

ABSTRACT

Title of Dissertation: MATERNAL AND NEONATAL HEALTH
INTERVENTION COVERAGE AND
MEASUREMENT IN URBAN KENYA

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High coverage of recommended maternal and neonatal health (MNH) interventions can reduce neonatal mortality in low- and middle-income countries. In Kenya, however, despite overall gains in MNH intervention coverage and neonatal survival, progress in urban areas has slowed. The neonatal mortality rate in Nairobi is 24% higher than rural areas, reversing a longstanding urban advantage in MNH. This multiple method dissertation draws on both quantitative and qualitative data to examine the role of five MNH interventions in explaining this urban disadvantage—health facility delivery (HFD), skilled birth attendance (SBA), early postnatal care (ePNC), skilled postnatal care (sPNC), and early breastfeeding initiation (eBFI). First, using data on mother-child pairs from the Kenya Demographic and Health Survey (KDHS) (n=1,058) this dissertation examines intra-urban variation in coverage, as high urban mortality rates may be explained by differences in coverage in rapidly expanding and impoverished urban informal settlements (IS) as compared to formal settlements (FS). Urban places of residence were operationalized using household- and neighborhood-level characteristics to differentiate informal

settlements from formal ones. IS were defined as KDHS clusters where >50% of households lacked ≥ 2 of 4 planned community features (access to improved water and sanitation, durable housing materials, and sufficient living area). Urban categories included: IS in cities, IS in towns, and FS in cities and towns. No differences were observed between settlement type and coverage of any intervention except ePNC. Neonates in IS in towns were less likely to receive ePNC compared to those in FS, suggesting that quality-adjusted measures of intervention coverage might offer evidence of intra-urban variation. Second, using semi-structured qualitative interviews with mothers (n=20) and providers (n=12) in two IS, this dissertation addresses concerns with the measurement of these five interventions within household-based surveys. Specifically, it explores the potential influence of social desirability bias and comprehension of questions and key terms on the validity of mothers' responses to survey questions that capture coverage. Data were analyzed using template and thematic analysis. Most mothers (1) associate payment with private facilities, (2) generalize the term "hospital" to other facility types, (3) generalize the terms "doctor" and "nurse" to other facility-based employees, (4) determine provider cadre based on role, uniform color, and gender, (5) understand the meaning of 'assisting with delivery' and 'postnatal care check' as intended, (6) report the timing of a range of postnatal checks, and (7) did not provide concrete descriptions of how they identify time to initiation of breastfeeding or first postnatal check. Women in these communities might: (1) indicate they delivered at a private facility to appear to be wealthier than their peers, (2) indicate they had a SBA if their true attendant was a TBA, and (3) over-report breastfeeding. Findings from this dissertation suggest that the urban disadvantage in neonatal mortality may not be explained by differences in intervention coverage within growing IS communities and may be more complex. Poor quality of facility-based care and low validity of data measuring intervention coverage in

household surveys may partly explain these findings. Linking household surveys with facility-based data, using quality-adjusted measures to examine intra-urban variation in coverage, and further exploring of the role of desirability bias and comprehension in survey data across diverse settings is recommended moving forward.

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Dedication

To my mother, my mother, my mother, and then, in no particular order, my sister and husband.

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List of Abbreviations

ANC	Antenatal care
aOR	Adjusted odds ratio
APHRC	African Population Health and Research Center
BCG	Bacillus Calmette-Guérin
eBFI	Early breastfeeding initiation
CAD	Care at delivery
CCI	Composite-coverage index
CHV	Community health volunteer
CHW	Community health worker
DHS	Demographic and Health Survey
DPT	Diphtheria-tetanus-pertussis
DRC	Democratic Republic of Congo
DU ERB	Daystar University Ethical Review Board
eBFI	Early breastfeeding initiation
ENAP	Every Newborn Action Plan
ePNC	Early postnatal care
FMS policy	Free Maternity Services (FMS) policy
Global Strategy	Global Strategy for Women's, Children's, and Adolescent's Health (2016-2030)
GN	Global Network
HBR	Home-based records
HDSS	Health and demographic surveillance systems
HFD	Health facility delivery
HMIS	Health management information system
IRB	Institutional Review Board
KDHS	Kenya Demographic and Health Survey
KMC	Kangaroo mother care
LMICs	Low-and middle-income countries
MDGs	Millennium Development Goals
MICS	Multiple Indicator Cluster Surveys
MNH	Maternal and neonatal health
MNHR	Maternal Newborn Health Registry
NACOSTI	National Commission for Science, Technology & Innovation
NASSEP V	Fifth National Sample Survey and Evaluation Programme
NCSS	Nairobi Cross Sectional Informal Settlements Survey
NMR	Neonatal mortality rate
NMS	Nairobi Metropolitan Services
NUHDSS	Nairobi Urban Health and Demographic Surveillance System
OOP	Out-of-pocket
OR	Odds ratio
PAMANECH	Partnership for Maternal, Newborn and Child Health Project
PNC	Postnatal care
PMR	Perinatal mortality ratio
PLF	Pre-lacteal feed
ProSHI	Promoting of the Sustainability of Healthcare Investments project
RA	Research Assistant
RCT	Randomized Controlled Trial
SBA	Skilled birth attendant
SDGs	Sustainable Development Goals
SMV program	Safe Motherhood Voucher program
SOWC	State of the World's Children Report
SPA	Service Provision Assessment
sPNC	Skilled postnatal care
sSA	Sub-Saharan Africa

