characteristics had a positive association with maternal health outcomes in Wajir County ($R = .486$). Demographic characteristics had explanatory power over maternal health outcomes in Wajir County since it accounts for 23.6 percent of maternal health outcomes in Wajir County change (R square = .236). The coefficient results showed that demographic characteristics are an important contributor to coefficient model of maternal health outcomes in Wajir County. The study coefficients results exposed a statistically significant positive influence of demographic characteristics on maternal health outcomes in Wajir County (p-value = .000). This is a demonstration that demographic characteristics had a statistically significant and positive

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influence on maternal health outcomes in Wajir County. The influence was found to be significant since p-value was less than .05 (p – value = .000).

The study results agree with those of a longitudinal study in Nepal indicated that women who were educated especially with secondary education and above were likely to deliver in hospital *(Karkee, Binns, & Lee, 2013)* suggesting that increasing level of education increase knowledge and awareness of obstetric danger signs (*Hailu & Berhe, 2014).* In addition, the proportion of private health facility deliveries is positively linked to maternal education (D*as et al., 2016*) while lower level of maternal education is associated with high morbidity and mortality (*Karlsen et al., 2011; Tuncalp et al., 2014)*indicating that education influences choice of quality health care. Therefore, it is possible that education affects individuals by increasing access to health care information.

Long distances are a hindrance to reaching a health facility, and the effect of distance is worsened with lack of transportation and poor roads. The highest proportion of users are located close to the health facility and that the proportion of users declines as the radius increases (*Asseffa, Bukola, & Ayodele, 2016).* In addition, adverse birth outcome in pregnant women is associated with long distance travel suggesting that the longer distance travelled act as a disincentive thus delaying the caretakers' decisions to seek care until complications of the initial disease develops (*Asundep et al., 2013).* Therefore, distance acts as a disincentive and actual obstacle in seeking health care.

5.1.2 Effect of Maternal Clinical condition at referrals on maternal health outcome

From the study findings, it emerged that that most of the referrals were as a result of prolonged labour 237 (38.3%). This view is also shared by *(Strand et al., 2017)* who stated that prolonged labor was the most common diagnosis for maternal referrals likely leading to caesarian section. Likely causes of prolonged labor are cephalo-pelvic disproportion (CPD), malpresentation and malposition as noted by *(Nystedt & Hildingsson, 2014).*

Prolonged labor exposes pregnant women and their unborn babies to certain maternal complications which (*Stephansson et al., 2016)* reported that the complications increase with the duration of the second stage of labor. The study also noted that special attention needs to be given to parous women with previous caesarean deliveries

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5.1.3 Influence of Cost of Ambulance on Maternal Health Outcomes

The study correlation results indicated that all the ambulance cost indicators had positive and significant association with maternal health outcomes in Wajir County. The association between the ambulance cost indicators was found to positive and statistically significant. The cost of fuel per referral had the highest statistically important positive association with maternal health outcomes ($r = .843$, $p < .05$). This has the implication that the cost of fuel per referral and maternal health outcomes association was very strong meaning the outcomes are highly dependent on each other. The lowest association was reported between the ANC number indicated and maternal health outcomes ($r = .127$, $p < .05$). The regression results demonstrated that cost of ambulance had a positive association with maternal health outcomes in Wajir County ($R = .898$). Cost of ambulance had explanatory power over maternal health outcomes in Wajir County because it accounts for 80.6 percent of maternal health outcomes in Wajir County change (R square = .806). The ANOVA results showed that the influence of cost of ambulance on maternal health outcomes in Wajir County was statistically significant p-value < .05 (p – value = .003).The study coefficients results revealed a statistically significant positive influence of cost of ambulance on maternal health outcomes in Wajir County ($\beta = .452$, p-value = .003). This is a demonstration that cost of ambulance had an overall statistically significant and positive influence on maternal health outcomes in Wajir County. The influence was found to be significant since p-value was less than .05 (p – value = .003).

