Distribution Agreement

Signature:

______________________ ___________04/25/2024

Beverly Bruno DATE

Assessing the Impact of Health Facility-Based Maternal Delivery Care on Adverse Pregnancy Outcomes in Kenya: A Multi-Factor Analysis Approach

By Beverly Bruno

MPH

Hubert Department of Global Health

____

Subasri Narasimhan, PhD, Emory University

Committee Chair

____

Jasmin A. Eatman, MS, Emory University

Committee Member

Assessing the Impact of Health Facility-Based Maternal Delivery Care on Adverse Pregnancy Outcomes in Kenya: A Multi-Factor Analysis Approach

By

Beverly Bruno

B.S. Health Sciences

Boston University

2022

Thesis Committee Chair: Subasri Narasimhan, PhD, Emory University

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Global Health
2024

Abstract

Assessing the Impact of Health Facility-Based Maternal Delivery Care on Adverse Pregnancy Outcomes in Kenya: A Multi-Factor Analysis Approach

By Beverly Bruno

Background: Globally, approximately 810 women die daily from preventable delivery complications, with Sub-Saharan Africa accounting for 66% of these deaths in 2017. Existing literature highlights differences in adverse maternal health outcomes based on delivery setting, method, and birth attendant type.

Methods: This study used the Theoretical Domains Framework (TDF) and Capability, Opportunity, and Motivation-Behavior (COM-B) model and utilized the 1998 Kenya Demographic Health Survey (DHS) data to examine obstetric outcomes of women aged 15-49 who gave birth in the 3-5 years preceding the survey. We quantified the impact of delivery conditions and country-level variation on obstetric hemorrhage (OH) burden, providing a foundational baseline for evaluating subsequent changes despite the data's focused scope. Birth attendants in the study were categorized according to DHS classifications into distinct groups. Those reporting excessive bleeding during delivery were categorized as having a high likelihood of experiencing OH. Additional regression and multifactorial analyses (MFA) highlight protective factors that can substantially mitigate the likelihood of adverse pregnancy outcomes.

Results: Among a representative sample of birthing Kenyan women (N=7881), significant associations were found between physician attendance during delivery and delivery method, with rates varying between 7.6% (N=111) in urban and 4.1% (N=261) in rural areas, showing increased likelihood of cesarean delivery when a doctor was present ($r = 0.175$, 95% CI: [0.140, 0.209], $p < 2.2e-16$). Regression analyses revealed increased log-odds of a doctor or nurse/midwife present when excessive bleeding was reported ($\beta = 1.45$, $p = 0.016$; $\beta = 1.32$, $p = 0.013$) with prolonged labor as a covariate. Government Maternal and Child Health Centers were associated with heightened odds of excessive bleeding for last births ($\beta = 0.617$, $p = 0.024$). Prolonged labor remained a significant risk factor ($\beta = 1.273$, $p < 0.001$). For second to last births, delivering at Private Hospitals/Clinics was linked to reduced likelihood of excessive bleeding ($\beta = -2.4429$, $p = 0.045$). MFA showed doctor and nurse/midwife absence contributed 13.933% and 10.676% respectively to variability, highlighting their impact on adverse pregnancy outcomes. Excessive bleeding rates were 7.5% (N=110) in urban and 8.7% (N=559) in rural areas.

Conclusions: These findings underscore the need for examination of the association between medical personnel presence and adverse pregnancy outcomes like excessive bleeding. A physician's presence may be a necessity during delivery, and crucial for some crisis management, but may also coincide with greater use of cesareans or other invasive techniques which require more resources and communication.

Assessing the Impact of Health Facility-Based Maternal Delivery Care on Adverse Pregnancy Outcomes in Kenya: A Multi-Factor Analysis Approach

By

Beverly Bruno

B.S. Health Sciences

Boston University

2022

Thesis Committee Chair: Subasri Narasimhan, PhD, Emory University

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Global Health
2024

Acknowledgements

I am deeply grateful to God for His unwavering support and guidance throughout this journey. His strength sustained me through every challenge and triumph.

My sincere appreciation goes to my thesis advisor, Suba Narasimhan, whose experience, encouragement, and positivity were invaluable. I am also indebted to Jasmin Eatman, whose insightful feedback and steadfast support helped dispel any doubts and keep me grounded.

I extend heartfelt thanks to my family and friends for their patience and support, enduring countless conversations about my thesis at every stage.

Special gratitude goes to my work sibling, Seun Aluko, whose expertise in R coding and immense flexibility, even on weekends, propelled me beyond my perceived limits in data analysis and interpretation.

I am also grateful to Morgan, John, Rob, and Wisdom for their kind support during the final stages of data analysis, as their technical assistance and reassurance helped me get to the finish line.

I would like to express my gratitude to IPUMS for granting me access to the Demographic Health Survey data, which provided a new perspective on obstetric hemorrhage outcomes and fueled my passion for advancing knowledge to promote safe birthing experiences.

Lastly, I acknowledge and commend myself for the dedication and determination to push through countless late nights of writing, outlining, and debugging code. In the words of 2 Chronicles 15:7, “Be ye strong therefore, and let not your hands be weak, for your work shall be rewarded.”

Table of Contents

Abbreviations

AMSTL: Active management of third stage of labor

COM-B: Capability, Opportunity, and Motivation-Behavior

DHIS: District Health Information System

DHS: Demographic and Health Survey

EmONC: Emergency obstetric and newborn care

FMHP: Free Maternal Health Care Policy

HDI: Hemodynamic instability

MMEIG: Maternal Mortality Estimation Interagency Group

MMR: Maternal mortality ratio

OH: Obstetric hemorrhage

PPH: Postpartum hemorrhage

SSA: Sub-Saharan Africa

TDF: Theoretical Domains Framework

WHO: World Health Organization

Introduction

In 2017, the Maternal Mortality Estimation Interagency Group (MMEIG) reported a global estimate of 295,000 maternal deaths, with Sub-Saharan Africa (SSA) accounting for a significant majority at 66%, totaling 196,000 deaths (Musarandega et al., 2021). Obstetric or postpartum hemorrhage (PPH) stands as the predominant root cause behind 24.5% of maternal fatalities in SSA (Ameh et al., 2022). Historically, PPH was routinely characterized by estimated blood loss thresholds, such as 1000 mL of blood loss for any delivery mode or 500 mL and 1000 mL for vaginal and cesarean delivery, respectively (Ende, 2022). More recent studies define PPH based on the requirement for at least 1 unit of packed red blood cell (pRBC) transfusion, recognizing the need for transfusion as a crucial indicator of PPH severity and potential morbidity (Ende, 2022).

PPH is often linked to obstructed labor, where the fetal presenting part fails to descend in the birth canal due to mechanical reasons, despite sufficient uterine contractions (Ayenew, 2021; Tadese et al., 2022). Diagnosis involves the patient's experience of prolonged labor duration, the mother's inability to support herself or move her lower extremities, abnormal vital signs, distended bladder, Bandle's ring formation in the lower uterine segment, fetal distress or death, edematous vulva, significant molding, big caput, and foul-smelling, thick meconium-stained amniotic fluid (Ayenew, 2021). Most maternal deaths from neglected obstructed labor, comprising 8% of global maternal deaths, disproportionately affect impoverished rural women without access to skilled birth attendants. Neglected obstructed labor poses risks to both mother and fetus, including infection, tissue damage, uterine rupture, and maternal fatality from hemorrhagic shock, while also increasing the risk of stillbirth and infant hypoxia (Girma, Gezimu, & Demeke, 2022). This neglect underscores inadequate obstetric care, exacerbated by poverty, limited healthcare access, cultural beliefs favoring vaginal delivery, delayed referrals, and reluctance towards cesarean delivery, especially post-previous surgeries (Ayenew, 2021). Most obstructed labor and PPH cases have been shown to be preventable, with nearly 90% of the latter condition demonstrating at least one provider-related preventability factor and one-third demonstrating at least one system-related factor (Ende, 2022).

Hemorrhage, the primary cause of maternal death, is often attributed to insufficient resources, encompassing a lack of standardized training in delivery assistance, inadequate childbirth facilities, and a scarcity of essential obstetric care materials such as transfusion blood (Musarandega et al., 2021). These challenges are widespread in SSA, where home deliveries and births in ill-equipped primary care facilities are common. Despite the increasing rates of deliveries in healthcare facilities and improved access to medications like uterotonic drugs, designed to initiate uterine contractions and manage bleeding, PPH prevalence remains elevated (Manrique Muñoz et al., 2012). This underscores the necessity for heightened focus on enhancing access, ensuring quality, and providing timely care during delivery hospitalizations to address this persistent challenge effectively.

Research into PPH quality of care is particularly important in settings with high maternal mortality such as Kenya. Kenya has a maternal mortality ratio of 338 deaths per 100,000 live births, with approximately 40% of maternal deaths attributable to PPH (Clarke-Deelder et al., 2023). The adoption of user fees for accessing healthcare, including essential services like maternal and child healthcare, introduced in 1989 due to economic challenges, insufficient financial resources, and international pressure, could have a notable impact on the overall evolution of maternal health and delivery outcomes over time (Lang'at, Mwanri, & Temmerman, 2019). Since then, user fees have been suspended on and off but were officially discontinued in 2004, when outpatient healthcare in public primary healthcare facilities (health centers and dispensaries), was declared free (Tama et al., 2018). In recent years, Kenya has implemented several reforms to increase access to maternity care, including a voucher program for subsidized maternity care and the introduction of free maternity care in public health facilities in 2013 (Clarke-Deelder et al., 2023). Such policies have led to significant increases in the rate of facility-based delivery over time.

Despite making significant progress towards improving access to maternal health services across diverse regions, informal urban settlements and slums continue to grapple with elevated rates of maternal and child mortality (Atahigwa et al., 2020). Urban areas like Nairobi, including informal urban settlement areas, face challenges in the effective utilization of maternal health care services due to socioeconomic and geographical disparities. Studies indicate that residents in Nairobi's informal urban settlement areas exhibit worse health outcomes compared to both urban and rural counterparts (Atahigwa et al., 2020, Wamukoya et al., 2020, Corburn & Karanja, 2016). The prevalence of health facility births in Nairobi informal urban settlements is notably lower, comprising only 52% of births compared to the citywide rate of 78% (Atahigwa et al., 2020). This, along with persistently high maternal mortality rates associated with PPH and obstructed labor, not only underscores challenges in accessing care but also identifies quality of care as a significant concern.

In Kenya, only 44% of births are overseen by skilled birth attendants. According to the World Health Organization (WHO), a skilled birth attendant is defined as *"an accredited health professional - such as a midwife, doctor or nurse - who has been educated and trained to proficiency in the skills needed to manage normal (i.e. uncomplicated) pregnancies, childbirth and the immediate postnatal period, and in the identification, management and referral of women and neonates for complications"* (WHO, 2024). Traditional birth attendants (TBA), regardless of their training status, do not fall within the classification of a "skilled attendant at delivery" (WHO, 2024). TBAs are involved in approximately 28% of childbirths, whereas friends or relatives, often assumed to lack formal training, are involved in 21% of deliveries. Notably, 7% of pregnant women receive no assistance (Odallo, Opondo, & Onyango, 2018). Additionally, the study by Odallo, Opondo, and Onyango (2018) highlights a significant discrepancy in access to adequate delivery care, revealing that merely 8% of impoverished women had access compared to 24% of wealthier women in 2016 (Odallo, Opondo, & Onyango, 2018). This underscores the inequities in healthcare provision that are also influenced by the patient's socio-economic status. Notably, the World Bank (2023) reported that in 2015/16, 36% of the Kenyan population lived below the national poverty line, providing context for the socio-economic landscape during this period (World Bank, 2023). Health facilities are ill equipped for quality maternal health care, as only 36% of public facilities providing delivery services possess essential infrastructure, including electricity and water (Odallo, Opondo, & Onyango, 2018). In 2014, a Kenya District Health Information System (DHIS) report revealed that 81% of 484 reported maternal deaths resulted from substandard care, emphasizing the potential prevention of many fatalities through improved standards of care (Odallo, Opondo, & Onyango, 2018).

As such, this thesis adds to the existing body of literature by analyzing population-level Demographic Health Survey (DHS) data to investigate trends in specific adverse pregnancy outcomes and facility-based delivery indicators. This, in turn, contributes to the broader global initiative to reduce maternal and neonatal deaths. A critical component of this effort involves understanding context-specific factors that contribute to morbidity and mortality, enabling targeted improvements in the quality of care to reduce the risk of maternal deaths.

Problem Statement

Despite continuous efforts to enhance maternal health, Kenya grapples with significant challenges in diminishing adverse pregnancy outcomes. PPH remains a significant contributor to maternal mortality and morbidity, standing as the leading cause of maternal death despite the availability of effective procedural approaches to acute management (Clarke-Deelder et al., 2023). PPH further triggers severe complications like anemia and shock, particularly in resource-limited regions where women lack access to quality healthcare services. Addressing these challenges is imperative for fostering sustainable improvements in maternal health and alleviating the burden of preventable complications.

Study Purpose

This study emerged from a recognition of the need to investigate trends in adverse pregnancy outcomes, focusing on obstetric hemorrhage (OH), across health facilities in Kenya. By analyzing predictors of obstetric care quality, considering factors like urban-rural residence, the research seeks to understand determinants of adverse maternal health events in Kenya, within the reproductive health landscape of the 1990's. Additionally, the study seeks to identify opportunities for improving health system capacity, enhancing access to quality care, addressing data gaps, informing evidence-based strategies for diverse healthcare settings.

Research Question and Aims

This study will examine the association between healthcare system-related indicators and adverse maternal health event prevalence, specifically PPH, within health facilities in Kenya through the following aims:

(1) Investigate healthcare system-related determinants associated with OH prevalence across diverse delivery settings in Kenya;

(2) Assess relationships between various indicators impacting the likelihood of adverse maternal health events, with a particular focus on the significance of interactions between the type of skilled birth attendant present and the use of delivery methods;

(3) Evaluate the necessary protective factors to reduce the risk of adverse pregnancy outcomes, utilizing regression and multifactorial analyses to identify key variables influencing OH burden.

This study addresses the following research questions:

1. How do healthcare system-related indicators correlate with the prevalence of adverse maternal health events across different delivery settings in Kenya?
    a. What urban-rural differences are observed in delivery conditions related to prolonged labor?
2. What protective factors are essential for mitigating the risk of adverse pregnancy outcomes across Kenya?

Significance Statement

Analyzing trends in OH, alongside identifying protective factors related to delivery indicators, serves as a vital foundation for advancing maternal healthcare and delivery conditions in Kenya. These findings have the potential to guide efforts in enhancing health workforce capacity, improving access to quality care, and ultimately reducing adverse pregnancy outcomes by identifying gaps from the past and assessing their persistence in present-day Kenya. The significance of this research is underscored by the persisting status of PPH as the leading cause of maternal mortality in Kenya, with 40% of maternal deaths attributed to this condition (Clarke-Deelder et al., 2023). The optimal management of obstructed labor and PPH in a clinical setting is shown to be most effective when employing a coordinated multidisciplinary approach. This approach hinges on elements such as effective communication, precise assessment of blood loss, continuous monitoring of maternal vital signs, fluid replacement, and simultaneous intervention to halt the source of hemorrhage (Bienstock, Eke, & Hueppchen, 2021). Given the clinical implications of emergency delivery response, it is imperative to study differences in the utilization of skilled care during childbirth and their association with maternal health outcomes.

This study relies on nationally representative data from Kenya DHS, ensuring comprehensive coverage across the country. This representativeness allows the research to delve into OH and obstructed labor in Kenya, providing crucial insights into obstetric care and maternal health outcomes. This singular dataset serves as a robust lens through which to observe historical trends and developments over time, offering a focused understanding of these associations at a national level.