TBA	Traditional birth attendant
TT vaccine	Tetanus toxoid vaccine
U5MR	Under-5 mortality rate
UMD	University of Maryland College Park
UN	United Nations
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Chapter 1: Introduction

Background

In 2019, 2.4 million of the world's infants died within the first 28 days of life (the neonatal period) (UNICEF et al., 2020). This is despite the global neonatal mortality rate (NMR) having decreased from 36.6 deaths per 1,000 live births in 1990 to 18.0 deaths in 2017 (Hug et al., 2019b). Most neonatal deaths in low- and middle-income countries (LMICs) occur soon after birth (de Bernis et al., 2016; Goudar, et al., 2020; Lawn et al., 2016; Oza et al., 2014), with a third occurring within six hours and just under half occurring within 24 hours (Baqui et al., 2016). Despite substantial gains towards reducing neonatal mortality over the past 30 years, there has been less progress than for older children (UNICEF et al., 2020). The annual rate of reduction in neonatal mortality was 1.1% slower than in children 1-59 months old. The proportion of under-5 deaths that occurred during the neonatal period increased from 40 to 47 percent despite a reduction in the overall under-5 mortality rate (U5MR) (UNICEF et al., 2020). Infants born in sub-Saharan Africa have the worst chances of survival in the world and account for 47% of neonatal deaths globally (UNICEF et al., 2020). Kenya's progress has followed the regional pattern from 1990 to 2019 with a larger improvement in U5MR (101 to 43 deaths per 1,000 live births) than NMR (28 to 21 deaths per 1,000 births). Two-thirds of all neonatal mortality is reported from Kenya and 11 other LMICs (WHO & UNICEF, 2014). Similar to global patterns, causes of neonatal mortality in Kenya include intrapartum related events (such as encephalopathy, birth trauma, and inability to resuscitate) (29%), preterm

birth complications (28%), sepsis/tetanus (16%), congenital abnormalities (13%), pneumonia (7%), and other conditions (8%) (Masaba & Mmusi-Phetoe, 2020); and survival varies across rural and urban contexts (Wamukoya et al., 2020).

Decades of research have contributed to a large evidence base for available interventions and strategies to end preventable neonatal deaths in LMICs (Bhutta et al., 2014). Existing interventions, such as appropriate care and neonatal resuscitation at birth, kangaroo mother care (KMC), scale up of antenatal steroids, and clean postnatal care practices, address three major causes of neonatal mortality (intrapartum, prematurity, and infection-related deaths), and can be delivered within existing care structures (Bhutta et al., 2014). Their potential impact is notable; high coverage (>90%) of 33 maternal and newborn health (MNH) interventions [the proportion of individuals receiving an intervention or practice (numerator) among the total population that requires it (denominator) (Day et al., 2021a)] could prevent 71% of neonatal deaths per year at an estimated cost of US\$1.15 per person, or US\$1,928 per life saved (Bhutta et al., 2014). Interventions provided to the mother and infant during labor and birth are more impactful than those provided at any other time in preventing neonatal deaths (Bhutta et al., 2014).

The data used to track MNH intervention coverage in LMICs are primarily sourced from two survey programs that began in the late 1980s: the Demographic and Health Surveys (DHS) (DHS Program, n.d.) and the Multiple Indicator Cluster Surveys (MICS) (UNICEF, n.d.-a). The DHS and MICS collect nationally representative data in over 90 LMICs approximately every five years. Questionnaires capture detailed data about household members, household characteristics, as well as

data on maternal and child health ranging from preconception through the first two to five years of a respondent's youngest child's life. Neonatal health interventions captured in these surveys form a subset of interventions recommended for low-risk pregnancies and uncomplicated deliveries by United Nations Children's Fund (UNICEF) (UNICEF, 2021b) or are part of global and national strategies in many LMICs to improve neonatal survival (Countdown 2030, 2021; Every Woman Every Child, 2015; WHO & UNICEF, 2014).