The study findings concur with a study by *Simfukwe et al., (2009)* which evidenced that cost-effective analysis informs decision on the choice of referral transport. For example, a cost effective analysis study in Zambia revealed that use of bicycle ambulance for maternal health was not associated with cost compared to ox-cart and motor vehicle ambulance *(Simfukwe et al., 2009).* In Malawi, the cost effectiveness of bicycle ambulance was nearly 200 times costlier than traditional methods such as homemade stretcher or hiring ordinary bicycle for accessing maternal health delivery (*Lungu et al., 2001*). In Malawi, annual operating costs of motorcycle ambulance was almost 24 times cheaper than for a car ambulance, and they are useful means of referral for emergency obstetric care and a relatively cheap option for the rural health centres (Hofman et al., 2008).In Scandinavia, the hourly cost of running the medical emergency motorcycle was two times cheaper compared to a car ambulance and the actual cost benefit is smaller since the weather conditions make it impossible to run a medical

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emergency motorcycle in wintertime (*Nakstad, Bjelland, & Sandberg, 200*9). In Uganda, annual operating costs of motorcycle ambulance is almost ten times lower than a 4WD motor vehicle ambulance and that motorcycle ambulance can easily be moved to remote places on roads inaccessible by vehicle ambulances *(Mohanty, 2013).* Taken together, a combination of both motor cycle and motor vehicle ambulance approaches might be cost effective, depending on distance, geographic terrain and weather conditions.

5.1.4 Effect of Ambulance Usage on Maternal Health Outcomes

The study correlation results revealed that all the measures of ambulance usage were statistically significant. The strongest association was between the discounted saved life in years and maternal health outcomes which was statistically significant ($p < .05$). The study results showed a positive correlation between the discounted saved amount in Ksh. and maternal health outcomes in Wajir County which was also statically significant ($p < .01$). The association between discounted saved life in years and discounted saved amount in Ksh. was also statistically positive.

Goodness of fit model or model summary results also exposed that ambulance usage had a positive relationship on maternal health outcomes in Wajir County ($R = .584$). The study found out that ambulance usage had explanatory power over maternal health outcomes in Wajir County because it accounts for 34.1 percent of maternal health outcomes in Wajir County change (R square = .341). This implies that 65.9 percent of variability in maternal health outcomes in Wajir County is accounted for by other variables. The coefficients results revealed that there was statistically significant and positive association of ambulance usage and maternal health outcomes in Wajir ($\beta = .523$, p-value = .000).

The study outcomes agreed with WHO (2016) Multicounty Survey on Maternal and New-born Health sampled more than 300,000 women attending 359 health care facilities in 29 countries. The study results showed a poor correlation between coverage of “essential interventions” (the proportion of the population who had received an indicated intervention, such as women with eclampsia who received magnesium sulphate) and maternal mortality in health facilities. Studies also show that high-quality care requires appropriate use of the available infrastructure, staff and commodities to ensure effective case management (*Roemer*

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et al, 2018). In addition, high-quality health care requires appropriate use of evidence-based clinical practices and non-clinical interventions, strengthened health infrastructure and optimum skills and a positive attitude of health providers.

The significance of ambulance referral in an obstetric emergency is related to the unpredictability of pregnancy complications, which can be severe, and life threatening. For instance, about 73% of maternal deaths are due to direct obstetric causes whereas 27% are linked to indirect causes *(Say et al., 2014).* These deaths are avoidable through timely referral to an emergency obstetric care health facility *(Tayler-Smith et al., 2013).* However, prompt, effective and efficient ambulance inter-facility referral services is a problem in low- and middle-income countries *(Wilson et al., 2013*) delineating the need to determine the effect of Ambulance Referral Network on maternal health care.