Definition of PPH

In 1990, the World Health Organization (WHO) defined “postpartum hemorrhage” (PPH) as blood loss equal to or exceeding 500 mL from the genital tract following delivery, which remains the widely accepted standard definition (Borovac-Pinheiro et al., 2018). Despite WHO’s caution regarding the clinical significance of the blood loss threshold due to insufficient evidence, 500 mL was adopted as the PPH diagnostic volume, based on perceptions of normal postpartum blood loss and with some variation (Borovac-Pinheiro et al., 2018). This volume of blood loss, if untreated, can lead to hemorrhagic shock and death in some cases (Rath, 2011). Moreover, historical studies from the early 1960's established that blood loss exceeding 1000 mL following a cesarean delivery was considered the threshold for diagnosing PPH (Rath, 2011). The further categorization of PPH into "primary," occurring within 24 hours post-delivery, and "secondary," occurring more than 24 hours post-delivery but within 12 weeks postpartum, marks the sole significant change in PPH definition in the last 50 years (Rath, 2011).

A major concern regarding PPH definition is WHO's recommendation of visually assessing blood loss, which may lead to underestimation errors related to volume. Visual quantification has been shown to underestimate blood loss by 33–50% compared to spectrophotometry, potentially delaying diagnosis and treatment (Borovac-Pinheiro et al., 2018). Alternative definitions for PPH have been proposed to enhance prompt recognition of its signs and facilitate diagnosis based on blood loss thresholds. One such suggestion is to define PPH based on any blood loss amount that results in hemodynamic instability (HDI), characterized by alterations in blood pressure and heart rate. (Borovac-Pinheiro et al., 2018; Abebe et al., 2022). However, a drawback to this approach is that symptoms of hemodynamic instability often appear as late indicators of significant blood loss, signaling the onset of critical conditions endangering the mother's life (Rath, 2011). For instance, typically, healthy non-anemic women do not show signs of hemodynamic instability until blood loss exceeds ≥1000 mL (Borovac-Pinheiro et al., 2018).

Etiology of PPH

PPH may be caused by a wide variety of issues, which includes uterine atony, trauma (uterine, cervical, or vaginal), tissue retention (like retained placenta or clots), and thrombin attributed to coagulopathy (Sebghati & Chandraharan, 2017). These causes are commonly referred to as the "Four T's" in the corresponding order: Tone (70% of PPH cases), Trauma (15-20%), Tissue (10-30%), and Thrombin (<1%) (Corvino et al., 2021). Uterine atony occurs when the myometrium, or the muscle layer of the uterine wall, does not sufficiently contract despite the release of oxytocin, a hormone that typically triggers contractions during and after childbirth (Gill, Patel, & Van Hook, 2023). Ineffective uterine contraction coupled with the flaccid state of the uterus post-childbirth can cause excessive postpartum bleeding due to insufficient pressure for hemostasis (Angelina, Kibusi, & Mwampagatwa, 2019, Ignacio et al., 2020). Trauma to the uterus, cervix, and/or vagina ranks as the second most common cause of PPH, during the third stage of delivery, immediately following the birth of the baby. These tissues become highly vascularized during pregnancy to support fetal development and childbirth preparation, thereby rendering them more prone to bleeding when injured and significantly raising PPH risk (Sebghati & Chandraharan, 2017).

Expanding on the impact of tissue on PPH occurrence, the retention of tissue—particularly retained placenta or clots—can lead to either primary or secondary PPH. Secondary PPH cases often result from both retained products and infection, potentially causing complications like endometritis, inflammation of the inner uterine lining. Treatment may involve antibiotics and surgical removal of retained products (Sebghati & Chandraharan, 2017). Even in the absence of infection, retained placental tissue interferes with uterine muscle contraction, hindering the mechanical hemostatic process post-placental delivery (McLintock, 2020). Finally, thrombin attributed to coagulopathy refers to the presence of abnormal blood clotting due to a coagulation disorder such as hemophilia, Von Willebrand's disease, etc. Coagulopathy can interfere with normal blood clotting, leading to excessive bleeding during and after delivery (Sebghati & Chandraharan, 2017). In individuals with coagulopathy, insufficient production or dysregulation of thrombin, a key clotting enzyme, increases PPH risk. While early coagulopathy is rare in most PPH cases (notably those caused by uterine atony, trauma, or uterine rupture), late-diagnosed or underestimated blood loss PPH episodes may show signs of earlier coagulopathy onset. Coagulopathy is observed in about 3% of PPH cases, with its occurrence rising with the volume of bleeding (Hofer et al., 2023).

In LMICs, PPH and related deaths often result from comorbidities or practices linked to the "Four T's," such as obstructed labor and cesarean sections performed by inexperienced providers in non-clinical or low-equipped settings. These challenges, compounded by institutional barriers like limited emergency transport and inadequate expertise and supplies, can elevate the risk of maternal mortality (Owen, Cassidy, Weeks, 2021).

Risk Factors for PPH

The primary risk factors for PPH can be divided into three categories: biological, demographic, and institutional. Biological factors encompass pregnancy complications like hypertensive disorders, as well as delivery-related factors such as prior cesarean delivery, retained placenta, and prolonged labor (Borovac-Pinheiro et al., 2018). A prolonged labor, especially during the initial stage, increases the risk of PPH by triggering uterine atony in the third stage after the infant's delivery. Continuous contractions over an extended labor duration can fatigue the uterine muscles, diminishing their capacity to constrict the spiral arteries, thereby leading to greater likelihood of PPH occurrence (Nyfløt et al., 2017). As highlighted in a 17-year maternal mortality review in Nigeria, demographic risk factors encompass education, marital status, and maternal age (Valdes et al., 2018). A study in Ghana analyzing the causes of maternal mortality among various socio-demographic groups found that in a sample of 2136 participants, married women over 35 faced a higher risk of dying from hemorrhage compared to younger women and other research has suggested that advancing age might be linked to reduced PPH risk (Valdes et al., 2018, Lao et al., 2014). Institutional risk factors include health facility accessibility, skilled provider availability, and medical resource availability (Valdes et al., 2018). For instance, to enhance the accuracy of blood loss measurement and enable timely PPH reporting and response, various measurement tools such as blood-soaked pads are utilized in clinical practice (McLintok, 2020). However, in remote areas, access to such tools, including affordable options like absorbent delivery mats, may be limited, affecting the ability of birth attendants in these settings to respond promptly to PPH (Rath, 2011).

Influence of Past Reproductive Health Policy on Obstetric Care Quality and Facility-Based Delivery Service Utilization

Kenya exhibits a high neonatal mortality rate of 22.6 per 1000 births (Gichuhi & Lusambili, 2019). This trend arises from multiple factors, such as the urban-rural disparity in health facility utilization, as emphasized in the 2014 KDHS, the considerable proportion (56%) of Kenyan women declining skilled birth attendant care, and only 28% seeking assistance from Traditional Birth Attendants (TBAs) when opting for home births (Lang'at & Mwanri, 2015).

To address these challenges, the Government of Kenya implemented the Free Maternal Health Care Policy (FMHP) on June 1, 2013, eliminating delivery fees at all public health facilities through a presidential directive. Originally introduced in 1989 as a health financing strategy, user fees for healthcare services were found to exacerbate healthcare access inequities, with poorer households utilizing fee-charging facilities less than their wealthier counterparts (Lang'at & Mwanri, 2015). In contrast, the 2013 policy update aimed to boost health facility delivery utilization and reduce pregnancy-related mortality, tackling barriers such as the lack of skilled birth attendants and high costs, particularly affecting lower-income women. By implementing FMHP, the Kenyan government hoped to encourage women to utilize skilled birth attendants trained in modern medical techniques rather than TBAs (Lang'at & Mwanri, 2015). Several studies have acknowledged the positive impact of this policy, noting enhancements such as higher rates of institutional deliveries, elective cesarean sections, and antenatal and postnatal care visits (Lang'at & Mwanri, 2015, Gichuhi & Lusambili, 2019). The removal of user fees significantly benefited financially disadvantaged populations, as shown by an immediate and sustained increase in the use of skilled care during pregnancy and childbirth (Gichuhi & Lusambili, 2019, Lang'at & Mwanri, 2015). A 2015 interrupted time series analysis (ITSA) spanning two years before and after FMHP implementation revealed substantial increases: 1293 more births attended by skilled birth attendants, 1183 additional antenatal care visits, and 1235 extra live births monthly, reflecting 97%, 98%, and 89% increases, respectively (Lang'at & Mwanri, 2015).

However, cost is not the sole barrier to utilizing health facility delivery services. Standard economic theory suggests that a reduction in healthcare prices may lead to decreased spending on essential resources such as medications and staffing, thereby resulting in a decline in healthcare service quality (Hatt et al., 2013, Lang'at & Mwanri, 2015). This theory was substantiated by reports from numerous health workers, indicating that the FMHP implementation lacked adequate resources, including consistent restocking of essential commodities, timely government reimbursements to facilities, and hiring additional healthcare professionals and administrators (Lang'at & Mwanri, 2015, Gitobu, Gichangi & Mwanda, 2018). The 2015 descriptive cross-sectional study of 110 health workers at Rift Valley Provincial General Hospital (RVPGH) and Bondeni Maternity Health Center examined challenges and strategies for FMHP implementation, which highlighted inadequate reimbursement as a major obstacle to full implementation (Wamalwa, 2015). The medical superintendent at RVPGH reported irregular reimbursements of 50-74% of expected funds, while the Nursing Officer in charge at Bondeni Maternity noted that the facility had never received any reimbursements since the FMHP's inception (Wamalwa, 2015). Additionally, staff highlighted that infrastructure concerns remained despite the removal of cost barriers. They highlighted limited space and bed capacity in the maternity and newborn areas, constraining them from providing adequate care and accommodating patients effectively (Gichuhi & Lusambili, 2019).

Present-Day Obstetric Care Quality

Healthcare provider understanding of clinical protocols for PPH is another important area of examination. Existing literature underscores significant gaps in providers' comprehension of these protocols, their adherence to monitoring guidelines for early complication detection, and their prompt assessment and administration of necessary treatments and medications. WHO recommends oxytocin as the first-line treatment for PPH, with misoprostol as an alternative. However, a 2021 cross-sectional assessment of oxytocin and misoprostol access in Kenya, Uganda, and Zambia found that while oxytocin availability was higher, misoprostol availability, particularly in the public sector, fell below WHO benchmarks at 45% in urban facilities and 27% in rural facilities (Kibira et al., 2021). This highlights the need to improve access to misoprostol, especially in rural areas, where barriers to optimal PPH management persist. In low- and middle-income countries (LMICs), such as those studied, obstructed labor and PPH prevalence remain high, particularly in rural areas, indicating ongoing challenges in medication accessibility, emergency response and management, and knowledge dissemination.

Knowledge Gaps in PPH Clinical Protocol for Providers

A mounting body of evidence points to gaps between healthcare providers' understanding of clinical protocols for maternity care and the practical implementation of these protocols, commonly known as "know-do gaps" (Rokicki, Mwesigwa, & Cohen, 2021). Know-do gaps may be attributed to various factors, including established health facility norms, healthcare provider burnout or diminished motivation, lack of accountability, and insufficient supportive supervision (Clarke-Deelder et al., 2023). A knowledgeable health workforce is crucial for delivering high-quality care. However, the apparent workforce shortage coupled with provider knowledge gaps are likely hindering the effective delivery of interventions to mothers and newborns, thereby contributing to suboptimal outcomes (Namayi, Makokha, & Echoka, 2020). The current literature on knowledge related to PPH protocols in SSA primarily focuses on preventive measures, particularly through active management of the third stage of labor (AMSTL). However, there exists a lack of in-depth studies examining healthcare providers' knowledge of PPH risk assessment and management. Notably, the imperative to address "know-do gaps" becomes especially paramount within the context of teaching and referral hospitals, where providers play pivotal roles in training students and managing obstetric emergencies referred from community and primary health centers (Henry et al., 2022).

A cross-sectional study by Henry et al. (2022) examining provider knowledge of PPH care protocols in three high-volume referral facilities in Nairobi and western Kenya revealed significant knowledge gaps in three key domains: risk assessment protocols, preventive care protocols, and PPH management protocols. The primary knowledge gaps in risk assessment protocols included inadequate attention to the initiation time of labor and monitoring of urine output, as mentioned by 31% and 51% of providers respectively. Preventive care knowledge gaps were observed regarding measures to avoid prolonged labor, monitoring blood loss, and advising mothers to seek medical attention about bladder issues. In provider interviews, 34% reported administering tranexamic acid, an antifibrinolytic agent known to reduce PPH-related mortality in women, in at least three relevant PPH cases (Henry et al., 2022).

Studies have pointed to the lack of various forms of obstetric training provided to obstetric providers throughout Kenya. Henry et al. (2022) also found that only 45% of healthcare providers had received additional training in basic emergency obstetric and newborn care (EmONC). This training encompasses critical interventions addressing major causes of morbidity and mortality, such as administering parenteral uterotonic drugs for PPH (Tiruneh et al., 2018). These lower rates of training participation are further emphasized by Muthoni et al., in which 31.8% and 36.5% of the midwives had trained on AMSTL and EmONC, respectively. The baseline data indicates that merely 30% of health workers received training on the national protocol in the two years prior to the study's initiation. These training gaps have been linked to government resource constraints and inadequate guideline implementation (Muthoni et al., 2021).

Such training gaps may worsen among TBAs, who play a crucial role in childbirth assistance, especially in regions with limited access to skilled healthcare and formal services (Garces et al., 2019). Reliance on TBAs can pose risks for PPH likelihood and outcomes, as their traditional practices lack evidence-based support, such as using raw boiled tree leaves with salt to shorten labor duration (Kassie et al., 2022). TBAs often lack formal medical training and essential skills to effectively manage PPH, resulting in delayed recognition and treatment—a concern studied extensively worldwide. In a 2014 study of 118,594 birthing women in rural Bangladesh focused on community-based provision of misoprostol and absorbent delivery mats, TBAs solely used visual estimation to identify PPH cases during home deliveries, revealing a critical gap in accurate blood loss assessment, diagnosis, and response. In contrast, the study also revealed that the presence of a trained TBA tripled the utilization of interventions such as misoprostol and delivery mats, indicating a substantial enhancement in symptom management (Prata et al., 2014).

Adherence to Monitoring Guidelines for Detection of PPH

Continuous monitoring of vital signs, blood loss, and uterine tone is imperative to promptly identify and address PPH cases, many of which may not be easily predicted based on patient characteristics. It is crucial to take prompt measures to address complications before they escalate in severity. Maternal death reviews conducted across various settings revealed insufficient monitoring as a significant factor contributing to mortality, playing a role in 27% of cases in a Kenyan review (Clarke-Deelder et al., 2023; Clarke-Deelder et al., 2023).

Clarke-Deelder and colleagues (2023) conducted direct observations of vaginal deliveries (N=907) in three Kenyan referral hospitals from October 2018 through February 2019, measuring provider adherence to WHO and Kenyan guidelines for PPH risk assessment and management. The study defines "suspected PPH" as the metric to evaluate provider adherence behaviors and actions undertaken when healthcare providers identify abnormal bleeding, with an observed suspected PPH rate of 9% among vaginal deliveries. Apart from checking patients' HIV and anemia status, providers showed limited adherence to PPH assessment guidelines, with only a 7% adherence rate for risk assessment and a 4% adherence rate for prevention among all observed deliveries. Complications in past pregnancies were inquired about by providers in just 67% of deliveries among women with a history of pregnancies. Furthermore, providers failed to adhere to postpartum monitoring guidelines, neglecting assessments of vital signs, uterine tone, and blood loss in all observed deliveries within the 24 hours following delivery. Similarly, a hospital-based study by Muthoni et al. (2021) conducted in Muranga County, Kenya among a sample of 85 midwives discovered that health workers did not consistently consult national guidelines, even though 90% of those interviewed were aware of the display location in the labor room. The absence of standardized PPH management could be attributed to the urgency of PPH emergency response, leading to the potential oversight of guidelines.

Delivery Location (Hospital vs. Home) and PPH

Adherence to PPH guidelines can vary significantly depending on the delivery location, whether it be a hospital or home setting. In hospitals, with readily available skilled healthcare professionals and resources, adherence to PPH guidelines is typically more feasible (Akter et al., 2022). Moreover, institutions like hospitals have greater capacity for collaborations to promote widespread implementation of organized and systematic processes in PPH management. Institutions like hospitals also have the capacity for collaborations to promote widespread implementation of organized and systematic processes in PPH management. Notable examples include the Alliance for Innovation on Maternal Health (AIM) Safety Bundle on PPH, which compiles evidence-based guidelines and contains 13 key practice elements to improve PPH management and outcomes. Healthcare facilities implementing the AIM Safety Bundle can streamline practices and ensure consistent application of evidence-based interventions to reduce PPH incidence and improve maternal outcomes (Joseph et al., 2020).