Nationally representative intervention coverage data from Kenya show an overall increase in MNH service utilization. Between 2003 and 2014, protection against neonatal tetanus increased by 3%, and both health facility delivery (HFD) and delivery under the supervision of a skilled birth attendant (SBA) increased by 18% (National Bureau of Statistics, 2014a), thanks, in part, to government-led initiatives to increase demand for, and access to, care by skilled providers at health facilities. The Safe Motherhood Voucher (SMV) program that began in 2006 offered women who purchased low-cost vouchers access to subsidized maternity services at accredited facilities of their choice (Amendah et al., 2013), and the 2013 Free Maternity Services (FMS) policy removed user fees for antenatal, delivery, and postnatal care at public health facilities (Gitobu et al., 2018). Studies have found positive associations between the SMV program and (1) HFD in informal settlements in the large capital city of Nairobi (Bellows et al., 2013), (2) HFD and SBA in other urban settings (Obare et al., 2013), and (3) receiving care throughout the antenatal, delivery, and postnatal periods across Kenya (Dennis et al., 2019). Research on the FMS policy suggests similar improvements in coverage. The policy was associated with increased

odds of birth at a public health facility compared to a private facility or home in five urban cities, including for the poor (Calhoun et al., 2018), and increased births attended by skilled providers in areas of western Kenya (Owuor & Amolo, 2019).

Problem Statement

Data from the DHS and MICS play an important role in global health efforts to improve neonatal survival; they are used to inform progress towards Sustainable Development Goals (SDGs) (WHO, 2016b), by policymakers to allocate resources, and by academics to identify trends, research gaps, and intervention impact (Carvajal–Aguirre et al., 2017; Moran & Marchant, 2017). The increasing availability and use of disaggregated data allow us to focus on advancing intervention coverage for all (UNICEF, 2017a), including for underserved areas, however concerns remain with respect to informal settlement settlements and data validity for intrapartum and postnatal intervention survey questions.

Poor representation of informal settlements in nationally representative surveys

The first concern is that we do not have a comprehensive understanding about coverage at the informal settlement level or one that is comparable to the national and sub-national levels, yet this is a population that is growing and has unique and dynamic health needs (APHRC, 2002, 2014). The pace of urbanization is increasing rapidly in sub-Saharan Africa with a concentrated population living in informal settlement settlements (Ritchie & Roser, 2019). While there are known social and economic benefits to urbanization for individuals and communities (Wamukoya et al.,

2020), it is also accompanied by challenges of intra-urban inequalities in healthcare provision and health outcomes (Sulemana et al., 2019). Though MNH intervention coverage has increased in urban Kenya, rapid urbanization is associated with increased socioeconomic disparities within urban populations (Wamukoya et al., 2020). Informal settlement residents in Nairobi, including children, have among the worst health outcomes of all of Kenya (Wamukoya et al., 2020). The world's urban population is estimated to increase from 55% in 2018 to 68% by 2050, with a concentration in Asia and Africa where an estimated 88% of new urban residents will live (Ritchie & Roser, 2019; United Nations, 2018). Given that urban areas are experiencing rapid change, it is important to better understand MNH intervention coverage patterns among informal settlement residents.

Analyses of DHS and MICS data point towards the importance of focusing on neonatal health in informal settlement settings in Kenya. Like global patterns, neonatal mortality in Kenya is declining at the slowest rate compared to all under-5 death (UNICEF, 2017b), and progress towards neonatal survival benchmarks has been uneven and slow in urban areas (Emina et al., 2011; Ezeh et al., 2017). In 2014, neonatal mortality was 24% higher in urban compared to rural areas (26 and 21 deaths per 1,000 live births, respectively) with the highest rate in Nairobi County (39 per 1,000) (National Bureau of Statistics, 2014a), and this is concerning because we typically expect better outcomes in urban areas. It is reasonable to suspect meaningful differences in intervention coverage within urban counties as informal settlements in Nairobi are themselves not homogenous with respect to wealth (Zulu et al., 2011), education (Bellows et al., 2013), or health outcomes (Emina et al., 2011; Ezeh et al.,

2017). Determining informal settlement level coverage and trends is important for programming and planning resource allocation which depend on current levels and projected changes in coverage.

Data collected by the African Population and Health Research Center (APHRC) in Nairobi help fill these gaps left by nationally representative surveys. APHRC has implemented the Nairobi Urban Health and Demographic Surveillance System (NUHDSS) since 2002 whereby approximately 65,000 residents from 24,000 households in the Nairobi informal settlements of Viwandani and Korogocho are tracked longitudinally (Beguy et al., 2015a). APHRC routinely collects vital statistics from informal settlement residents and serves as a platform for nesting other research projects that examine the impacts of urbanization on health and poverty outcomes over time (Beguy et al., 2015a). While some of these projects have measured MNH intervention coverage, documentation has neither been consistent (as it is project-driven) nor comprehensive of important neonatal survival interventions (as objectives vary by project). The result is a database with neonatal survival data from every household in Korogocho and Viwandani, but intervention coverage data from only some households, making studies underpowered to detect impacts of MNH interventions on neonatal survival. A first step in this direction is to describe levels of coverage and enter them into conversation and comparison with coverage estimates from other and larger geographic and administrative units in Kenya.