5.1.5 Effect of Health Facility Condition on Maternal Health Outcomes

The study results indicated that health facility condition had a positive association with maternal health outcomes in Wajir County (R = .682). Health facility condition had explanatory power over maternal health outcomes in Wajir County since it accounts for 46.5 percent of maternal health outcomes in Wajir County change (R square = .465). This had the implication that 53.5 percent of change in maternal health outcomes in Wajir County can be accounted for by other factors other than health facility condition. The study coefficients results exposed a statistically significant positive influence of health facility condition on maternal health outcomes in Wajir County (β = .658, p-value = .000). This is a demonstration that health facility condition had an individual statistically significant and positive influence on maternal health outcomes in Wajir County. The influence was found to be significant since p-value was less than .05 (p – value = .000).

The study findings are in concurrence with those of a study done by *Mazalale et al., (2015)* which indicated that the existing medical facilities are more often than not concentrated in and around urban areas. Urban residents are more likely to receive skilled antenatal and delivery care compared to rural residents (Fawole & Adeoye, 2015) indicating inequality and inequity in health care utilization and distribution, respectively *(Phiri & Ataguba, 2014).* For instance, a survey of private health facilities in Uganda revealed that compared to urban, only 47 (19.5 %) were in rural areas, and they more likely to be drug shops, unregistered, manned by

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untrained clinicians, and lacked zinc tablets (*Rutebemberwa et al., 2016).*It has been reported that deaths due to direct causes of maternal mortality were strongly related to distance, with mortality increasing from 111 per 100, 000 live births among women who lived within 5 km to 422 deaths per 100,000 live births among those who lived more than 35km from a hospital (Hanson et al., 2015). This is unsafe for the patients, because emergencies can occur in all wards at once. This shortage is often not only a matter of staff numbers; it is also a matter of competence. For instance, a cross sectional assessment of health facilities in Ghana revealed that 28% of doctors and midwives are incompetent in management of obstetric emergencies hence limiting provision of health care in certain health facilities (*Lohela et al., 2016).* Staff incompetence also leads to poor assessment of pregnant women resulting in poor maternal care. For example, as reviewed by *(Fyfe et al., 2014).*

5.1.6 Ambulance Referral Network Interventions and Maternal Health Outcomes

The correlation study results indicated that all measures of between ambulance referral network interventions and maternal health outcomes in Wajir County was a statistically significant and positive ($p < .05$). All the measures of ambulance referral network interventions (Demographic characteristics, maternal clinical condition cost of ambulance, ambulance usage and health facility condition) had statistically significant positive correlation between them. This means that all the measures were moving in the same direction.

The regression results revealed that there was an association between ambulance referral network interventions and maternal health outcomes which was positive ($R = .869$). The results also indicated that ambulance referral network interventions had explanatory power over maternal health outcomes in Wajir County because it accounted for 75.5 percent of organizations' (R square = .755). This has the implication that 14.5 percent of change in maternal health outcomes in Wajir County is accounted for by other factors not covered by this study. At individual level, ANOVA results showed that the overall influence of ambulance referral network interventions measures on maternal health outcomes in Wajir County was significant in that p-value was < .05 (p – value = .008). The coefficient results indicated that ambulance referral network interventions measures (Demographic characteristics, cost of ambulance, ambulance usage and health facility condition) all had important contribution to the coefficient model of maternal health outcomes ($t = 11.138$, $\rho < .05$).

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CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the study conclusion based on the study findings in chapter five. The chapter also offers the recommendations made by the study which are as per the conclusions made by the same study.

6.1 Study Conclusion

The following sub-section presents the conclusions made by the study based on the study objectives and the study findings.

6.1.1 Demographic Characteristics and Maternal Health Outcomes

The study results indicated that there was statistically significant positive association reported between all the demographic characteristics indicators with maternal health outcomes in Wajir County. The regression results also indicated that demographic characteristics had explanatory power over maternal health outcomes in Wajir County since it accounts for 23.6 percent of maternal health outcomes in Wajir County change (R square = .236). Based on these study results, the study concluded that there was a significant effect of demographic characteristics on maternal health outcomes in Wajir County.