Healthcare providers in hospitals are well-versed in standardized protocols for managing postpartum hemorrhage (PPH), facilitating prompt and effective responses to signs of hemorrhage. Hospitals provide an environment conducive to continuous maternal health monitoring during labor and delivery, leveraging patient-level data to track clinical information, risk factors, and comorbidities. This enables early detection and intervention in cases of excessive bleeding (Fein et al., 2019). For instance, the Association of Women's Health, Obstetric and Neonatal Nurses' Postpartum Hemorrhage Risk Assessment Tool (PHRAT) utilizes an algorithm to systematically categorize delivering women into low-, medium-, or high-risk groups based on patient responses, clinical factors, and available chart data (Joseph et al., 2020).

On the other hand, adherence to PPH guidelines may pose challenges in home birth settings, especially in resource-limited areas with limited access to skilled healthcare providers and medical facilities. Home births, often attended by traditional birth attendants or family members, may lack the resources and expertise to manage PPH according to guidelines. Delays in recognizing and responding to PPH may occur, relying on visual estimation of blood loss and traditional practices for managing hemorrhage (Prata et al., 2014). Limited access to essential medications and emergency obstetric care further complicates timely PPH management. While efforts to train and equip traditional birth attendants may help, ensuring consistent adherence to

PPH guidelines in home birth settings remains a significant challenge, emphasizing the importance of expanding access to skilled birth attendance and emergency obstetric care in resource-limited areas.

Delays in Assessments and Emergency Response

When providers adhered to guidelines, they did not consistently do so in a timely manner, out of step with international guidelines. Muthoni et al. (2021) also discovered that only a few demonstrated proficient skills in administering prophylactic uterotonic within a minute after delivery, with the majority not adhering to the recommended timing guidelines (Muthoni et al., 2021). Clarke-Deelder et al. (2023) similarly observed that treatment uterotonics were typically given between 5 and 15 minutes after identifying PPH, with 24% of patients not receiving them until more than 15 minutes (Clarke-Deelder et al., 2023). These findings contradict the foundational WHO guidelines, which recommend administering uterotonics immediately (preferably within one minute) after childbirth for optimal efficacy (WHO, 2018).

Additional time-sensitive clinical actions following delivery and PPH identification were not promptly carried out, experiencing delays exceeding 15 minutes. In 32% of cases, diagnostic blood compatibility tests, including blood typing and cross-matching, were delayed by over 30 minutes after initial PPH identification, and in 33% of cases, no tests were conducted at all (Clarke-Deelder et al., 2023). Some instances revealed notable delays in fundamental PPH management, such as vaginal exams and tear repair. Delays in the latter could be linked to the general unavailability of sutures at the bedside, leading providers to retrieve them (Clarke-Deelder et al., 2023). A qualitative study exploring the perspectives of 45 maternity healthcare providers (midwives, nurses, doctors, managers) across nine hospitals in Kenya, Nigeria, and South Africa identified shortages of equipment specific for PPH detection as a significant source of time constraints regarding PPH management (Akter et al., 2022).

Evidence from the literature points to a need to improve emergency preparedness and timely clinical decision-making and actions being performed. As supported by Muthoni et al. findings, adoption of simulation training, early warning systems, and other quality improvement interventions should be considered to improve the timeliness of critical PPH emergency response steps within highly dynamic situations and settings. While efforts have increased to implement workforce development measures, there has been limited evaluation of their impact on PPH and obstructed labor outcomes, particularly in conjunction with other healthcare system-related factors within health facilities and across regions. These outcomes serve as crucial metrics for assessing the quality of obstetric care at the population level. It is essential to examine how demands for quality care improvement have evolved and how they have been addressed over time.

Theoretical Framework/Evidence-Based Practice Model

Prior research identifies various factors affecting adherence to PPH detection and management recommendations in LMICs, including inaccuracies in blood loss estimation, limited skills in detection and management, and broader health system challenges. Such challenges include lack of health workforce knowledge and capacity, limited resources, and unreliable drug supplies (Forbes et al., 2023). The joint application of the Theoretical Domains Framework (TDF) and the Capability, Opportunity, and Motivation-Behavior (COM-B) model offers valuable insights into the determinants of behavior change. These frameworks underpin the current study, focusing on analyzing predictors of obstetric quality, particularly healthcare system-related factors such as place of delivery. These conditions influence birth attendants' response behaviors, particularly in assessing and managing PPH risks. The study explores what can be supported in the context of health system circumstances, such as the availability of medicines, impacting the likelihood of PPH occurrences and the responsiveness of emergency management.

Theoretical Domains Framework

The Theoretical Domains Framework (TDF) systematically categorizes 14 theoretical domains, each encapsulating psychological and environmental factors influencing behavior change. These domains cover knowledge, skills, social/professional role, beliefs about capabilities, optimism, beliefs about consequences, reinforcement, intentions, goals, memory, attention and decision processes, environmental context and resources, social influences, emotion, and behavioral regulation. TDF integrates diverse behavior change constructs into these domains, providing a comprehensive understanding of cognitive, affective, social, and environmental influences on behavior (Atkins et al., 2017). This study employs TDF version 2, published in 2012 after validation to refine its structure and content (Table 1).

Table 1. *The Theoretical Domains Framework (v2) with Definitions and Component Constructs (Atkins et al., 2017)*

Domain (definition)	Constructs
1. Knowledge (An awareness of the existence of something)	Knowledge (including knowledge of condition/scientific rationale) Procedural knowledge Knowledge of task environment
2. Skills (An ability or proficiency acquired through practice)	Skills Skills development Competence Ability Interpersonal skills Practice Skill assessment
3. Social/professional role and identity (A coherent set of behaviors and displayed personal qualities of an individual in a social or work setting)	Professional identity Professional role Social identity Identity Professional boundaries Professional confidence Group identity Leadership Organizational commitment
4. Beliefs about capabilities (Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use)	Self-confidence Perceived competence Self-efficacy Perceived behavioral control Beliefs Self-esteem Empowerment Professional confidence
5. Optimism (The confidence that things will happen for the best or that desired goals will be attained)	Optimism Pessimism Unrealistic optimism Identity
6. Beliefs about consequences (Acceptance of the truth, reality, or validity about outcomes of a behavior in a given situation)	Beliefs Outcome expectancies Characteristics of outcome expectancies Anticipated regret Consequents
7. Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	Rewards (proximal/distal, valued/not valued, probable/improbable) Incentives Punishment Consequents

	Reinforcement Contingencies Sanctions
8. Intentions (A conscious decision to perform a behavior or a resolve to act in a certain way)	Stability of intentions Stages of change model Transtheoretical model and stages of change
9. Goals (Mental representations of outcomes or end states that an individual wants to achieve)	Goals (distal/proximal) Goal priority Goal/target setting Goals (autonomous/controlled) Action planning Implementation intention
10. Memory, attention, and decision processes (The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	Memory Attention Attention control Decision making Cognitive overload/tiredness
11. Environmental context and resources (Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behavior)	Environmental stressors Resources/material resources Organizational culture/climate Salient events/critical incidents Person × environment interaction Barriers and facilitators
12. Social influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviors)	Social pressure Social norms Group conformity Social comparisons Group norms Social support Power Intergroup conflict Alienation Group identity Modelling
13. Emotion (A complex reaction pattern, involving experiential, behavioral, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	Fear Anxiety Affect Stress Depression Positive/negative affect Burn-out
14. Behavioral regulation (Anything aimed at managing or changing objectively observed or measured actions)	Self-monitoring Breaking habit Action planning

Note. Adapted from the Theoretical Domains Framework (Atkins et al., 2017)

In this study, TDF is applied across diverse healthcare settings and clinical behaviors to gauge obstetric care quality. Specifically, attention is directed towards domains encompassing knowledge, skills, social/professional roles and identity, beliefs about capabilities, and environmental consequences and resources.

Within the “knowledge” domain, birth attendants’ understanding of clinical guidelines for PPH management and detection is examined. This understanding influences their decision-making processes and response strategies during emergencies, such as determining when to actively monitor for early signs and symptoms of PPH (Han et al., 2023). The level of knowledge within the sample population may be linked to their formal education and prior training, serving as an indicator of the effectiveness of the health education system (Esan et al., 2023).

The “skills” domain differs from the previous one by focusing on birth attendants’ performance in managing PPH, especially regarding the timely administration of prophylactic uterotonic within one minute of delivery, given its critical role in prevention (Muthoni et al., 2021).Its importance is evidenced by inconsistent provider adherence to postpartum monitoring guidelines, with only a minority of birth attendants (e.g., midwives) demonstrating proficient skills in administering prophylactic uterotonic within one minute after delivery (Muthoni et al., 2021; Han et al., 2023). The domain of “social/professional role and identity” encompasses the range of actions and behaviors exhibited by birth attendants within the sample, which vary based on factors such as skill level and available resources. This variation may stem from differences in settings, whether social/communal or clinical. “Beliefs about capabilities” pertain to birth attendants’ confidence in their ability to safely deliver an infant. This confidence influences their diagnostic and response decisions, such as whether to actively monitor or adopt a wait-and-see approach (Han et al., 2023). The domain of “environmental consequences and resources” is represented by the place of delivery, which serves as a determinant of birth attendants' access to resources crucial for effectively monitoring and responding to PPH symptoms, thus impacting their overall adaptive behavior. The TDF domains have also been further condensed into three over-arching minimum constructs necessary for behavior change: Capability, Opportunity, and Motivation-Behavior (the COM-B model).

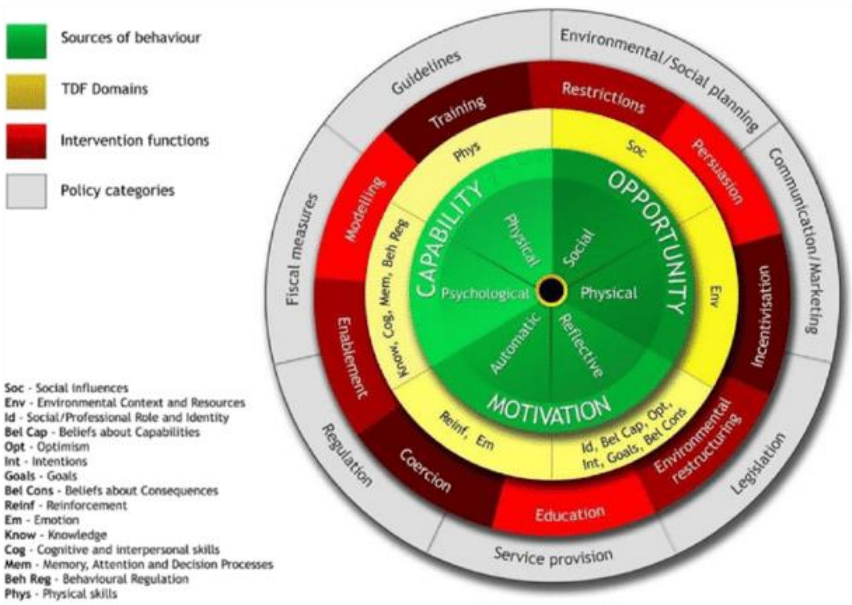
COM-B Model

The COM-B model provides a theoretical foundation for understanding behavior change by focusing on three essential components: Capability, Opportunity, and Motivation. "Capability" denotes an individual's ability, both physically and psychologically, to participate in a behavior or task. In this study, capability is assessed in terms of physical skills necessary for managing PPH, such as uterine massage or medication administration, and psychological proficiency, encompassing understanding of PPH risk factors, symptoms, and management techniques. "Opportunity" encompasses external elements that can either support or impede behavior change. In this study, it pertains to the level of human support (e.g., peers, trained supervisors) during childbirth and the availability of essential resources and infrastructure (e.g., medical supplies and equipment) across different delivery settings in Kenya. "Motivation" encompasses the cognitive and emotional drivers of behavior, which specifically relates to the responses of birth attendants during a PPH emergency (Michie, van Stralen, & West, 2011).

Behavioral Change Wheel

The Behavior Change Wheel (BCW) comprises four layers: sources of behavior (based on the COM-B model), TDF domains, intervention functions, and policy categories. Intervention functions include education, training, incentivization, modeling, coercion, persuasion, enablement, environmental restructuring, and restriction. Policy categories for implementation assistance encompass guidelines, environmental/social planning, communication/marketing, legislation, service provision, regulation, and fiscal measures (Figure 1).

Figure 1



Note. Adapted Behavior Change Wheel, combined Theoretical Domains Framework and COM-B model (Forbes et al., 2023)

The BCW combines the COM-B model with the TDF to facilitate the design of behavior change interventions. The COM-B model identifies the components of capability, opportunity, and motivation requiring targeting for behavior change, while the TDF pinpoints specific factors within each component for intervention strategies (Forbes et al., 2023). The BCW guides the identification of interventions to address barriers in PPH management and prevention across diverse delivery settings in Kenya, aligning with the study's objective to identify healthcare facility-related factors associated with the lowest incidence and prevalence of PPH.

Methods

Data Source

This cross-sectional secondary analysis utilized the 1998 KDHS, conducted by the National Council for Population and Development and the Central Bureau of Statistics (CBS). Funded by the U.S. Agency for International Development (USAID) and the Department for International Development (DFID), KDHS is part of the worldwide DHS program, focusing on fertility, family planning, and maternal and child health. The survey covered the entire nation, excluding less than 4 percent of the population in three districts in Northeastern Province and four northern districts. The sampling involved a two-stage, stratified approach, selecting 536 clusters (444 rural, 92 urban) with six inaccessible clusters.

Expanding the KDHS sample to cover all 75 districts in Kenya was difficult for data management and collection reasons, partially due to rurality, but reliable estimates were attainable for rural areas in 15 districts. These districts, along with Nairobi and Mombasa, were chosen based on historical presence of District Population Officers and inclusion in previous KDHS projects.

During late 1997 to early 1998, CBS field staff conducted household listings, selecting a systematic sample of 9,465 households. All eligible women aged 15-49 in these households were interviewed. The 1998 KDHS comprised Household, Women's, and Men's Questionnaires. To assess adverse pregnancy outcomes and facility-based delivery indicators, we analyzed responses from women aged 15-49 using the Women's Questionnaire. As in previous Demographic and Health Surveys, respondents were asked to provide a detailed history of each live birth. The data encompassed essential information such as the child's name, gender, date of birth, survival status (whether currently alive or deceased), current age if alive, and age at the time of death if applicable (NCPD, CBS (Office of the Vice President and Ministry of Planning and National Development), & MI, 1999).

Of 8,233 eligible women, 7,881 were successfully interviewed (96% response rate). At the individual level, response rates ranged from 91.5% in Central Province to 98.4% in Nyanza. Overall, response rates for female individual interviews were higher in rural areas (96.4%) than in urban areas (93.0%).

Sample

Tables 2a and 2b show the distribution of study variables by urban-rural status. The study excludes reports of stillbirths and spontaneous abortions due to their well-documented association with increased risk of PPH, as evidenced in the literature (Valdes et al., 2018). We conducted a thorough examination of the distribution of various categorical independent characteristics, stratified by urban-rural status, as part of the univariable analysis process (see Appendix below).

Table 2a presents the demographic characteristics for the 7,881 women in the sample. The birthing women in our sample were predominantly young, rural, and married. The proportion of older respondents decreased across urban and rural areas. The rural population constituted a larger proportion (81.4%) compared to urban areas (18.6%). Currently married women comprised 53.4% in urban areas and 60% in rural areas. Conversely, the percentage of never-married women was slightly higher in urban areas (33.1%) compared to rural areas (29.5%).