Data validity concerns

The second concern with DHS and MICS, common to all self-reports, is data validity, particularly as it relates to delivery and postnatal care. The gold standard in the measurement of intervention coverage when evaluating data from facility registers and self-reports is direct observation in clinical settings; for most interventions, it produces results with higher accuracy as compared to other sources (Day et al., 2021a). Self-reports are more accurate for care directly experienced by a mother, such as KMC, as compared to care that can be provided without her knowledge or awareness, such as provision of antibiotics for neonatal infection in a hospital setting (Day et al., 2021a). Further, early breastfeeding initiation is often overestimated in self-reports compared to facility records and direct observations (Day et al., 2021a).

Inaccurate self-reports can be attributed to lack of mothers' knowledge or awareness about care provided to their infants after delivery, issues with maternal recall, poor question comprehension (Moran et al., 2013), and social desirability bias (BosireRose et al., 2016). For example, a mother may not have asked or been informed about the qualification level of the care provider (knowledge), may forget this information soon after the birth (recall), and in the case of whether a postnatal check was provided, may not understand what is meant by a "check" (comprehension). A mother may also feel pressure to claim breastfeeding was initiated (ever or early) given recent efforts to promote it in Kenya (social desirability) (BosireRose et al., 2016). Further, a study comparing facility register to exit surveys found that exit surveys overestimated breastfeeding initiation by over 53% (Day et al., 2021a). High proportions of "don't know" responses in household

questionnaires indicate women were either never provided the information or that their ability to recall information from two years prior to the survey, and even within a few days, is poor for some indicators (Day et al., 2021a), resulting in an underestimation of coverage. Given the crucial role survey data play in public health decision-making and the slow improvement of neonatal health outcomes in informal settlement settings, it is important to understand how data quality collected in informal settlements can be improved.

Dissertation research setting

To begin to address these concerns, I focused my dissertation research efforts on the following: (1) identifying urban informal settlements in the Kenya DHS (KDHS) and comparing their coverage of neonatal health interventions with other urban areas in the KDHS as well as two known urban informal settlements in Nairobi, Korogocho and Viwandani, and (2) exploring validity concerns with respect to survey questions that capture coverage of neonatal health interventions in this population.

Urban informal settlement communities and other urban area types were derived from the most recent available KDHS. An APHRC-nested study served as the data source for developing coverage estimates for Korogocho and Viwandani. The Partnership for Maternal, Newborn and Child Health (PAMANECH) project sought to improve maternal and child health outcomes through strengthening public and private partnerships on the delivery of maternal healthcare in Korogocho and Viwandani beginning in 2013 (Bakibinga et al., 2014). The survey instrument used to collect baseline data was largely modeled on DHS questionnaires, allowing for comparisons between the national- and informal settlement-levels of MNH

intervention coverage. The interventions under examination were health facility delivery (HFD), skilled birth attendance (SBA), early postnatal care (ePNC), skilled provider of postnatal care (sPNC), and early breastfeeding initiation (eBFi); these are described in detail in the following sections. Primary qualitative data collection with mothers of young children and facility-based healthcare providers in Korogocho and Viwandani was also conducted.

Research Questions, Specific Aims, and Hypotheses

Research Question 1: How does MNH intervention coverage in informal settlements compare with other urban sub-populations in Kenya?

- *Aim 1.1 (process aim): To identify women in the KDHS who lived in formal towns, formal cities, informal towns, and informal cities (settlements) and had a live birth in 2012-13 that survived the first two days of life.*
- *Aim 1.2: To describe coverage of neonatal health interventions (individually) for mother-child pairs (identified in Aim 1.1) across formal towns, formal cities, informal towns, informal cities, and Korogocho and Viwandani.*
 - Hypothesis 1.2: In line with findings from the 2000 and 2012 waves of the Nairobi Cross-Sectional Informal settlements Survey (NCSS) (APHRC, 2002, 2014), coverage of all interventions is higher in informal settlements compared to any other geographic level.
- *Aim 1.3 (process aim): To develop a composite measure of coverage of five neonatal health interventions.*