6.1.2 Maternal Clinical condition at referrals and maternal health outcome

It emerged that that most of the referrals were as a result of prolonged labour 237 (38.3%). From the study findings, Maternal clinical condition had in general significant relationship (R=) with p value of 0.00 on the outcome. This view is also shared by (Strand et al., 2017) who stated that prolonged labour was the most common diagnosis for maternal referrals likely leading to caesarean section. Likely causes of Prolonged labour are cephalo-pelvic disproportion (CPD), malpresentation and malposition as Noted by (Nystedt & Hildingsson, 2014). Prolonged labour exposes pregnant women and their unborn babies to certain maternal complications which (Stephansson *et al.,* 2016) reported that the complications increase with the duration of the second stage of labour. The study also noted

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that special attention needs to be given to parous women with previous caesarean deliveries. Based on the study findings, this study concluded that maternal clinical condition had a significant influence on maternal health outcomes in Wajir County.

6.1.3 Cost of Ambulance and Maternal Health Outcomes

The study correlation results indicated that all the ambulance cost indicators had positive and significant association with maternal health outcomes in Wajir County. The association between the ambulance cost indicators was found to positive and statistically significant. The regression results demonstrated that cost of ambulance had a positive association with maternal health outcomes in Wajir County (R = .898). Cost of ambulance had explanatory power over maternal health outcomes in Wajir County because it accounts for 80.6 percent of maternal health outcomes in Wajir County change (R square = .806). Based on the study findings, this study concluded that cost of ambulance had a significant influence on maternal health outcomes in Wajir County.

6.1.4 Ambulance Usage and Maternal Health Outcomes

The study correlation results revealed that all the measures of ambulance usage were statistically significant. The study found out that ambulance usage had explanatory power over maternal health outcomes in Wajir County because it accounts for 34.1 percent of maternal health outcomes in Wajir County change (R square = .341). This study agree with Tayler-Smith *et al*., 2013 ,which indicated that 73% of maternal death are due to direct obsteric couse .These deaths are avoidable through timely usage of ambulance referral to an emergency obstetric care health facility in order to save live ,The study therefore concluded that the effect of ambulance usage on maternal health outcomes in Wajir County was significant.

6.1.5 Health Facility Condition and Maternal Health Outcomes

The study results indicated that health facility condition had a positive association with maternal health outcomes in Wajir County (R = .682). Health facility condition had explanatory power over maternal health outcomes in Wajir County since it accounts for 46.5 percent of maternal health outcomes in Wajir County change (R square = .465). The study hence concluded that the association between health facility condition and maternal health referrals outcomes in Wajir County was significant.

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The study agrees with findings of a study done by *Mazalale et al., (2015*) which indicated that the existing welle quiped medical facilities are more often than not concentrated in and around urban areas and that Urban residents are more likely to receive skilled antenatal and delivery care compared to rural residents *(Fawole & Adeoye, 2015)* indicating inequality and inequity in health care utilization and distribution, respectively *(Phiri & Ataguba, 2014*)

6.2 Recommendations from the study

Based on the study conclusion, the study made the following recommendations for the purpose of policy, practice and further study.

6.2.1 Recommendations for Policy

1. The Ministry of health should consider reviewing the existing policies on the effectiveness of ambulance referral network interventions and maternal health outcomes in Wajir County, Kenya as one of the priority areas since this study has found ambulance referral network interventions to have a significant and positive effect on maternal health outcomes in Wajir County, Kenya.
2. The County government of Wajir should review policies on ambulance referral network interventions to enable them to improve the maternal health outcomes in Wajir County, Kenya.

6.2.2 Recommendations for Practice

1. The County government of Wajir should allocate more resource for the ambulance referral network interventions in an effort to improve maternal health outcomes in Wajir County.
2. The County government of Wajir should adopt this study findings and recommendations on ambulance referral network interventions and maternal health outcomes since the study found out ambulance referral network interventions measures had statistically significant and positive correlation with maternal health outcomes in Wajir County.