There was a diversity in wealth status across urban and rural locations. Most urban respondents belonged to the "richest" wealth quintile (68.1%), while most rural respondents fell into the “poorer” wealth quintile (24.3%) – the second lowest wealth quintile. Primary school was the highest level of education attained by most urban (44.8%) and rural (63.3%) respondents. Across all categories of birth attendants in our sample, the most common provider of delivery care for last births was a nurse/midwife in both urban and rural areas, with respective percentages of 16.4% and 12.1% (Table 2b). Following closely behind, relatives were the next most frequent providers, accounting for 4.6% of live births in urban areas and 12.4% in rural areas. Vaginal delivery was the most common type of delivery for the last birth across both urban (27.7%) and rural (37.5%) areas, compared to cesarean deliveries (3.2% and 2.4% respectively). Live births in urban areas were predominantly in government hospitals, with increasing rates as the recency of birth increased. Conversely, in rural areas, most live births occurred at the respondent’s home, following a similar trend with recency. While more respondents reported experiencing prolonged labor and excessive bleeding in rural areas compared to urban areas, the differences were not significant. Tables 2a and 2b hold further details on the survey participants and associated delivery characteristics.

Ethical Considerations

The data analyses were conducted using the publicly available 1998 KDHS data obtained from the Integrated Public Use Microdata Series (IPUMS) database, and the DHS data used for the study's analysis can be accessed upon reasonable request from this database. IPUMS USA data is available free of charge. Before using the data, researchers must complete a user registration webpage that states the research purpose and agree to not redistribute direct sample data without permission and cite IPUMS USA data appropriately.

Data Preparation and Variable Selection

In our dataset, missing data were defined as instances where certain variables crucial for analysis were not recorded or unavailable. Specifically, “Not Interviewed/Unknown” (NIU) and “Not Applicable” (NA) categories were used to categorize missing data. NIU refers to cases where respondents were not interviewed or where the information was unknown, while NA indicates instances where certain variables were not applicable to the respondent's situation. This approach aligns with the standard practices observed in DHS data handling, particularly regarding the categorization and handling of missing data.

Moreover, it is important to note that the present study’s analyses are based on data collected from mothers on all live births which occurred in the three years preceding the survey. This information was collected by first asking the women to indicate the number of their own children who were living with them, the number who were staying elsewhere, and the number who had died. As in previous Demographic and Health Surveys, the women were then asked to provide a detailed history of each live birth. The birth histories are lists of all the live births ever born to the main survey respondents, women aged 15- 49 at the date of interview (Pullum & Becker, 2014). The information collected on each live birth included name, sex, date of birth, survival status (whether alive or dead), current age if alive, and age at death if dead (NCPD, CBS (Office of the Vice President and Ministry of Planning and National Development), & MI, 1999).

Outcome Variable

The outcome measure of excessive bleeding, a proxy measure for PPH in our analysis focused on specific parameters. The determination of excessive bleeding relied on self-reported responses from women who gave birth in the last three to five years, where they were asked whether they experienced excessive bleeding around the time of the birth. “Excessive” bleeding was defined as bleeding "so much that you feared that it threatened your life." Following the framework proposed by Valdes et al., mothers who did not report excessive bleeding were designated as having a low likelihood of experiencing PPH, whereas those reporting excessive bleeding during delivery were categorized as having a high likelihood of experiencing PPH (Valdes et al., 2018). In our analysis, we recognize the subjective nature of individuals' experiences during labor and childbirth, acknowledging diverse personal fears and concerns. Perceptions of threats to life can vary subjectively, influenced by individual perspectives, cultural backgrounds, and contextual factors. This acknowledgment aims to underscore the inherent complexity and diversity in the childbirth journey. Additionally, it is crucial to highlight that later iterations of the Kenya DHS are labeled as "bleeding during pregnancy," diverging from the bleeding period examined in this study. PPH occurs specifically during or after delivery, contrasting with the 2022 version that emphasizes bleeding throughout pregnancy but not specifically in relation to delivery.

Predictor Variables

The main predictor variables in this study are persons who gave delivery care, delivery method, and place of delivery. For women who gave birth in the last three to five years, the type of person who assisted with the delivery was categorized into the following sub-variables of doctor, nurse/midwife, TBA, trained TBA, relative, other person, and no one. For delivery method, "delivery by cesarean section" was selected for analysis due to its association with adverse pregnancy and neonatal outcomes based on similar research and literature. Additionally, a new variable for vaginal deliveries was created from the existing cesarean delivery variable within the dataset, operating under the assumption that the inverse of a cesarean delivery would represent a vaginal birth. Place of delivery was categorized into the subsequent groups: "Respondent's

Home," "Other Home," "Government Hospital," "Government Health Center," "Government Maternal and Child Health (MCH) Center," "Private Hospital/Clinic," "Religious Hospital/Clinic," and "Other."

Covariates

The identification of presence of labor complications at delivery relied on self-reported responses from women who gave birth in the last three to five years, where they were asked whether they experienced prolonged labor, defined as experiencing regular contractions lasting more than 12 hours. In this study, covariates were identified a priori and through development of a Directed Acyclic Graph (DAG) based on prior peer-reviewed research in this domain. The selection of prolonged labor as a covariate was selected to address its potential impact on the association between delivery characteristics and excessive bleeding reports among birthing women in Kenya. Prolonged labor, characterized by extended duration and potential complications, may directly contribute to PPH or necessitate interventions such as assisted vaginal delivery or cesarean section, which are themselves associated with increased bleeding risk. Additionally, delays in accessing emergency obstetric care during prolonged labor may exacerbate the likelihood of adverse outcomes. By controlling for prolonged labor as a covariate, we aim to isolate the independent effects of delivery characteristics on excessive bleeding reports, thereby enhancing the precision of our analysis.

Stratified Variable

"URBAN" indicates whether the person's de facto residence was in an urban or rural location. Kenya has defined urban as towns with more than 2,000 inhabitants since the 1969 census. Urban-rural status was examined and categorized as a stratified variable based on research that has shown associated differences in access and quality of delivery care. In KDHS, urban-rural status is typically determined based on the administrative classification of enumeration areas by the Kenya National Bureau of Statistics. Enumeration areas are defined during the census and are generally classified as urban or rural based on various criteria such as population density, infrastructure, and economic activities. Survey respondents are usually classified according to the urban-rural status of the enumeration area in which they reside. The codes were assigned as follows: *1=urban, 2=rural*.

Analysis

R software was used in all statistical analyses. The statistical analyses were performed using R software. Univariate analyses were conducted to explore the completeness and distributions of all variables. After conducting a thorough analysis of the missing data, the "visdat" package in R was employed to visualize patterns of missingness through heat maps. The plots indicated that the missing data appeared to be randomly distributed. Additionally, upon closer examination of the survey questions, it was observed that no skip logic was implemented for the variables of interest, which could have led to systematic missingness. Therefore, any instances of missing data should be considered as occurring "missing at random" rather than exhibiting "systematic randomness."

All variables were categorical and reported as frequency and percentage. In this analysis, the outcome variable, predictor variables, and covariate are examined across two sub-variables, encompassing births from the most recent to the second-most-recent within the reference period preceding the survey. Participant demographic factors (age grouped in 5-year intervals, education level, marital status, wealth quintile), were collected during the 1998 KDHS and are incorporated in the present analysis. Pearson's product-moment correlation tests were conducted to investigate the associations among delivery attendants, place of delivery, and delivery outcomes in Kenya. These analyses aimed to assess the correlations between the type of delivery attendant and the delivery method, place of delivery and the delivery method, as well as the type of delivery attendant and the place of delivery. Urban-rural status, an associated observed variable, was subject to correlational analysis to further illuminate its role in the context of adverse pregnancy outcomes. At the univariable point, the chi-square test of association ($\chi 2$) was used to statistically test whether there was a meaningful association between reports of excessive bleeding and urban-rural status. In investigating factors related to excessive bleeding during childbirth within the KDHS dataset, logistic regression analyses were employed for both the last and second to last births. Bivariate logistic regressions were conducted for each predictor variable, with adverse maternal health events as outcome variables, to establish unadjusted associations and calculate adjusted odds ratios. These ratios elucidated the independent associations between predictor variables and adverse maternal health events, accounting for the prolonged labor covariate. To explore urban-rural differences in delivery conditions across delivery settings in Kenya, multivariate logistic regression was employed. The level of significance for probability value (p-value) was set at <0.05. Variables with a p-value of less than 0.05 are considered significant.

A multifaceted approach was taken to identify combinations of healthcare facility-associated factors leading to the lowest incidence and prevalence of select adverse pregnancy outcomes. Utilizing Multifactor Analysis (MFA), latent constructs were formed to represent complex protective factors not directly measured by single variables. These constructs were derived from multiple observed variables, allowing for a comprehensive exploration of the underlying dimensions contributing to adverse pregnancy outcomes. The first latent construct, “Delivery Care Quality,” encapsulated variables pertaining to the presence of skilled healthcare providers during childbirth. Specifically, this construct included the presence of a doctor and a nurse/midwife at the last birth. These variables were chosen based on their critical role in ensuring the provision of high-quality delivery care and their potential impact on maternal health outcomes, as shown in our regression analyses. In the second latent construct, denoted as “Delivery Setting Quality,” focused on the quality of the delivery setting and its association with adverse pregnancy outcomes. Within this construct, particular attention was given to two sub-categories: Government Maternal and Child Health (MCH) centers and Private hospital/clinics.

The “survey” package was used for regression analysis taking into consideration the primary sample unit, strata, and individual weights. To identify the units at the first stage of sampling, the primary sampling unit variable was utilized, represented by v021. The stratum variable based on urban-rural status was used, represented by v025. Individual sample weights (represented by v005) were applied to compensate for unequal selection probabilities between geographically defined strata. Standard errors were adjusted for the stratified, multistage, cluster sample design of the KDHS survey. IRB approval was not required for this study since it relies on secondary data analysis.

Results

Correlations Between Delivery Attendant, Delivery Location, and Delivery Type

There were correlations between types of birth attendants and the occurrence of cesarean section deliveries and vaginal deliveries (Table 3a). Notably, doctor-assisted births had a significant positive correlation with cesarean section deliveries for both the last birth ($r = 0.175$, 95% CI: [0.140, 0.209], p < 2.2e-16) and the second to last birth (r = 0.331, 95% CI: [0.246, 0.412], p = 8.941e-13). Similarly, nurse/midwife-assisted last births also showed a significant positive correlation with cesarean section experience at last birth (r = 0.082, 95% CI: [0.046, 0.117], p = 6.841e-06). The presence of no attendant and CS at most recent delivery had a significant negative correlation (r = -0.057, 95% CI: [-0.093, -0.022], p = 0.002). Negative correlations were also observed when various types of attendants, including traditional birth attendants (TBAs) (r = -0.061, 95% CI: [-0.097, -0.026], p = 0.0008) and trained TBAs (r = -0.037, 95% CI: [-0.072, -0.001], p = 0.045), were involved. Moreover, significant negative associations were found for deliveries attended by relatives (r = -0.095, 95% CI: [-0.130, -0.059], p = 1.947e-07). There was a significant negative correlation between doctor-assisted births (r = -0.175, 95% CI: [-0.209, -0.140], p < 2.2e-16) and nurse/midwife-assisted births (r = -0.082, 95% CI: [-0.117, -0.046], p = 6.841e-06) and vaginal delivery type. In contrast, significant positive correlations were found for deliveries attended by TBAs (r = 0.061, 95% CI: [0.026, 0.097], p = 0.0008), trained TBAs (r = 0.037, 95% CI: [0.0009, 0.072], p = 0.045), relatives (r = 0.095, 95% CI: [0.060, 0.130], p = 1.947e-07), and no attendants (r = 0.057, 95% CI: [0.021, 0.093], p = 0.002).

The relationship between the place of delivery and the mode of delivery for first and second births (Table 3b) was examined. For first births, there was a significant weak positive correlation between the place of delivery and CS delivery (r = 0.175, 95% CI [0.139, 0.210], p < 2.2e-16) and a corresponding significant weak negative correlation between delivery location and vaginal birth (r = -0.175, 95% CI [-0.210, -0.139], p < 2.2e-16). For second births, there was a significant positive association between place of delivery and CS birth (r = 0.268, 95% CI [0.175, 0.355], p = 3.751e-08) and a significant negative association between delivery location and vaginal delivery (r = -0.268, 95% CI [-0.355, -0.175], p = 3.751e-08).

Moreover, we examined correlations between the birth attendant and the chosen place of delivery for both first and second births (Table 3c). We observed a significant moderate positive correlation between the presence of a doctor at delivery and the chosen place of delivery ($r = 0.425$, 95% CI [0.394, 0.454], $p < 2.2e-16$). Similarly, a significant strong positive correlation was noted between the presence of a nurse/midwife and the place of delivery ($r = 0.598$, 95% CI [0.574, 0.621], $p < 2.2e-16$). Conversely, there was also a significant moderate negative correlation was found between the presence of a traditional birth attendant and the chosen place of delivery ($r = -0.241$, 95% CI [-0.275, -0.206], $p < 2.2e-16$), suggesting a preference for healthcare facilities. These correlations persisted in the same manner for subsequent births attended by TBAs ($r = -0.061$, 95% CI: [-0.197, -0.126], $p < 2.2e-16$), relatives ($r = -0.427$, 95% CI: [-0.457, -0.397], $p < 2.2e-16$), other persons ($r = -0.040$, 95% CI: [-0.076, -0.003], $p = 0.033$), and no attendants ($r = -0.232$, 95% CI: [-0.266, -0.197], $p < 2.2e-16$).

Urban-rural Delivery Distribution of Excessive Bleeding Reports

Figures 2a and 2b illustrate the distribution of reported incidents of excessive bleeding, categorized by urban-rural status for the most recent and second to last birth, respectively. Analyzing data from 3048 respondents reporting on recent births, chi-square tests revealed no significant relationship between these variables for the most recent births reported. Pearson's chi-square test yielded a statistic of 1.548 ($df = 1$, $p = 0.213$), while applying Yates' continuity correction resulted in a statistic of 1.399 ($df = 1$, $p = 0.237$). The data showed that 2379 respondents reported no excessive bleeding during their last birth, with 669 reporting such incidents. Additionally, 455 respondents were from urban areas, while 2593 were from rural areas. These findings suggest that urban-rural status does not appear to be associated with the likelihood of experiencing excessive bleeding during the last birth among the study population. For the second to last birth, no statistically significant relationship was found between these variables (χ -squared = 0.231, df = 1, p = 0.631), even after applying Yates' continuity correction (χ -squared = 0.102, df = 1, p = 0.749). Among 453 respondents who self-reported bleeding there was no significant association between urban-rural status and self-report of excessive bleeding at last birth.

Birth Attendant Type and Excessive Bleeding Self-report

Giving birth with a doctor in attendance showed significant positive association with excessive bleeding likelihood during the last birth ($\beta = 1.45$, $p = 0.016$), this relationship was not present second to last birth ($\beta = 1.21$, $p = 0.672$). Additionally, the presence of a nurse or midwife had a significant positive association with excessive bleeding for last births ($\beta = 1.32$, $p = 0.013$), whereas no significant association in this relationship was observed at second to last birth ($\beta = 0.71$, $p = 0.239$).

Furthermore, there was a strong significant association between prolonged labor and increased odds of excessive bleeding, persisting across both urban ($\beta = 3.54$, $p < 0.001$) and rural ($\beta = 4.80$, $p < 0.001$) settings for last births. Similarly, for previous birth, prolonged labor significantly elevated the odds of excessive bleeding in urban areas ($\beta = 4.80$, $p < 0.001$), while rural areas did not exhibit this trend. Notably, the presence of a traditional birth attendant did not exhibit a significant association with excessive bleeding reporting in either urban ($\beta = 0.90$, $p = 0.584$) or rural ($\beta = 1.36$, $p = 0.102$) areas (see Tables 4a and 4b).

Association Between Delivery Method and Excessive Bleeding Self-report

The results presented in Tables 5a and 5b highlight the associations between mode of delivery and adverse maternal outcomes, specifically focusing on excessive bleeding and prolonged labor, stratified by urban and rural settings. For last births, cesarean delivery was not significantly associated with reporting excessive bleeding in either urban ($\beta = 1.43$, $p = 0.057$) or rural ($\beta = 1.24$, $p = 0.273$) areas (Table 5a). Similarly, for second to last births, cesarean delivery did not show a significant association with reporting excessive bleeding in either urban ($\beta = 1.25$, $p = 0.647$) or rural ($\beta = 1.24$, $p = 0.328$) areas (Table 5b).