- *Aim 1.4: To describe the composite measure of coverage of neonatal health interventions for mother-child pairs in formal towns, formal cities, informal towns, informal cities, and Korogocho and Viwandani.*
 - Hypothesis 1.4: Given higher neonatal mortality in densely populated Nairobi (National Bureau of Statistics, 2014a), informal settlement coverage is lower than anywhere else.
- *Aim 1.5: To examine the contributions of maternal sociodemographic characteristics (age, education, partnership status), health seeking behaviors (early and skilled antenatal care, antenatal iron supplementation, use of antenatal anti-malarial drugs, completed tetanus vaccination), and maternal health history (parity, prior pregnancy and infant loss, and pregnancy wantedness) in predicting intervention coverage at each geographic level (excluding Korogocho and Viwandani).*
 - Hypothesis 1.5: The odds of coverage will be higher in formal areas after controlling for sociodemographic characteristics compared to informal settlement areas.

Research Question 2: How can data quality from household surveys about delivery and neonatal care be improved?

To conduct interviews with 20 mothers of young children and 12 facility-based healthcare providers in Korogocho and Viwandani, toward a better understanding of: (1) comprehension of DHS/MICS questions that capture MNH interventions, (2) and social norms surrounding reporting MNH interventions.

Conceptual Framework

The theoretical underpinning of Research Question 1 is adapted from the Mosley-Chen framework (Mosley & Chen, 1984) (see Figure 1).

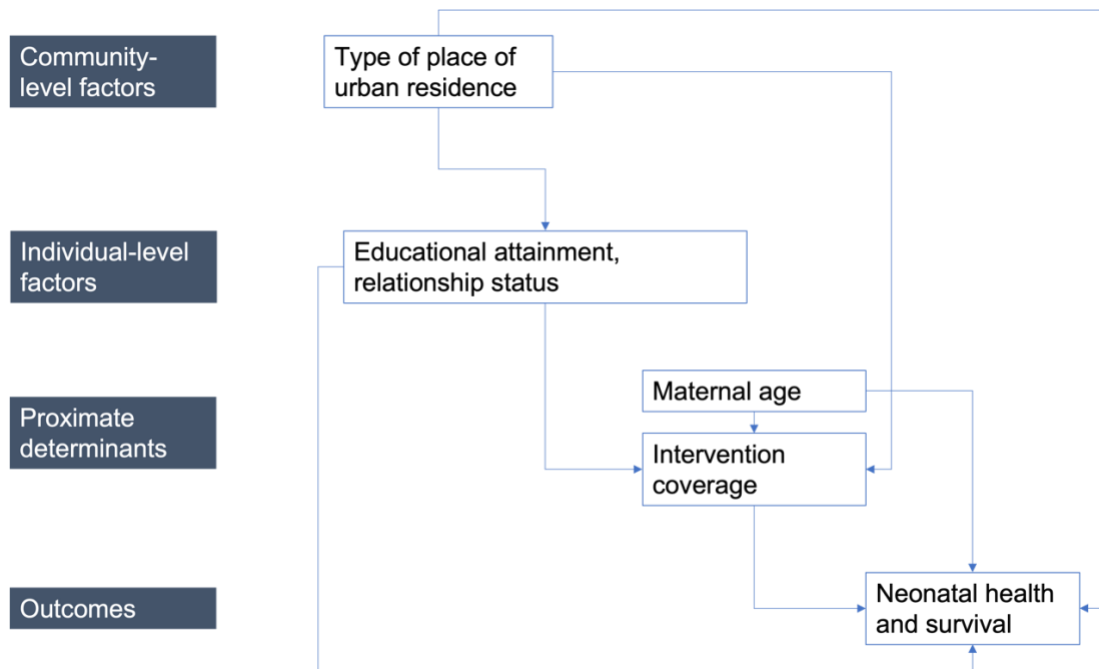


Figure 1. Conceptual framework

The Mosley-Chen framework combines the contributions of social and biological variables of child survival, positing that all community, household, and individual-level social and economic determinants of child morbidity and mortality operate through a common set of proximate determinants, or biological mechanisms (Mosley & Chen, 1984). In this framework, the ecological setting is seen to influence access to and use of health facilities, an important consideration for intervention coverage. There is a large body of literature that finds intra-urban variation with respect to health outcomes (APHRC, 2002, 2014; Mberu et al., 2016; Faye et al., 2020), suggesting settlement type is an important variable to consider. Mothers'

skills, time, and health are seen to directly operate on proximate determinants. Her education level, for example, impacts her child's health by influencing the choices she makes to practice preventive and curative behaviors. In many LMIC contexts, time to attend postnatal visits and breastfeed often competes with time required for income-generating work (Birdsall & Greevey, 1978; Engle, 1981). Being partnered (married or living with a partner) and having no personal income might suggest a mother has more time for childcare as compared to being partnered and having an income or being unpartnered and having an income. Maternal age has an independent influence on neonatal survival as well as has been associated with intervention coverage. In this framework, personal illness control is a proximal determinant of neonatal survival and is defined as the preventive measures healthy individuals take to avoid disease. In the promotion of neonatal health and survival, several interventions have been identified as important for the routine care and management of delivery and neonates, five of which are the subject of this dissertation (i.e., HFD, SBA, ePNC, sPNC, and eBFI).