6.2.3 Recommendations for further Studies

The study recommends that further studies can be carried out on the following;

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i) While the study concentrated on the effect of ambulance referral network interventions and maternal health outcomes in Wajir County. The researcher suggests that further research be done on ambulance referral network interventions and maternal health outcomes in other Counties with similar health systems in Kenya

ii) In order to provide an in-depth, broad and better understanding of the effectiveness of ambulance referral network on maternal health outcome; the researcher recommends a large study using superior methodology such as Randomized Control Trial with control and intervention arms of the study. However, we learnt that with effective ambulance referral network can contribute to positive maternal health outcome by saving live thereby contributing to economic development

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APPENDICES

Appendix I: Informed Consent for Hospital Managers

ANALYTICAL REVIEW OF THE ASSOCIATION BETWEEN AMBULANCE REFERRAL NETWORK INTERVENTION AND MATERNAL HEALTH OUTCOMES

Informed Consent

Dear Participant,

The main purpose of this study is to develop an intervention with the goal to significantly improve the quality care services for women during labor and delivery at the health facilities. Specifically, we will try to identify factors and challenges that might hinder quality Improvement efforts in health facilities. In order to do so, we would like to hear from health workers such as yourself about the availability of resources and quality of emergency obstetric health services for women in this area.

I will give you information and invite you to participate in this research by taking part in an in-depth interview during the formative phase of the research. This interview will take about 45 minutes. If you decide to participate, you will receive a copy of this consent form.

You are being invited to take part in this research because we feel that your experience as a health care worker in Wajir County, Kenya, can contribute much to our understanding and knowledge of local health practices. Your thoughts and opinions are valuable to us, so please feel free to interrupt us anytime during the interview if you want to raise an issue or seek clarification. I will be leading the discussion and a colleague of mine will be present to take notes. In addition, because it might be difficult to jot down everything while we discuss, we might tape record our conversation to be sure that we don't miss anything but no-one will be identified by name on the tape only unique codes will be given to the tapes for identification. The tape with the information recorded will be kept confidential in a lockable cabinet where no one will have access to the information documented during your interview, except the research team. The tapes will be destroyed after four weeks of data collection.

This information will only be used for the purposes of this evaluation; it will be kept confidential and it and will not be transferred to your colleagues or seniors. The study team believes that participating in this study does not carry any risks and you will not suffer from

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any harm or injury because of your participation. Further, your name and that of your institution will not be specifically mentioned or referred to in the report that we will produce at the end of the evaluation.

Appendix II: Issues to Cover

Our discussion will cover the following topic/issues:

We would like to ask your insights about the capacity of facilities in terms of ambulance transport, supplies, equipment and staff available to provide a number of life-saving essential obstetric functions. These life-saving functions are those used to treat the most common or major obstetric complications including hemorrhage (antepartum, intrapartum, or postpartum); prolonged/obstructed labor; pre-eclampsia/eclampsia; and ruptured uterus. In addition, during the interview we will also discuss the quality of care provided.

Confidentiality of your information: A data collection form will contain the name of the health facility you are working in but it will not contain your name or any other information that could directly identify you. Your name and that of your institution will not be specifically mentioned or referred to in the report that we will produce at the end of the evaluation. The data collection forms, which contain this information, will be kept confidentially in a lockable cabinet where except the research team no one will access them.

Voluntary participation: The choice that you make about whether to participate in this study will have no bearing on your job or on any work-related evaluations or reports. You may change your mind later and stop participating during the interview even if you sign the Informed Consent form. You may stop participating in the interview at any time that you wish without your job being affected. I will give you an opportunity at the end of the interview to review your remarks, and you can ask to modify or remove portions of those, if you do not agree with my notes or if I did not understand you correctly.