However, in urban settings, the odds of experiencing prolonged labor were significantly higher among individuals who underwent cesarean delivery for their last birth compared to those who did not ($\beta = 1.90$, $p < 0.001$). This association was not significant in rural areas ($\beta = 1.14$, $p = 0.242$). Moreover, for second to last births, in urban areas, individuals who had a cesarean delivery were significantly more likely to experience prolonged labor compared to those who did not ($\beta = 3.32$, $p = 0.015$). Conversely, in rural settings, the association between cesarean delivery and prolonged labor was not statistically significant ($\beta = 1.18$, $p = 0.633$). Additionally, our analysis found no significant association between urban-rural status and reporting excessive bleeding or prolonged labor ($p > 0.05$).

Shifting focus to vaginal deliveries, our findings reveal significant differences between urban and rural settings. In urban areas, individuals who had a vaginal delivery for their last birth were significantly less likely to experience prolonged labor compared to those who did not ($\beta = 0.526$, $p < 0.001$). Similarly, for second to last births, individuals living in urban areas who had a vaginal delivery were significantly less likely to experience prolonged labor compared to those who did not ($\beta = 0.301$, $p = 0.015$).

Association Between Place of Delivery and Excessive Bleeding Self-report

For the last births reported by survey respondents, our analysis revealed significant disparities in the risk of excessive bleeding across various delivery settings (Table 6a). Specifically, delivering at a Government Maternal and Child Health (MCH) Center was significantly associated with heightened significant odds of excessive bleeding ($\beta = 0.617$, $p = 0.024$). Conversely, no statistically significant associations were found for other government healthcare facilities, private hospitals/clinics, or religious hospitals/clinics. However, prolonged labor emerged as a significant risk factor, exhibiting a substantial increase in the odds of excessive bleeding ($\beta = 1.273$, $p < 0.001$) across the delivery settings of focus for last births.

For previous births, delivering at a Private Hospital/Clinic significantly reduced likelihood of excessive bleeding ($\beta = -2.443$, $p = 0.045$) (Table 6a). Conversely, prolonged labor exhibited a strong positive association, substantially elevating the odds of reporting excessive bleeding ($\beta = 1.806$, $p < 0.001$). Other delivery settings, including Government Hospital, Government Health Center, and Religious Hospital/Clinic, did not demonstrate statistically significant associations with excessive bleeding reports. Urban/rural residence did not emerge as a significant predictor for either the last or second to last birth.

Multifactor Analysis and Protective Factors

In the construct of "Delivery Care Quality", not having a doctor present during delivery (referred to as "Doctor Not Present") contributed 13.933% to dataset variability, demonstrating relatively high representation quality with a cos2 value of 0.915. Similarly, cases where a nurse/midwife was not present during delivery (referred to as "Nurse/Midwife Not Present") contributed approximately 10.676% to the variability observed in the sample. The moderate representation quality, indicated by a cos2 value of 0.706, suggests that the absence of nurses/midwives is moderately represented in the latent construct representing delivery care quality. The "Government Maternal and Child Health (MCH) Center" category within the "Delivery Setting Quality" construct exhibits a relatively modest contribution and quality of representation concerning adverse pregnancy outcomes, implying a limited impact on the variability in such outcomes.

Discussion

Influence of Provider Birth Preferences on Delivery Method Choice

This study examined the interplay delivery attendants, place of delivery, delivery modes, specifically CS or vaginal delivery, and delivery outcomes in Kenya using a nationally representative dataset.

The positive correlation observed between doctor-assisted births and cesarean sections highlights the influential role of birth attendants in influencing delivery modes. Similarly, nurse/midwife-assisted births showed a positive correlation with cesarean sections, albeit to a lesser degree, suggesting a potential association between in-hospital care and increased cesarean rates (Sakai-Bismark et al., 2021). These findings indicate that cesarean deliveries are largely medically trained providers, possibly reflecting clinical decision-making processes favoring surgical intervention in certain cases. Our results align with prior research demonstrating significant associations between individual provider attitudes towards birth and cesarean delivery rates which found that the more providers' birth attitudes favored cesarean, the higher their nulliparous, term, singleton, vertex (NTSV) cesarean rate (White VanGompel et al., 2018). Concerns regarding these influences are heightened by the rising prevalence of cesarean section deliveries coinciding with the increase in facility-based births. This concern is particularly pertinent given the documented associations between cesarean deliveries performed without clear medical necessity and adverse outcomes for both mothers and babies (Elnakib et al., 2019). This preference for medicalized birth practices among hospital-based providers is further supported by our correlation results, which revealed negative associations with doctor and nurse/midwife-assisted births, implying a reduced likelihood of vaginal childbirth when attended by medical professionals (White VanGompel et al., 2018). Our examination of healthcare provider attendance and chosen delivery locations underscores that medically trained attendants may shape birth choices as demonstrated by the positive correlations between the presence of doctors or nurse/midwives (Cole et al., 2019, Esan et al., 2023, Elnakib et al., 2019).

Prolonged Labor in Resource-Limited Settings

Regression analyses consistently identified prolonged labor as a risk factor for excessive bleeding, regardless of urban-rural variations. Prolonged labor is associated with increased risks of complicated deliveries and interventions, such as operative delivery, PPH, and neonatal intensive care unit transfers. Some studies suggest that women with long labors may have a negative birth experience, potentially leading to preferences for avoiding childbearing or opting for elective cesarean sections in subsequent pregnancies (Gaudernack et al., 2020). Prolonged labor has been identified as a risk factor for both urban and rural women. Nevertheless, hospital births typically offer resources to manage prolonged labor effectively (Ayenew, 2021).

However, it is notable that cesarean deliveries did not show a significant association with excessive bleeding, indicating a nuanced relationship between delivery modes and adverse outcomes in delivery. This finding contradicts prior systematic reviews that have consistently highlighted strong associations between cesarean deliveries and PPH, wherein excessive bleeding is a notable concern (Borovac-Pinheiro et al., 2018; Fawcus et al., 2016). Possible explanations for this discrepancy include issues with reporting practices or inadequate measurement of blood loss, especially considering that most respondents delivered at home for their recent births. Accurately quantifying blood loss outside clinical settings presents challenges, potentially resulting in underreporting or inaccurate assessment of excessive bleeding in home births. Additionally, inconsistent definitions of the PPH blood loss threshold, as defined by WHO in 1990, shortly before the data collection period of the 1998 KDHS, may contribute to this contradiction. WHO's subsequent caution regarding the clinical significance of the blood loss threshold due to insufficient evidence further complicates the interpretation of findings related to excessive bleeding in cesarean deliveries (Borovac-Pinheiro et al., 2018).

Finally, consistent with prior research, our multifactor analysis highlights the pivotal role of skilled birth attendants as protective in delivery when it comes to excessive bleeding, a precursor to PPH. The absence of doctors and nurse/midwives during childbirth significantly contributes to adverse pregnancy outcomes (Nove et al., 2021, Ackers, Ioannou, & Ackers-Johnson, 2016). These findings underscore the necessity of ensuring access to skilled birth attendants to mitigate the risk of adverse maternal health outcomes. They provide valuable insights for informing strategies aimed at improving access to skilled birth attendants and enhancing the quality of delivery care to reduce the incidence of adverse pregnancy outcomes.

Strengths and Limitations

A strength of this study lies in its utilization of population-level DHS data to explore trends in specific adverse pregnancy outcomes and facility-based delivery indicators, thereby contributing to global efforts aimed at reducing maternal and neonatal deaths. The research addresses a critical gap in the literature by focusing on understanding context-specific factors contributing to the occurrence of excessive bleeding, essential for targeted interventions to improve healthcare quality and mitigate maternal deaths. This nationally representative survey also utilized standardized methods, thereby achieving high response rates and ensuring the robustness of the dataset. The strength of the survey was further bolstered by the rigorous training undergone by the 120 interviewers responsible for data collection. These interviewers were carefully selected and underwent extensive preparation specifically tailored for KDHS fieldwork. The training regimen covered various essential aspects, including a thorough understanding of questionnaire content, proficiency in interviewing techniques, and practical exercises conducted in local languages to ensure effective communication with respondents (NCPD, CBS (Office of the Vice President and Ministry of Planning and National Development), & MI, 1999). Furthermore, the study's methodology and design exhibit several strengths, particularly in data preparation, variable selection, and analytical approaches. Firstly, the meticulous handling of missing data, utilizing categories such as "Not Interviewed/Unknown" and "Not Applicable," aligns with standard DHS practices. This approach, supported by existing literature, ensures the robustness and reliability of the dataset. Secondly, the careful selection and definition of the outcome variable, excessive bleeding, provides clarity and consistency in identifying OH cases. By utilizing self-reported responses from women who recently gave birth, the study acknowledges the subjective nature of individuals' experiences during childbirth, thereby capturing a diverse range of perspectives.

However, acknowledging and discussing the inherent limitations of the study is crucial, as they directly impact the interpretation and generalizability of findings. Firstly, the reliance on retrospective self-reported data in the DHS introduces the potential for recall bias, which may compromise the accuracy and reliability of reported pregnancy-related events, including excessive bleeding. Secondly, the 1998 KDHS was the most recent dataset to include the variable concerning "excessive bleeding," a variable notably absent in subsequent DHS datasets. Consequently, the study's temporal limitation to 1998 restricts the analysis to understanding obstetric care and maternal health outcomes prevalent specifically 3-5 years preceding the survey, potentially overlooking developments and trends beyond that period. Given the dynamic nature of healthcare systems and evolving policy interventions, findings from the 1998 dataset may not fully capture present-day maternal health challenges' nuances and complexities. Therefore, the study's ability to offer insights into contemporary maternal health issues and inform evidence-based policy interventions may be compromised by its reliance on historical data. Despite these limitations, utilizing the 1998 DHS dataset provides a pragmatic approach to exploring historical trends in maternal health outcomes and understanding obstetric care practices in Kenya. However, caution is warranted in extrapolating the study findings to contemporary contexts, emphasizing the need for future research to incorporate more recent and comprehensive datasets that address gaps in data on excessive bleeding to offer a nuanced understanding of maternal health dynamics in Kenya.

Future Research

Study findings underscore the need for targeted interventions to address the varying risk profiles across different delivery settings and the importance of timely management of prolonged labor to mitigate the risk of excessive bleeding during childbirth. Future research should investigate the influence of clinical settings on birthing decisions, particularly regarding the prevalence of cesarean section deliveries. Understanding factors contributing to unnecessary surgical interventions is crucial for developing strategies to optimize maternal and neonatal health outcomes without compromising safety. Additionally, exploring the role of skilled birth attendants as protective factors in maternal healthcare delivery is essential. Assessing the impact of ensuring access to skilled birth attendants on reducing adverse pregnancy outcomes across diverse settings, including rural and urban areas, can inform interventions aimed at improving maternal health services. Moreover, research should explore training programs designed to reduce obstetric complication rates and their influence on provider decision-making during labor and delivery. Assessing the effectiveness of integrating midwives into traditional obstetric training to promote vaginal birth practices is also warranted. Furthermore, delving deeper into the multifaceted implications of prolonged labor on maternal health outcomes and birth experiences is crucial. Investigating psychosocial factors influencing women's preferences for childbirth interventions following prolonged labor can guide the development of supportive strategies to promote positive birth outcomes.

Conclusion

The present study reveals the intricate relationship between healthcare provider involvement and labor experiences in maternal health outcomes, highlighting avenues for targeted intervention and continued investigation. Variability in reports of excessive bleeding during childbirth suggests potential disparities in quality of care and risk management across healthcare delivery settings. Understanding the association between medical personnel presence and adverse pregnancy outcomes, such as excessive bleeding, emphasizes the importance of physician and nurse/midwife presence for crisis management, while also acknowledging potential implications for increased cesarean or invasive techniques.

Public Health Implications

This study yields valuable insights into emergency obstetric care and lays the groundwork for analyzing subsequent trends in Kenya while utilizing nationally representative data.

Monitoring PPH rates and trends enables healthcare authorities to assess the effectiveness of interventions aimed at reducing maternal mortality and improving obstetric care. Understanding the prevalence and characteristics of PPH cases allows for targeted interventions, resource allocation, and training programs to better manage and prevent PPH-related complications. Additionally, monitoring PPH helps identify disparities in maternal healthcare access and quality between different regions, including urban and rural areas.

To mitigate urban-rural differentials in PPH emergency response, efforts should focus on enhancing access to quality maternal healthcare services in rural areas. This involves increasing supportive supervision and expanding traditional TBA training programs, which have proven effective in promoting safe birthing experiences (Prata et al., 2014). Training also presents a promising avenue for influencing attitudes favoring vaginal birth. Research suggests that providers trained in hospitals with lower obstetric complication rates maintain lower complication rates in practice. Recent findings indicate that senior obstetric supervision of residents during labor and delivery significantly reduced primary cesarean rates in one hospital program, highlighting the influence of preceptor experience on trainees. Integrating midwives into traditional obstetric training has been proposed but remains untested against clinical outcomes (White VanGompel et al., 2018). The need for such training is underscored by the negative correlations observed when no attendants were present for cesarean deliveries, indicating a reduced likelihood of surgical interventions without formal medical assistance, emphasizing the role of clinical settings in facilitating cesarean procedures.

The data from Kenya used for examining postpartum hemorrhage (PPH) dates back to 1998, emphasizing the critical need for updated data to monitor evolving trends in healthcare systems and population demographics. For example, a 2013 retrospective observational study conducted at the University of Michigan assessed the effectiveness of an automated surveillance system and the Maternal Early Warning Criteria (MEWC) in detecting severely morbid PPH after delivery. The combined sensitivity of these systems was 83.3% (95% CI, 75.4–89.5), indicating their success in identifying the majority of severe PPH cases and providing early warning signs for prompt intervention to prevent adverse outcomes (Klumpner et al., 2020). This underscores the potential of automated surveillance systems and MEWC in improving PPH detection, thereby enhancing patient safety and maternal health outcomes. Updating PPH case data in Kenya could facilitate the implementation of such strategies in the future.

This lack of data also prompts questions about discontinuation of collecting DHS data on OH after this period, whether due to lack of prioritization, capacity constraints for assessing the impact of obstetric health, or other factors. A new wave of data collection is necessary to fully grasp OH and its related maternal outcomes. This updated data should extend beyond 1998, enabling longitudinal analysis and the recognition of evolving challenges. It must also consider changing population dynamics, healthcare infrastructure, and socioeconomic factors influencing maternal health outcomes.

While obtaining national-scale data may pose challenges, leveraging smaller surveys conducted in Kenya or similar contexts can provide complementary insights. Collaborating with international organizations or neighboring countries with comparable healthcare systems and maternal health challenges can enrich understanding. However, acknowledging the limitations of smaller surveys is crucial, necessitating rigorous sampling techniques and quality assurance measures to ensure representativeness and reliability.

Addressing the data gap is crucial for informing evidence-based policies and interventions in public health. Timely and accurate data are essential for identifying priority areas, allocating resources effectively, and monitoring the impact of interventions on maternal health outcomes. Implementing robust surveillance systems for obstetric complications, including OH, can provide real-time data for improved monitoring and intervention. Furthermore, investing in training programs for healthcare providers, community engagement, and quality improvement initiatives can enhance obstetric care delivery and minimize adverse outcomes related to excessive bleeding during childbirth.

In conclusion, addressing excessive bleeding during childbirth within Kenya's healthcare system requires a multifaceted approach encompassing surveillance, capacity building, community engagement, service integration, and quality improvement. Leveraging these opportunities for public health surveillance and intervention is essential for advancing maternal health goals and ensuring the well-being of mothers and newborns.