Coverage of the five interventions under examination was broken down by the first three levels of the Mosley-Chen framework, namely: community-level factors (i.e., type of place of residence), individual-level factors (i.e., educational attainment and relationship status), and proximate determinants (i.e., age).

Research Question 2 was driven by literature on effective communication between patients and providers, which was identified as a key recommendation in the 2018 World Health Organization (WHO) guidelines for intrapartum care for a positive childbirth experience (WHO, 2018b). Effective communication between

maternity care providers and women during delivery should include at minimum: (1) introducing themselves to the woman and her companion; (2) offering the woman and her family information they need in their language, in a concise manner, without the use of medical jargon, and with the use of pictorial or graphic materials to facilitate understanding when necessary; (3) responding to questions with a positive attitude; (4) ensuring that procedures are explained and informed consent is obtained prior to performing them, as needed; (5) and regularly updating her about what is happening. Article 2 of the Respectful Maternity Care Charter has a similar focus on communication or information sharing, stating that, “*every woman has the right to information, informed consent and refusal, and respect for her choices and preferences, including companionship during maternity care*” (The White Ribbon Alliance, 2011). Effective communication can play three important roles towards achieving better health: (1) improving quality of care, (2) improving measurement of intervention coverage (or care provided), and (3) instilling, building, and maintaining trust. The WHO’s Quality of Care framework for maternal and newborn health for improving health outcomes recognizes that women’s perspectives on quality of care influences their care-seeking behavior (WHO, 2016a). It also recognizes that an important aspect of having a positive experience of care involves effective communication between providers, mothers, and their families about the care women and their newborns receive. In addition to being linked with demand for care, research suggests that patient experience is predictive of clinical effectiveness as well (Doyle et al., 2013).

Effective communication is also considered important in the valid measurement of intervention coverage through household surveys (Moran et al., 2013). Women who are aware of the care they and their newborns are provided are more likely report on it accurately (Blanc et al., 2016a; McCarthy et al., 2016), producing more accurate population-level estimates of intervention coverage, in turn allowing for appropriate and targeted resource allocation and resulting in better health outcomes. Based on this framework, one long-term goal of this research is to use findings from the qualitative portion to improve effective communication between providers and mothers towards better health outcomes.

Public Health Significance

The long-term goal of this research is two-pronged. First, this work can support efforts to accurately measure the coverage and impact of maternal and neonatal health interventions on birth outcomes and to encourage uptake and promote effectiveness of those interventions in informal settlement contexts in LMICs. This study can help determine the extent to which resources currently allocated towards improving neonatal health in informal settlements are appropriate and how allocation may be improved. Harmonizing several data sources to produce a comprehensive picture of coverage at various geographic and administrative levels facilitates an understanding of inequalities in coverage and allow improvements in healthcare delivery, program implementation, and the development of more effective interventions for informal settlement populations.

This research also helps identify ways in which users of DHS and MICS data can better understand their results as well as ways in which survey items can be

improved to capture intervention coverage more accurately. Addressing concerns with household and exit survey data validity is important because, as mentioned above, they are the least accurate compared to direct observation of care (gold standard) and facility health records in measuring care that does not practically require the knowledge or involvement of the mother, yet they are the least expensive and heavily relied upon in policymaking (Carvajal–Aguirre et al., 2017; Moran & Marchant, 2017). It is also important because recent research from Kenya and across sub-Saharan Africa present mixed findings on the survival benefit of receiving some MNH interventions for neonates (Goudar et al., 2015; Kunkel et al., 2019a; Patel et al., 2020b) which might be explained, in part at least, by low data validity (Lohela et al., 2012). There are several possible explanations for this that are independent of measurement accuracy, such as: poor quality of care at health facilities (Bhutta et al., 2014; Kunkel et al., 2019a; UNICEF, 2015; Wall et al., 2010), referral or selection bias (i.e., complicated pregnancies that arrive at the appropriate facility too late to impact the outcome) (Patel et al., 2020b), providers having poor clinical knowledge, high health worker absenteeism, and low drug availability at health facilities (Di et al., 2020). However, there are still gaps in our understanding of the relative contribution of each of these factors in explaining the inconsistent relationships between intervention coverage and neonatal mortality, and this research begins to uncover areas of improvement in survey measurement using informal settlement settings as a case study.