Who to call for information: If you have any questions, please do not hesitate to ask me at this time? If you have questions later, you can **contact Fatuma Adan (Mobile number: 0728011151).**

This proposal has been reviewed and approved by **Masinde Muliro University -ERC, NACOSTI** which are committee whose task it is to make sure that research participants are

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protected from harm. If you wish to find about more about the Institution Review Board, contact Masinde Muliro, Kenya.

What are the benefits of this research?

What we learn from this study may benefit future pregnant women and their children in the county of Wajir and other pregnant women in similar areas who receive health facility medical care during delivery. We hope that the results of this research will improve quality of care during delivery and help save many lives.

Research costs: You will not be paid to participate in this study. If you decide to participate, there is no cost.

Participant's Statement/Certificate of Consent

The reason why this study is being conducted has been explained to me and I have agreed to take part. I have been given a chance to ask any questions I may have and my questions have been answered to my satisfaction. I understand that the information collected through my participation will be kept confidential /private.

I understand that I may withdraw from this study at any time. My withdrawal from this study or my refusal to participate will in no way affect my working conditions at this health facility or at any other facility.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Participant's Name….Signature: ……Date:……

Witness: ……Signature:…….Date:……

Principal Investigator……. Signature……Date……

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APPENDIX III: Checklist Documents (2019-2016)

S/NO	Name of Document	Available	Comments
1.	Maternal and Child Health Reports		
2.	Emergency Obstetrics Care unit records		
3.	Training Records/Training Manual		
4.	Ambulance Logbook		
5.	Theatre Register		
6.	Health Records		
7.	Birth Notifications		
8.	Death Notifications		
9.	Maternal death Audit		

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Map Wajir county kenya

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Appendix IV: NACOSTI CERTIFICATE:

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Appendix V: Institutional ERC Certificate

GREAT LAKES UNIVERSITY OF KISUMU (GLUK)

September 19, 2019

National Commission for Science, Technology and Innovation
Upper Kabete, Off Waiyaki Way
P. O. Box 30623 - 00100
NAIROBI- KENYA
Tel: (254 713 788 787 / 254 735 404 245)
E-Mail: registry@nacosti.go.ke

RE: ANALYTICAL REVIEW OF THE COST EFFECTIVENESS OF AMBULANCE REFERRAL NETWORK ON MATERNAL HEALTH OUTCOME IN WAJIR COUNTY, KENYA.

Dear Sir/Madam,

This letter is to confirm that **Ms. Fatuma Ibrahim Adan** (Reg. No. P12/M03/2018) is a PhD student in Community Health and Development at Great Lakes University of Kisumu. She has chosen to do her thesis on the above-mentioned study. The study received ethical approval from Masinde Muliro University of Science and Technology on 9th September 2019, Reference number MMU/COR: 403012 Vol2(44).

This study aims to analytically review the cost effectiveness of ambulance referral network on maternal health outline in Wajir County, Kenya.

We would appreciate your informed review and approval. If you have any questions or concerns, please contact Mr. Dan O. Odindo at +254 723 220 564 or me at +254 728 011151. Ms. Fatuma will serve as the contact person for this study. We look forward to your comments and approval.

Sincerely,

Mr. Dan Odindo
Associate Dean - Research and Post Graduate Studies.

Main Campus, Kibos (Miwani Road); P.O.Box 2224-40100 Kisumu, Kenya. Tel. Number: 0722 683 813 OR 0736 550 505/ 0770 410 698
Milimani Campus (Off Tom Mboya Drive, Milimani Estate - Kisumu)
Nairobi Campus: Centro House, Westlands P.O.Box 36163 - 00200 Nairobi; Tel Number: 0723 686 443
Kisumu CBD Campus: Mega Plaza, 5th Floor, Tel Number: 0712 054623
Email: vc@gluk.ac.ke, shortcourses@gluk.ac.ke.
Website: www.gluk.ac.ke