Appendix: Tables and Figures

Table 2a

Demographic Characteristics

	Urban (N=1466)	Rural (N=6415)	Overall (N=7881)
Marital Status			
Never married	485 (33.1%)	1890 (29.5%)	2375 (30.1%)
Unconsummated marriage	0 (0%)	0 (0%)	0 (0%)
Married or living together	0 (0%)	0 (0%)	0 (0%)
Married	783 (53.4%)	3848 (60.0%)	4631 (58.8%)
Living Together	55 (3.8%)	161 (2.5%)	216 (2.7%)
Formerly in union	0 (0%)	0 (0%)	0 (0%)
Widowed	33 (2.3%)	266 (4.1%)	299 (3.8%)
Divorced	43 (2.9%)	92 (1.4%)	135 (1.7%)
Separated/not living together	67 (4.6%)	158 (2.5%)	225 (2.9%)
Deserted	0 (0%)	0 (0%)	0 (0%)
Age in 5 Year Groups			
15-19	312 (21.3%)	1540 (24.0%)	1852 (23.5%)
20-24	363 (24.8%)	1179 (18.4%)	1542 (19.6%)
25-29	291 (19.9%)	1053 (16.4%)	1344 (17.1%)
30-34	194 (13.2%)	783 (12.2%)	977 (12.4%)
35-39	166 (11.3%)	833 (13.0%)	999 (12.7%)
40-44	70 (4.8%)	573 (8.9%)	643 (8.2%)
45-49	70 (4.8%)	454 (7.1%)	524 (6.6%)
Wealth Quintiles			
Poorest	28 (1.9%)	1395 (21.7%)	1423 (18.1%)
Poorer	67 (4.6%)	1557 (24.3%)	1624 (20.6%)
Middle	107 (7.3%)	1446 (22.5%)	1553 (19.7%)
Richer	265 (18.1%)	1339 (20.9%)	1604 (20.4%)
Richest	999 (68.1%)	678 (10.6%)	1677 (21.3%)
Highest Education Level			
No education	134 (9.1%)	876 (13.7%)	1010 (12.8%)
Primary	657 (44.8%)	4062 (63.3%)	4719 (59.9%)
Secondary	603 (41.1%)	1401 (21.8%)	2004 (25.4%)
Higher	72 (4.9%)	76 (1.2%)	148 (1.9%)

Note. Demographic characteristics were stratified by urban-rural status.

Table 2b

Delivery Characteristics, Continued

	Urban (N=1466)	Rural (N=6415)	Overall (N=7881)
Doctor Gave Delivery – Last Birth			
No	345 (23.5%)	2334 (36.4%)	2679 (34.0%)
Yes	111 (7.6%)	261 (4.1%)	372 (4.7%)
Missing	1010 (68.9%)	3820 (59.5%)	4830 (61.3%)
Doctor Gave Delivery – Second to Last Birth			
No	51 (3.5%)	353 (5.5%)	404 (5.1%)
Yes	14 (1.0%)	36 (0.6%)	50 (0.6%)
Missing	1401 (95.6%)	6026 (93.9%)	7427 (94.2%)
Nurse/Midwife Gave Delivery – Last Birth			
No	215 (14.7%)	1817 (28.3%)	2032 (25.8%)
Yes	241 (16.4%)	778 (12.1%)	1019 (12.9%)
Missing	1010 (68.9%)	3820 (59.5%)	4830 (61.3%)
Nurse/Midwife Gave Delivery – Second to Last Birth			
No	30 (2.0%)	258 (4.0%)	288 (3.7%)
Yes	35 (2.4%)	131 (2.0%)	166 (2.1%)
Missing	1401 (95.6%)	6026 (93.9%)	7427 (94.2%)
Traditional Birth Attendant Gave Delivery – Last Birth			
No	439 (29.9%)	2288 (35.7%)	2727 (34.6%)
Yes	17 (1.2%)	307 (4.8%)	324 (4.1%)
Missing	1010 (68.9%)	3820 (59.5%)	4830 (61.3%)
Traditional Birth Attendant Gave Delivery – Second to Last Birth			
No	62 (4.2%)	342 (5.3%)	404 (5.1%)
Yes	3 (0.2%)	47 (0.7%)	50 (0.6%)
Missing	1401 (95.6%)	6026 (93.9%)	7427 (94.2%)
Trained Traditional Birth Attendant Gave Delivery – Last Birth			
No	410 (28.0%)	2292 (35.7%)	2702 (34.3%)
Yes	46 (3.1%)	303 (4.7%)	349 (4.4%)
Missing	1010 (68.9%)	3820 (59.5%)	4830 (61.3%)
Trained Traditional Birth Attendant Gave Delivery – Second to Last Birth			
No	58 (4.0%)	333 (5.2%)	391 (5.0%)
Yes	7 (0.5%)	56 (0.9%)	63 (0.8%)
Missing	1401 (95.6%)	6026 (93.9%)	7427 (94.2%)
Relative Gave Delivery – Last Birth			
No	388 (26.5%)	1800 (28.1%)	2188 (27.8%)
Yes	68 (4.6%)	795 (12.4%)	863 (11.0%)
Missing	1010 (68.9%)	3820 (59.5%)	4830 (61.3%)
Relative Gave Delivery – Second to Last Birth			
No	56 (3.8%)	304 (4.7%)	360 (4.6%)
Yes	9 (0.6%)	85 (1.3%)	94 (1.2%)
Missing	1401 (95.6%)	6026 (93.9%)	7427 (94.2%)
Other Person Gave Delivery – Last Birth			
No	455 (31.0%)	2580 (40.2%)	3035 (38.5%)
Yes	1 (0.1%)	15 (0.2%)	16 (0.2%)

Note. Demographic characteristics were stratified by urban-rural status.

Table 2b

Delivery Characteristics, Continued

	Urban (N=1466)	Rural (N=6415)	Overall (N=7881)
Missing	1010 (68.9%)	3820 (59.5%)	4830 (61.3%)
Other Person Gave Delivery – Second to Last Birth			
No	65 (4.4%)	376 (5.9%)	441 (5.6%)
Yes	0 (0%)	13 (0.2%)	13 (0.2%)
Missing	1401 (95.6%)	6026 (93.9%)	7427 (94.2%)
No One Gave Delivery – Last Birth			
No	439 (29.9%)	2308 (36.0%)	2747 (34.9%)
Yes	17 (1.2%)	287 (4.5%)	304 (3.9%)
Missing	1010 (68.9%)	3820 (59.5%)	4830 (61.3%)
No One Gave Delivery – Second to Last Birth			
No	63 (4.3%)	351 (5.5%)	414 (5.3%)
Yes	2 (0.1%)	38 (0.6%)	40 (0.5%)
Missing	1401 (95.6%)	6026 (93.9%)	7427 (94.2%)
Delivery by Cesarean Section – Last Birth			
No	406 (27.7%)	2408 (37.5%)	2814 (35.7%)
Yes	47 (3.2%)	151 (2.4%)	198 (2.5%)
Missing	1013 (69.1%)	3856 (60.1%)	4869 (61.8%)
Delivery by Cesarean Section – Second to Last Birth			
No	55 (3.8%)	360 (5.6%)	415 (5.3%)
Yes	8 (0.5%)	19 (0.3%)	27 (0.3%)
Missing	1403 (95.7%)	6036 (94.1%)	7439 (94.4%)
Vaginal Delivery – Last Birth			
No	47 (3.2%)	151 (2.4%)	198 (2.5%)
Yes	406 (27.7%)	2408 (37.5%)	2814 (35.7%)
Missing	1013 (69.1%)	3856 (60.1%)	4869 (61.8%)
Vaginal Delivery – Second to Last Birth			
No	8 (0.5%)	19 (0.3%)	27 (0.3%)
Yes	55 (3.8%)	360 (5.6%)	415 (5.3%)
Missing	1403 (95.7%)	6036 (94.1%)	7439 (94.4%)
Place of Delivery – Last Birth			
Respondent's Home	140 (9.5%)	1552 (24.2%)	1692 (21.5%)
Other Home	0 (0%)	0 (0%)	0 (0%)
Government Hospital	165 (11.3%)	507 (7.9%)	672 (8.5%)
Government Health Center	16 (1.1%)	124 (1.9%)	140 (1.8%)
Government Maternal and Child Health (MCH) Center	31 (2.1%)	37 (0.6%)	68 (0.9%)
Private Hospital/Clinic	37 (2.5%)	48 (0.7%)	85 (1.1%)
Religious Hospital/Clinic	52 (3.5%)	179 (2.8%)	231 (2.9%)
Other	0 (0%)	0 (0%)	0 (0%)
Missing	1025 (69.9%)	3968 (61.9%)	4993 (63.4%)
Place of Delivery – Second to Last Birth			
Respondent's Home	20 (1.4%)	217 (3.4%)	237 (3.0%)
Other Home	0 (0%)	0 (0%)	0 (0%)
Government Hospital	26 (1.8%)	84 (1.3%)	110 (1.4%)
Government Health Center	1 (0.1%)	24 (0.4%)	25 (0.3%)

Note. Demographic characteristics were stratified by urban-rural status.

Table 2b

Delivery Characteristics, Continued

	Urban (N=1466)	Rural (N=6415)	Overall (N=7881)
Government Maternal and Child Health (MCH) Center	3 (0.2%)	4 (0.1%)	7 (0.1%)
Private Hospital/Clinic	6 (0.4%)	5 (0.1%)	11 (0.1%)
Religious Hospital/Clinic	4 (0.3%)	26 (0.4%)	30 (0.4%)
Other	0 (0%)	0 (0%)	0 (0%)
Missing	1406 (95.9%)	6055 (94.4%)	7461 (94.7%)
Excessive Bleeding – Last Birth			
No	345 (23.5%)	2034 (31.7%)	2379 (30.2%)
Yes	110 (7.5%)	559 (8.7%)	669 (8.5%)
Missing	1011 (69.0%)	3822 (59.6%)	4833 (61.3%)
Excessive Bleeding – Second to Last Birth			
No	52 (3.5%)	300 (4.7%)	352 (4.5%)
Yes	13 (0.9%)	88 (1.4%)	101 (1.3%)
Missing	1401 (95.6%)	6027 (94.0%)	7428 (94.3%)
Prolonged Labor – Last Birth			
No	281 (19.2%)	1721 (26.8%)	2002 (25.4%)
Yes	175 (11.9%)	874 (13.6%)	1049 (13.3%)
Missing	1010 (68.9%)	3820 (59.5%)	4830 (61.3%)
Prolonged Labor – Second to Last Birth			
No	45 (3.1%)	265 (4.1%)	310 (3.9%)
Yes	20 (1.4%)	123 (1.9%)	143 (1.8%)
Missing	1401 (95.6%)	6027 (94.0%)	7428 (94.3%)

Note. Demographic characteristics were stratified by urban-rural status.

Table 3a

Correlations for Person Who Gave Delivery Care and Delivery Method for Last and Second to Last Birth

	Last Birth				Second to Last Birth			
	Vaginal Delivery		**Cesarean Delivery**		**Vaginal Delivery**		**Cesarean Delivery**	
Variable	*R*	*p-value*	*R*	*p-value*	*R*	*p-value*	*R*	*p-value*
Person who gave delivery care								
Doctor	-0.175	**<2.2e-16**	0.175	**<2.2e-16**	-0.331	**8.941e-13**	0.331	**8.941e-13**
Nurse/midwife	-0.082	**6.841e-06**	0.082	**6.841e-06**	-0.079	0.096	0.079	0.096
Traditional birth attendant	0.061	**0.0008**	-0.061	**0.0008**	0.088	0.065	-0.088	0.065
Trained traditional birth attendant	0.037	**0.045**	-0.037	**0.045**	0.103	**0.030**	-0.103	**0.030**
Relative	**0.095**	**1.947e-07**	-0.095	**1.947e-07**	0.106	**0.025**	-0.106	**0.025**
Other person	-0.021	0.372	0.021	0.372	0.043	0.244	-0.043	0.244
No one	**0.057**	**0.002**	**0.057**	**0.002**	0.079	0.096	0.079	0.096

Note. All tables controlled for urban-rural status. Bold text indicates significant association.

Table 3b

Correlations for Place of Delivery and Delivery Method for Last and Second to Last Birth

	Last Birth		Second to Last Birth	
	Place of Delivery		**Place of Delivery**	
Variable	*R*	*p-value*	*R*	*p-value*
Delivery method				
Cesarean	0.175	**<2.2e-16**	0.268	**3.751e-08**
Vaginal	-0.175	**<2.2e-16**	-0.268	**3.751e-08**

Note. All tables controlled for urban-rural status. Bold text indicates significant association.

Table 3c

Correlations for Person Who Gave Delivery Care and Place of Delivery for Last and Second to Last Birth

	Last Birth		Second to Last Birth	
	Place of Delivery		**Place of Delivery**	
Variable	*R*	*p-value*	*R*	*p-value*
Person who gave delivery care				
Doctor	0.425	**<2.2e-16**	0.383	**4.223e-16**
Nurse/midwife	0.598	**<2.2e-16**	0.571	**<2.2e-16**
Traditional birth attendant	-0.241	**<2.2e-16**	-0.253	**1.491e-07**
Trained traditional birth attendant	-0.161	**<2.2e-16**	-0.247	**2.819e-07**
Relative	-0.427	**<2.2e-16**	-0.362	**1.777e-14**
Other person	-0.040	**0.033**	-0.125	**0.010**
No one	-0.232	**<2.2e-16**	-0.201	**3.265e-05**

Note. All tables controlled for urban-rural status. Bold text indicates significant association.

Table 4a

Binomial Logistic Regressions for Person Who Gave Delivery Care and Excessive Bleeding Reports (Last Birth)

A

Characteristic	OR[1]	95% CI[1]	p-value
Doctor Gave Delivery – Last Birth			
No	—	—	
Yes	1.45	1.07, 1.97	**0.016**
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.54	2.93, 4.28	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.89	0.63, 1.27	0.5

[1] OR = Odds Ratio, CI = Confidence Interval

B

Characteristic	OR[1]	95% CI[1]	p-value
Nurse/Midwife Gave Delivery – Last Birth			
No	—	—	
Yes	1.32	1.06, 1.65	**0.013**
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.53	2.92, 4.27	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.91	0.65, 1.27	0.6

[1] OR = Odds Ratio, CI = Confidence Interval

C

Characteristic	OR[1]	95% CI[1]	p-value
Traditional Birth Attendant Gave Delivery – Last Birth			
No	—	—	
Yes	0.90	0.61, 1.33	0.6
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.57	2.96, 4.32	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.86	0.61, 1.21	0.4

[1] OR = Odds Ratio, CI = Confidence Interval

D

Characteristic	OR[1]	95% CI[1]	p-value
Trained Traditional Birth Attendant Gave Delivery – Last Birth			
No	—	—	
Yes	0.77	0.55, 1.07	0.12
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.61	2.99, 4.35	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.86	0.61, 1.21	0.4

[1] OR = Odds Ratio, CI = Confidence Interval

E

Characteristic	OR[1]	95% CI[1]	p-value
Relative Gave Delivery – Last Birth			
No	—	—	
Yes	0.94	0.75, 1.17	0.6
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.57	2.95, 4.31	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.86	0.61, 1.21	0.4

[1] OR = Odds Ratio, CI = Confidence Interval

F

Characteristic	OR[1]	95% CI[1]	p-value
Other Person Gave Delivery – Last Birth			
No	—	—	
Yes	1.45	0.24, 8.93	0.7
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.58	2.96, 4.32	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.85	0.60, 1.20	0.3

[1] OR = Odds Ratio, CI = Confidence Interval

G

Characteristic	OR[1]	95% CI[1]	p-value
No One Gave Delivery – Last Birth			
No	—	—	
Yes	0.73	0.49, 1.08	0.11
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.54	2.94, 4.28	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.87	0.61, 1.22	0.4

[1] OR = Odds Ratio, CI = Confidence Interval

Note. All tables controlled for urban-rural status, with doctor **(A)**, nurse/midwife **(B)**, traditional birth attendant **(C)**, trained traditional birth attendant **(D)**, relative **(E)**, other person **(F)**, and no one **(G)** as predictors. Prolonged labor was included as a covariate in the analysis. Bold text indicates significant association.