Chapter 2: Literature Review

This research is an examination of the coverage of five neonatal health interventions in informal settlement settlements in Kenya, and how measurement of coverage can be improved through surveys. This chapter reviews the literature on these components, specifically: the need to focus on neonatal health in informal settlements (section 2.1); measuring urbanicity (section 2.2); the evidence base for each of the interventions and their effect on neonatal survival, interpretations of the findings, and specific areas for measurement improvement (2.3); the organizations that track the interventions under examination in this study (2.4); universal recommendations for measurement improvement (2.5); and strengths and weaknesses of household surveys compared to other data collection tools (2.6).

Why focus on neonatal health in informal settlements?

An estimated 6.5 billion people, two-thirds of the world's population, will live in urban areas by 2050 (UNDP, 2019). As a result of this rapid growth caused by rising populations and increasing rural to urban migration, informal settlement settlements are also growing (UNDP, 2019). Historically, compared to rural residence, urban residence has been associated with better health outcomes and access to more resources that impact health such as healthcare, water and sanitation, and infrastructure (Lalou & LeGarnd, 1997; Sastry Rand, 1997). However, studies are finding that rapid urbanization leads to vast intra-urban inequalities in terms of economic and physical well-being (United Nations, 2019), and Kenya is no exception. Approximately 60% of urban residents in Kenya live in informal

settlement settlements (UN-HABITAT, 2010) and are predominantly served by health infrastructure that was designed for people living in relatively less concentrated, formal settlements (Bazant et al., 2009; Ziraba, Mills, et al., 2009a). Kenya's efforts towards reaching Millennium Development Goal (MDG) neonatal mortality targets were least beneficial in urban areas. Studies that measure and track the health and economic wellbeing of informal settlement residents across Nairobi find that on several important indicators, they have worse outcomes than their rural and non-poor urban counterparts, and that, contrary to popular belief, they are not homogenous with respect to health (APHRC, 2002, 2014) or wealth (Zulu et al., 2011).

The NCSS, conducted in 2000 (APHRC, 2002) and 2012 (APHRC, 2014), documented the sociodemographic characteristics and health status of Nairobi's informal settlement population using a representative sample. In 2000, the report found that overall, informal settlement residents had worse general health, reproductive health, and socioeconomic conditions than their rural and non-poor urban counterparts (APHRC, 2002). Children, for example, had the lowest school enrolment rates, higher morbidity risk for major childhood illnesses (fever, cough, diarrhea), and less access to healthcare. This was reflected in lower immunization coverage (lower by 25% in informal settlement children compared to rural children) and common childhood illness incidence (2-3 times higher in informal settlement vs rural children).

The 2000 NCSS survey also revealed sociodemographic inequities in MNH intervention coverage among Nairobi informal settlement residents. More women with secondary or higher education had a HFD (70%) and SBA (72%) compared to

women with less education (36-47%, 38-49%, respectively) (APHRC, 2002). Of note is that women with no education were more likely to have a HFD and SBA (41% each) compared to women with incomplete primary education (36% and 38%, respectively). Women aged 35 and older were least likely to have a HFD (46%) compared to younger women (49-55%). Never married women had higher HFD coverage (60%) than partnered and formerly partnered women (51 and 50%, respectively). More informal settlement births occurred in health facilities (54%) compared to the national (42%) and rural (36%) averages, but less than the Nairobi (76%) and urban (64%) averages.

The 2012 NCSS documented improvements in HFD and SBA, but some intra-informal settlement inequality persisted (APHRC, 2014) (see Table 1). Whereas the proportion of women with secondary or higher education who had a HFD increased by over 20 percentage points between 2000 and 2012, it increased less than eight percent for women with no education. Older women (≥ 35) were still least likely to have a HFD and SBA. There was a similar increase in proportions of women receiving HFD from 2000 to 2012 by marital status and less variation between the groups (never married, partnered, and formerly partnered) in 2012 as compared to in 2000. HFD and SBA coverage remained lower than overall 2008-09 Nairobi levels, but was greater than the national, rural, and other urban area levels.

Table 1. Percent distribution of births in three years preceding the survey by intervention received in the 2000 and 2012 NCSS and 2008-09 KDHS				
	NCSS 2000		NCSS 2012	
Background characteristics	HFD	SBA	HFD	SBA
Education				
None	40.7	40.7	48.3	58.1
Primary incomplete	36.1	38.2	67.5	68.4
Primary complete	47.2	49.2	80.8	80.7
Secondary +	69.9	72.4	91.6	90
Age				
<20	55.2	58.1	81.2	81.4
20-24	49.3	51.7	84.2	84.9
25-34	54.4	55.4	83.5	81.4
35+	46.4	49.3	75.0	73.4
Marital status				
Never married	60.4	n/a	80.5	n/a
Married/living together	51.6	n/a	83.6	n/a
Widowed/separated/divorced	50.0	n/a	79.0	n/a
NCSS Total	52.3	54.3	83.0	82.6
	KDHS 2008-09			
National	43.4	45.2		
Rural	36.0	38.2		
Other urban	68.4	68.6		
Nairobi	90.3	90.6		
Notes: NCSS: Nairobi Cross-Sectional Informal settlements Survey; KDHS: Kenya Demographic and Health Survey; HFD: health facility delivery; SBA: skilled birth attendance, defined as a doctor, nurse or trained midwife				
Source: NCSS 2000, NCSS 2012, KDHS 2008-09				