Table 4b

Binomial Logistic Regressions for Person Who Gave Delivery Care and Excessive Bleeding Reports (Second to Last Birth)

A

Characteristic	OR[1]	95% CI[1]	p-value
Doctor Gave Delivery – Second to Last Birth			
No	—	—	
Yes	1.21	0.56, 2.63	0.6
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.53	2.80, 7.33	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.18	0.55, 2.52	0.7

[1] OR = Odds Ratio, CI = Confidence Interval

B

Characteristic	OR[1]	95% CI[1]	p-value
Nurse/Midwife Gave Delivery – Second to Last Birth			
No	—	—	
Yes	0.71	0.40, 1.26	0.2
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.81	2.96, 7.80	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.07	0.51, 2.26	0.9

[1] OR = Odds Ratio, CI = Confidence Interval

C

Characteristic	OR[1]	95% CI[1]	p-value
Traditional Birth Attendant Gave Delivery – Second to Last Birth			
No	—	—	
Yes	1.40	0.61, 3.19	0.4
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.70	2.88, 7.66	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.13	0.53, 2.37	0.8

[1] OR = Odds Ratio, CI = Confidence Interval

D

Characteristic	OR[1]	95% CI[1]	p-value
Trained Traditional Birth Attendant Gave Delivery – Second to Last Birth			
No	—	—	
Yes	0.88	0.41, 1.87	0.7
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.60	2.81, 7.54	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.16	0.55, 2.44	0.7

[1] OR = Odds Ratio, CI = Confidence Interval

E

Characteristic	OR[1]	95% CI[1]	p-value
Relative Gave Delivery – Second to Last Birth			
No	—	—	
Yes	1.49	0.76, 2.91	0.2
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.70	2.93, 7.55	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.13	0.54, 2.35	0.8

[1] OR = Odds Ratio, CI = Confidence Interval

F

Characteristic	OR[1]	95% CI[1]	p-value
Other Person Gave Delivery – Second to Last Birth			
No	—	—	
Yes	0.43	0.04, 4.22	0.5
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.51	2.79, 7.30	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.17	0.56, 2.46	0.7

[1] OR = Odds Ratio, CI = Confidence Interval

G

Characteristic	OR[1]	95% CI[1]	p-value
No One Gave Delivery – Second to Last Birth			
No	—	—	
Yes	1.00	0.37, 2.68	>0.9
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.56	2.80, 7.43	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.15	0.55, 2.43	0.7

[1] OR = Odds Ratio, CI = Confidence Interval

Note. All tables controlled for urban-rural status, with doctor **(A)**, nurse/midwife **(B)**, traditional birth attendant **(C)**, trained traditional birth attendant **(D)**, relative **(E)**, other person **(F)**, and no one **(G)** as predictors. Prolonged labor was included as a covariate in the analysis. Bold text indicates significant association.

Table 5a

Binomial Logistic Regressions for Cesarean Delivery Method and Excessive Bleeding Reports

A

Characteristic	OR[1]	95% CI[1]	p-value
Delivery by Cesarean Section – Last Birth			
No	—	—	
Yes	1.43	0.99, 2.07	0.057
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.51	2.90, 4.25	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.85	0.61, 1.20	0.4

[1] OR = Odds Ratio, CI = Confidence Interval

B

Characteristic	OR[1]	95% CI[1]	p-value
Delivery by Cesarean Section – Second to Last Birth			
No	—	—	
Yes	1.25	0.48, 3.22	0.6
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.34	2.69, 7.00	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.18	0.54, 2.57	0.7

[1] OR = Odds Ratio, CI = Confidence Interval

Note. All tables controlled for urban-rural status. Prolonged labor was included as a covariate in the analysis. Bold text indicates significant association.

Table 5b

Binomial Logistic Regressions for Vaginal Delivery Method and Excessive Bleeding Reports

A

Characteristic	OR[1]	95% CI[1]	p-value
Vaginal Delivery – Last Birth			
No	—	—	
Yes	0.70	0.48, 1.01	0.057
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.51	2.90, 4.25	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.85	0.61, 1.20	0.4

[1] OR = Odds Ratio, CI = Confidence Interval

B

Characteristic	OR[1]	95% CI[1]	p-value
Vaginal Delivery – Second to Last Birth			
No	—	—	
Yes	0.80	0.31, 2.07	0.6
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	4.34	2.69, 7.00	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.18	0.54, 2.57	0.7

[1] OR = Odds Ratio, CI = Confidence Interval

Note. All tables controlled for urban-rural status. Prolonged labor was included as a covariate in the analysis. Bold text indicates significant association.

Table 6a

Binomial Logistic Regressions for Place of Delivery and Excessive Bleeding Reports (Last Birth)

Characteristic	OR[1]	95% CI[1]	p-value
place1			
Respondent's Home	—	—	
Government Hospital	1.26	0.94, 1.68	0.12
Government Health Center	0.92	0.55, 1.53	0.7
Government Maternal and Child Health (MCH) Center	1.85	1.09, 3.16	**0.024**
Private Hospital/Clinic	0.99	0.55, 1.79	>0.9
Religious Hospital/Clinic	1.05	0.71, 1.56	0.8
Prolonged Labor – Last Birth			
No	—	—	
Yes	3.57	2.93, 4.35	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	0.91	0.64, 1.29	0.6

[1] OR = Odds Ratio, CI = Confidence Interval

Note. All tables controlled for urban-rural status. Prolonged labor was included as a covariate in the analysis. Bold text indicates significant association.

Table 6b

Binomial Logistic Regressions for Place of Delivery and Excessive Bleeding Reports (Second to Last Birth)

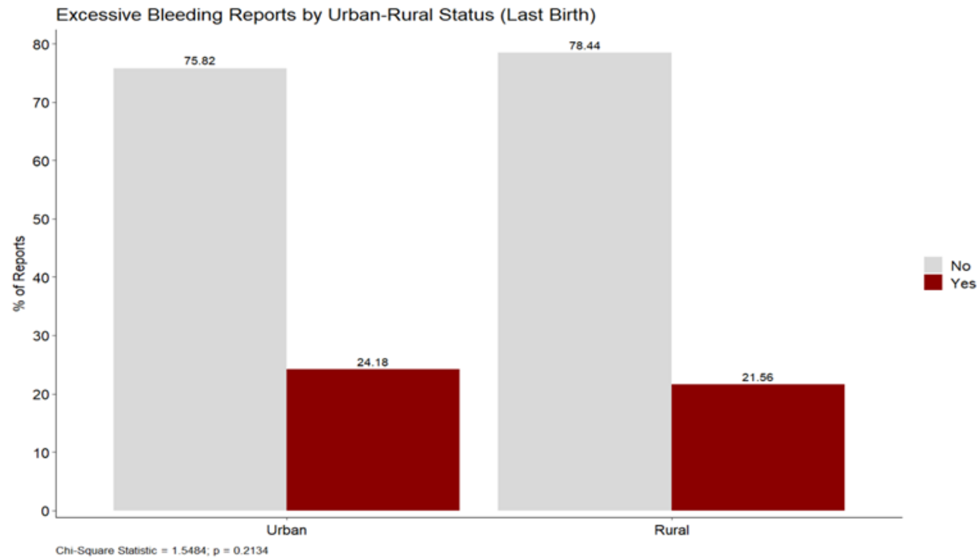
Characteristic	OR[1]	95% CI[1]	p-value
place2			
Respondent's Home	—	—	
Government Hospital	0.90	0.41, 1.98	0.8
Government Health Center	0.45	0.12, 1.73	0.2
Government Maternal and Child Health (MCH) Center	1.28	0.19, 8.53	0.8
Private Hospital/Clinic	0.09	0.01, 0.95	**0.045**
Religious Hospital/Clinic	0.61	0.20, 1.87	0.4
Prolonged Labor – Second to Last Birth			
No	—	—	
Yes	6.09	3.73, 9.93	**<0.001**
Urban-Rural Status			
Urban	—	—	
Rural	1.30	0.57, 2.97	0.5

[1] OR = Odds Ratio, CI = Confidence Interval

Note. All tables controlled for urban-rural status. Prolonged labor was included as a covariate in the analysis. Bold text indicates significant association.

Figure 2a

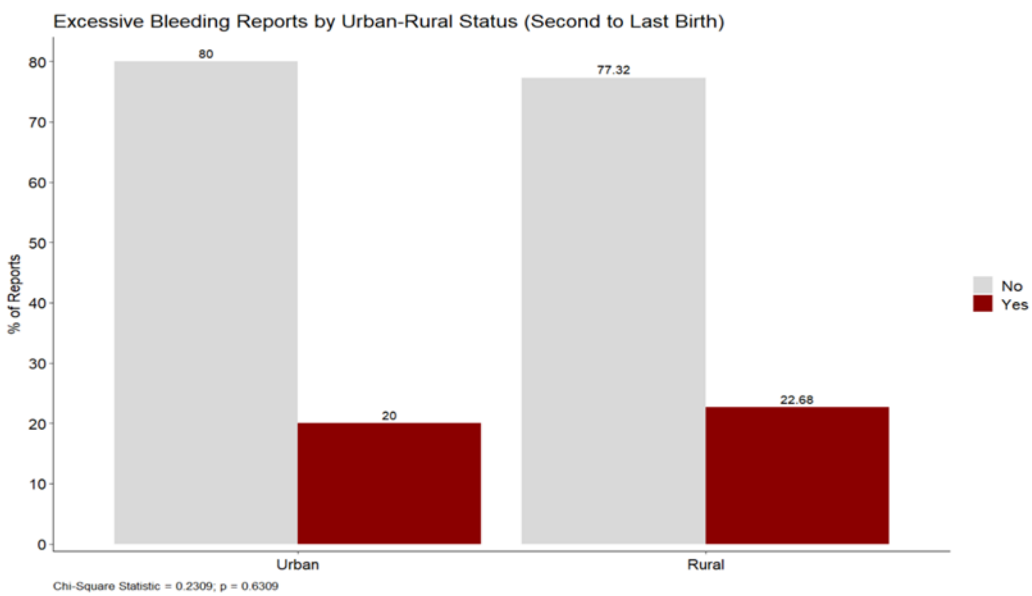
Excessive Bleeding Reports by Urban-Rural Status (Last Birth)



Note. Results were not significant.

Figure 2b

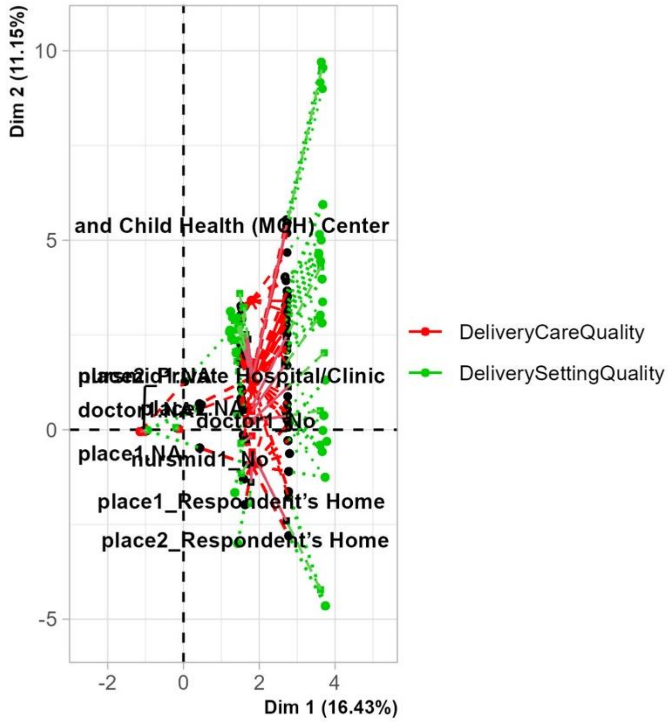
Excessive Bleeding Reports by Urban-Rural Status (Second to Last Birth)



Note. Results were not significant.

Figure 3

Individual Factor Map



Note. Dimension 1 explains 16.43% and Dimension 2 explains 11.5% of the total variability observed in the dataset.

References

Abebe, M. M., Arefayne, N. R., Temesgen, M. M., & Admass, B. A. (2022). Incidence and predictive factors associated with hemodynamic instability among adult surgical patients in the post-anesthesia care unit, 2021: A prospective follow up study. *Annals of Medicine and Surgery*, *74*. https://doi.org/10.1016/j.amsu.2022.103321

Ackers, L., Ioannou, E., Ackers-Johnson, J. (2016). The impact of delays on maternal and neonatal outcomes in Ugandan public health facilities: The role of absenteeism. *Health Policy and Planning*, *31*(9), 1152–1161. https://doi.org/10.1093/heapol/czw046

Akter, S., Forbes, G., Miller, S., Galadanci, H., Qureshi, Z., Fawcus, S., Hofmeyr, G. J., Moran, N., Singata-Madliki, M., Amole, T. G., Gwako, G., Osoti, A., Thomas, E., Gallos, I., Mammoliti, K., Coomarasamy, A., Althabe, F., Lorencatto, F., & Bohren, M. A. (2022). Detection and management of postpartum haemorrhage: Qualitative evidence on healthcare providers' knowledge and practices in Kenya, Nigeria, and South Africa. *Frontiers in Global Women's Health*, *3*. https://doi.org/10.3389/fgwh.2022.1020163

Atkins, L., Francis, J., Islam, R., O'Connor, D., Patey, A., Ivers, N., Foy, R., Duncan, E. M., Colquhoun, H., Grimshaw, J. M., Lawton, R., & Michie, S. (2017). A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implementation Science*, *12*(1), 77. https://doi.org/10.1186/s13012-017-0605-9

Ameh, C. A., Meka, R. J., West, F., Dickinson, F., Allott, H., & Godia, P. (2022). A synthesis of clinical and health system bottlenecks to implementing new WHO postpartum hemorrhage recommendations: Secondary data analysis of the Kenya Confidential Enquiry into Maternal Deaths 2014–2017. *International Journal of Gynecology & Obstetrics*, *158*, 14-22. https://doi.org/10.1002/ijgo.14270

Atahigwa, C., Kadengye, D. T., Iddi, S., Abrams, S., & Van Rie, A. (2020). Trends and determinants of health facility childbirth service utilization among mothers in urban slums of Nairobi, Kenya. *Global Epidemiology*, *2,* https://doi.org/10.1016/j.gloepi.2020.100029

Ayenew, A. A. (2021). Incidence, causes, and maternofetal outcomes of obstructed labor in Ethiopia: systematic review and meta-analysis. *Reproductive Health*, *18*, 61. https://doi.org/10.1186/s12978-021-01103-0

Bienstock, J. L., Eke, A., & Hueppchen, N. A. (2021). Postpartum hemorrhage. *The New England Journal of Medicine*, *384*, 1635-1645. https://doi.org/10.1056/NEJMra1513247

Borovac-Pinheiro, A., Pacagnella, R. C., Cecatti, J. G., Miller, S., El Ayadi, A. M., Souza, J. P., Durocher, J., Blumenthal, P. D., & Winikoff, B. (2018). Postpartum hemorrhage: New insights for definition and diagnosis. *American Journal of Obstetrics and Gynecology*, *219*(2), 162–168. https://doi.org/10.1016/j.ajog.2018.04.013

Clarke-Deelder, E., Opondo, K., Achieng, E., Garg, L., Han, D., Henry, J., Guha, M., Lightbourne, A., Makin, J., Miller, N., Otieno, B., Borovac-Pinheiro, A., Suarez-Rebling, D., Menzies, N. A., Burke, T., Oguttu, M., McConnell, M., & Cohen, J. (2023). Quality of care for postpartum hemorrhage: A direct observation study in referral hospitals in Kenya. *PloS Global Public Health*, *3*(3), https://doi.org/10.1371/journal.pgph.0001670

Clarke-Deelder, E., Opondo, K., Oguttu, M., Burke, T., Cohen, J. L., & McConnell, M. (2023). Immediate postpartum care in low- and middle-income countries: A gap in healthcare quality research and practice. *American Journal of Obstetrics & Gynecology MFM*, *5*(2). https://doi.org/10.1016/j.ajogmf.2022.100764

Cole, L., LeCouter, A., Feo, R., & Dahlen, H. (2019). "Trying to give birth naturally was out of the question": Accounting for intervention in childbirth. *Women and Birth*, *32*(1), 95-101. https://doi.org/10.1016/j.wombi.2018.04.010

Corburn, J., & Karanja, I. (2016). Informal settlements and a relational view of health in Nairobi, Kenya: Sanitation, gender and dignity. *Health Promotion International*, *31*(2), 258–269, https://doi.org/10.1093/heapro/dau100

Corvino, F., Giurazza, F., Vallone, M., Mosca, S., Fischer, M. J., Corvino, A., Niola, R. (2021). Postpartum hemorrhage: Rescue. *Seminars in Ultrasound, CT, and MRI*, *42*(1), 75-84. https://dx.doi.org/10.1053/j.sult.2020.09.001

Elnakib, S., Abdel-Tawab, N., Orbay, D., & Hassanein, N. (2019). Medical and non-medical reasons for cesarean section delivery in Egypt: a hospital-based retrospective study. *BMC Pregnancy Childbirth*, *19*(411). https://doi.org/10.1186/s12884-019-2558-2

Ende, H. B. (2022). Risk assessment tools to predict postpartum hemorrhage. Best Practice & Research Clinical Anaesthesiology, *36*(3-4), 341-348. https://doi.org/10.1016/j.bpa.2022.08.003

Esan, D. T., Ayenioye, O. H., Ajayi, P.O., & Sokan-Adeaga, A. A. (2023). Traditional birth attendants' knowledge, preventive and management practices for postpartum haemorrhage in Osun State, Southwestern Nigeria. *Scientific Reports*, *13*, 12314. https://doi.org/10.1038/s41598-023-39296-y

Fawcus, S., Pattinson, R. C., Moodley, J., Moran, N. F., Schoon, M. G., Mhlanga, R. E., Baloyi, S., Bekker, E., & Gebhardt, G. S. (2016). Maternal deaths from bleeding associated with caesarean delivery: A national emergency. *South African Medical Journal*, *106*(5), 53–57. https://doi.org/10.7196/SAMJ.2016.v106i5.10821

Fein, A., Wen, T., Wright, J. D., Goffman, D., D'Alton, M. E., Attenello, F. J., Mack, W. J., Friedman, A. M. (2019). Postpartum hemorrhage and risk for postpartum readmission. *The Journal of Maternal-Fetal & Neonatal Medicine*, *34*(2). https://doi.org/10.1080/14767058.2019.1601697

Forbes, G., Akter, S., Miller, S., Galadanci, H., Qureshi, Z., Fawcus, S., Hofmeyr, G. J., Moran, N., Singata-Madliki, M., Dankishiya, F., Gwako, G., Osoti, A., Thomas, E., Gallos, I., Mammoliti, K. M., Devall, A., Coomarasamy, A., Althabe, F., Atkins, L., Bohren, M. A., Lorencatto, F. (2023). Factors influencing postpartum haemorrhage detection and management and the implementation of a new postpartum haemorrhage care bundle (E-MOTIVE) in Kenya, Nigeria, and South Africa. *Implementation Science*, *18*(1), 1. https://doi.org/10.1186/s13012-022-01253-0

Garces, A., McClure, E. M., Espinoza, L., Saleem, S., Figueroa, L., Bucher, S., & Goldenberg, R. L. (2019). Traditional birth attendants and birth outcomes in low-middle income countries: A review. *Seminars in Perinatology*, *43*(5), 247–251. https://doi.org/10.1053/j.semperi.2019.03.013

Gaudernack, L. C., Michelsen, T. M., Egeland, T., Voldner, N., & Lukasse, M. (2020). Does prolonged labor affect the birth experience and subsequent wish for cesarean section among first-time mothers? A quantitative and qualitative analysis of a survey from Norway. *BMC Pregnancy Childbirth*, *20*(605). https://doi.org/10.1186/s12884-020-03196-0

Gichuhi, E., & Lusambili, A. (2019). Efficacy of free maternity health policy at Machakos Level 5 County Hospital (Kenya): An exploratory qualitative study. *Health Systems and Policy Research*, *6*(1). https://doi.org/10.21767/2254-9137.100097

Gill, P., Patel, A., Van Hook, J. W. Uterine Atony. [Updated 2023 Jul 4]. In: StatPearls

[Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK493238/

Girma, T., Gezimu, W., & Demeke, A. (2022). Prevalence, causes, and factors associated with obstructed labour among mothers who gave birth at public health facilities in Mojo Town, Central Ethiopia, 2019: A cross-sectional study. *PloS One*, *17*(9), https://doi.org/10.1371/journal.pone.0275170

Gitobu, C. M., Gichangi, P. B. & Mwanda, W. O. (2018). The effect of Kenya's free maternal health care policy on the utilization of health facility delivery services and maternal and neonatal mortality in public health facilities. *BMC Pregnancy Childbirth*, *18*(77). https://doi.org/10.1186/s12884-018-1708-2

Han, D., Clarke-Deelder, E., Miller, N., Opondo, K., Burke, T., Oguttu, M., McConnell, M., & Cohen, J. (2023). Health care provider decision-making and the quality of maternity care: An analysis of postpartum care in Kenyan hospitals. *Social Science & Medicine*, *331*. https://doi.org/10.1016/j.socscimed.2023.116071

Hatt, L. E., Makinen, M., Madhavan, S., & Conlon, C. M. (2013). Effects of user fee exemptions on the provision and use of maternal health services: A review of literature. *Journal of Health, Population, and Nutrition*, *31*(4 Suppl 2), S67–S80.

Henry, J., Clarke-Deelder, E., Han, D., Miller, N., Opondo, K., Oguttu, M., Burke, T., Cohen, J. L., & McConnell, M. (2022). Health care providers' knowledge of clinical protocols for postpartum hemorrhage care in Kenya: A cross-sectional study. *BMC Pregnancy and Childbirth*, *22*(1), 828. https://doi.org/10.1186/s12884-022-05128-6

Hofer, S., Blaha, J., Collins, P. W., Ducloy-Bouthors, A. S., Guasch, E., Labate, F., Lança, F., Nyfløt, L. T., Steiner, K., & Van de Velde, M. (2023). Haemostatic support in postpartum haemorrhage: A review of the literature and expert opinion. *European Journal of Anaesthesiology*, *40*(1), 29–38. https://doi.org/10.1097/EJA.0000000000001744

Ignacio, E. A., Osman, M., Igboagi, U., Razjouyan, F., Liddel, R. P., & Hill, M. C. (2020). Management of the High-Risk Obstetric Patient. In M. A. Mauro, K. P. Murphy, K. R. Thomson, A. C. Venbrux, & R. A. Morgan (Eds.), *Expert Radiology, Image-Guided Interventions* (Third Edition) (pp. 358-363.e2). Elsevier. https://doi.org/10.1016/B978-0-323-61204-3.00044-0.

Joseph, N. T., Worrell, N. H., Collins, J., Schmidt, M., Sobers, G., Hutchins, K., Chahine, E. B., Faya, C., Lewis, L., Green, V. L., Castellano, P. Z., & Lindsay, M. K. (2020). Implementation of a postpartum hemorrhage safety bundle at an urban safety-net hospital. *AJP Reports*, *10*(3), e255–e261. https://doi.org/10.1055/s-0040-1714713

Kassie, A., Wale, A., Girma, D., Amsalu, H., & Yechale, M. (2022). The role of traditional birth attendants and problem of integration with health facilities in remote rural community of West Omo Zone 2021: Exploratory qualitative study. *BMC Pregnancy Childbirth*, *22*(425). https://doi.org/10.1186/s12884-022-04753-5

Kibira, D., Ooms, G. I., van den Ham, H. A., Namugambe, J. S., Reed, T., Leufkens, H. G., & Mantel-Teeuwisse, A. (2021). Access to oxytocin and misoprostol for management of postpartum haemorrhage in Kenya, Uganda and Zambia: A cross-sectional assessment of availability, prices and affordability. *BMJ Open*, *11*(1), e042948. https://doi.org/10.1136/bmjopen-2020-042948

Klumpner, T. T., Kountanis, J. A., Meyer, S. R., Ortwine, J., Bauer, M. E., Carver, A., Piehl, A. M., Smith, R., Mentz, G., & Tremper, K. K. (2020). Use of a novel electronic maternal surveillance system and the Maternal Early Warning Criteria to detect severe postpartum hemorrhage. *Anesthesia & Analgesia*, *131*(3), 857-865. https://doi.org/10.1213/ANE.0000000000004605

Lang'at, E., & Mwanri, L. (2015). Healthcare service providers' and facility administrators' perspectives of the free maternal healthcare services policy in Malindi District, Kenya: A qualitative study. *Reproductive Health*, *12*(59). https://doi.org/10.1186/s12978-015-0048-1

Lang'at, E., Mwanri, L., & Temmerman, M. (2019). Effects of implementing free maternity service policy in Kenya: An interrupted time series analysis. *BMC Health Services Research*, *19*(1), 645. https://doi.org/10.1186/s12913-019-4462-x

Lao, T. T., Sahota, D. S., Cheng, Y. K., Law, L. W., & Leung, T. Y. (2014). Advanced maternal age and postpartum hemorrhage - risk factor or red herring? *The Journal of Maternal-Fetal & Neonatal Medicine*, *27*(3), 243–246. https://doi.org/10.3109/14767058.2013.807240

Manrique Muñoz, S., Munar Bauzà, F., Francés González, S., Suescun López, M. C., Montferrer Estruch, N., & Fernández López de Hierro, C. (2012). Actualización en el uso de uterotónicos [Update on the use of uterotonic agents]. *Revista Espanola de Anestesiologia y Reanimacion*, *59*(2), 91–97. https://doi.org/10.1016/j.redar.2012.02.019

McLintock, C. (2020). Prevention and treatment of postpartum hemorrhage: Focus on hematological aspects of management. *Hematology: The American Society of Hematology Education Program*, *2020*(1), 542-546. https://doi.org/10.1182/hematology.2020000139

Michie, S., van Stralen, M. M. & West, R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6(42) (2011). https://doi.org/10.1186/1748-5908-6-42

Musarandega, R., Nyakura, M., Machekano, R., Pattinson, R., & Munjanja, S. P. (2021). Causes of maternal mortality in Sub-Saharan Africa: A systematic review of studies published from 2015 to 2020. *Journal of Global Health*, *11*. https://doi.org/10.7189/jogh.11.04048

Muthoni, D. M., Kabue, P. N., & Ambani, E. K. (2021). Factors that influence management of postpartum hemorrhage among midwives in a rural setting in Kenya. *African Health Sciences*, *21*(1), 304-10. https://dx.doi.org/10.4314/ahs.v21i1.39

Namayi, I., Makokha, A., & Echoka, E. (2020). Health providers´ knowledge on maternal and newborn care: Implications on health systems strengthening in Vihiga County, Kenya. *The Pan African Medical Journal*, *37*, 73. https://doi.org/10.11604/pamj.2020.37.73.24597

National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], & Macro International Inc. (MI). (1999). *Kenya Demographic and Health Survey 1998*. Calverton, Maryland: NDPD, CBS, and MI.

Nove, A., Friberg, I. K., de Bernis, L., McConville, F., Moran, A. C., Najjemba, M., Ten Hoope-Bender, P., Tracy, S., & Homer, C. S. E. (2021). Potential impact of midwives in preventing and reducing maternal and neonatal mortality and stillbirths: a Lives Saved Tool modelling study. *The Lancet Global Health*, *9*(1), e24–e32. https://doi.org/10.1016/S2214-109X(20)30397-1

Nyfløt, L. T., Stray-Pedersen, B., Forsén, L., & Vangen, S. (2017). Duration of labor and the risk of severe postpartum hemorrhage: A case-control study. *PloS One*, *12*(4), e0175306. https://doi.org/10.1371/journal.pone.0175306

Odallo, B., Opondo, E., & Onyango, M. (2018). Litigating to ensure access to quality maternal health care for women and girls in Kenya. *Reproductive Health Matters*, *26*(53), 123-129. https://doi.org/10.1080/09688080.2018.1508172

Owens, M. D., Cassidy, A. L., & Weeks, A. D. (2021). Why are women still dying from obstetric hemorrhage? A narrative review of perspectives from high and low resource settings. *International Journal of Obstetric Anesthesia*, *46*. https://doi.org/10.1016/j.ijoa.2021.102982

Prata, N., Bell, S., Holston, M., & Quaiyum, M. A. (2014). Is attendant at delivery associated with the use of interventions to prevent postpartum hemorrhage at home births? The case of Bangladesh. *BMC Pregnancy and Childbirth*, *14*, 24. https://doi.org/10.1186/1471-2393-14-24

Pullum, T. W., & Becker, S. (2014). Evidence of Omission and Displacement in DHS Birth Histories (DHS Methodological Reports No. 11). Rockville, MD, USA: ICF International.

Rath, W. H. (2011). Postpartum hemorrhage – update on problems of definitions and diagnosis. *Acta Obstetricia et Gynecologica Scandinavica*, *90*. https://doi.org/10.1111/j.1600-0412.2011.01107.x

Rokicki, S., Mwesigwa, B., & Cohen, J. L. (2021). Know-do gaps in obstetric and newborn care quality in Uganda: A cross-sectional study in rural health facilities. *Tropical Medicine & International Health*, *26*(5), 535-545. https://doi.org/10.1111/tmi.13557

Sakai-Bizmark, R., Ross, M. G., Estevez, D., Bedel, L. E. M., Marr, E. H., Tsugawa, Y. (2021).

Evaluation of hospital cesarean delivery–related profits and rates in the United States. *JAMA Network Open*, *4*(3):e212235. https://doi.org/10.1001/jamanetworkopen.2021.2235

Sebghati, M., & Chandraharan, E. (2017). An update on the risk factors for and management of obstetric haemorrhage. *Women's Health*, *13*(2), 34–40. https://doi.org/10.1177/1745505717716860

Tadese, M., Dagne, K., Wubetu, A. D., Abeway, S., Bekele, A., Misganaw Kebede, W., & Baye Mulu, G. (2022). Assessment of the adverse pregnancy outcomes and its associated factors among deliveries at Debre Berhan Comprehensive Specialized Hospital, Northeast Ethiopia. *PloS One*, *17*(7). https://doi.org/10.1371/journal.pone.0271287

Tama, E., Molyneux, S., Waweru, E., Tsofa, B., Chuma, J., & Barasa, E. (2018). Examining the implementation of the Free Maternity Services Policy in Kenya: A mixed methods process evaluation. *International Journal of Health Policy and Management*, *7*(7), 603–613. https://doi.org/10.15171/ijhpm.2017.135

Tiruneh, G. T., Karim, A. M., Avan, B. I., Zemichael, N. F., Wereta, T. G., Wickremasinghe, D., Keweti, Z. N., Kebede, Z., & Betemariam, W. A. (2018). The effect of implementation strength of basic emergency obstetric and newborn care (BEmONC) on facility deliveries and the met need for BEmONC at the primary health care level in Ethiopia. *BMC Pregnancy Childbirth*, *18,* 123. https://doi.org/10.1186/s12884-018-1751-z

Valdes, V., Adongo, P. B., Nwameme, A. U., Tabong, P. T. N., Fernandes, M. (2018). Risk factors for self-reported postpartum hemorrhage in Ga East, Ghana. *International Journal of Gynecology & Obstretrics*, *142*(2), 201-206. https://doi-org.proxy.library.emory.edu/10.1002/ijgo.12523

Wamalwa, E. W. (2015). Implementation challenges of free maternity services policy in Kenya: the health workers' perspective. *The Pan African Medical Journal*, *22*, 375. https://doi.org/10.11604/pamj.2015.22.375.6708

Wamukoya, M., Kadengye, D. T., Iddi, S., & Chikozho, C. (2020). The Nairobi Urban Health and Demographic Surveillance of slum dwellers, 2002–2019: Value, processes, and challenges. *Global Epidemiology*, *2*, 100024. https://doi.org/10.1016/j.gloepi.2020.100024

White VanGompel, E., Main, E. K., Tancredi, D., & Melnikow, J. (2018). Do provider birth attitudes influence cesarean delivery rate: a cross-sectional study. *BMC Pregnancy Childbirth*, *18*(184). https://doi.org/10.1186/s12884-018-1756-7

World Bank Group. (2023, April). *Poverty & Equity Brief: Kenya, Africa Eastern & Southern*. Retrieved from https://www.worldbank.org/en/topic/poverty/publication/poverty-and-equity- briefs

World Health Organization. (2024). *Births attended by skilled health personnel*. https://www.who.int/data/nutrition/nlis/info/births-attended-by-skilled-health-personnel

World Health Organization. (2018). WHO recommendations: Uterotonics for the prevention of postpartum haemorrhage (Publication No. 3, Recommendations and supporting evidence). https://www.ncbi.nlm.nih.gov/books/NBK535984/