The NMR in urban areas in Kenya is 24% higher than in rural areas, and in Nairobi is higher than any region in Kenya (39 vs. 19-25 per 1,000 live births, respectively) (National Bureau of Statistics, 2014a). This surprising finding may be explained by the large proportion of informal settlement populations within urban areas. The estimated maternal mortality ratio in Korogocho and Viwandani between 2003 and 2005 was 706 per 100,000 live births (Ziraba et al., 2009a) while the 2005 national estimate was 560 (WHO et al., 2007). The U5MR in the two informal settlements was 86.2 per live births in 2008 (Emina et al., 2011) compared to 63.5 in all of Nairobi, 74.3 in urban Kenya, and 83.7 nationally (National Bureau of Statistics & ICF Macro, 2009).

The relatively poor health outcomes of Nairobi informal settlement residents are attributed to poor environmental conditions and infrastructure, poor access to health services due to inability to afford them, and reliance on unregulated and poor quality health services (Zulu et al., 2011). Qualitative research from Korogocho and Viwandani finds that in addition to cost, women report inadequate transportation services, insecurity traveling at night, unfriendly attitudes of health service personnel, and poor-quality facilities located within informal settlement settlements as barriers (Zulu et al., 2011).

Government efforts to increase access to maternal and child health care include such initiatives as the FMS policy in 2013 (Gitobu et al., 2018) and the SMV program in 2006 (Amendah et al., 2013). Though evaluations have found an overall positive effect of both programs, it should be noted that between Korogocho and Viwandani, there are three public health facilities, all on the outskirts of the informal settlements' borders (Bazant et al., 2009; Fotso & Mukiira, 2012; Kyobutungi et al., 2008).

How coverage of neonatal survival interventions in informal settlement settlements compares to all urban areas and other regions is an important gap that this dissertation fills.

Measuring urbanicity

The urban-rural dichotomy is considered inadequate (Champion & Hugo, 2016; McDade & Adair, 2001; Vlahov & Galea, 2002; Yach et al., 1990) in part because there are no universally agreed upon definitions of “urban” or “rural” (Deuskar, 2015; Vlahov & Galea, 2002). Urban has been defined using minimum

population and density thresholds, type of economic activity, physical characteristics, level of infrastructure, or some combination of these and other characteristics (Deuskar, 2015). Some countries have no definition, and some define all or none of their population as urban (Deuskar, 2015), complicating cross-geography comparisons and aggregations (Dorélien et al., 2013). Further, the dichotomy is criticized for its inability to capture temporal shifts in what is and is not considered “urban” (Dahly & Adair, 2007) and utilize characteristics of contemporary human settlements in describing geographies (Dorélien et al., 2013). For example, rural areas that now have features that were associated with urban in the past (e.g., access to services) and new types of settlements that have formed (e.g., conurbations [continuous network of urban communities]) do not fit neatly into this classification (Dorélien et al., 2013). Urban-ness, or urbanicity, on a continuum has been used to address these shortcomings, but it too lacks a standard measure.

Urbanicity, defined as “the impact of living in urban areas at a given point in time,” refers to conditions that affect urban areas only or to a greater extent than rural areas (Vlahov & Galea, 2002). The construct is used in the conceptualization of urban health and in describing intra-urban variation in health outcomes (Fink et al., 2014; Macintyre et al., 2002; Vlahov & Galea, 2002). Operational definitions of urbanicity and its synonyms have included various combinations of community-level variables such as population size, density, travel time to city centers (World Bank, 2009; Chomitz et al., 2005; Uchida & Nelson, 2015), availability of communications, transportation infrastructure, educational facilities, health services, markets (Dahly & Adair, 2007), nighttime lights satellite data (Dorélien et al., 2013), built cover and

settlement size (*Global Human Settlement - GHSL Data Overview - European Commission*, n.d.), and individual- and household-level characteristics such as educational attainment, employment, household features and wealth (Antai & Moradi, 2010; Dorélien et al., 2013; Jones et al., 2016). Intra-urban variation has also been measured by comparing capital cities with other urban areas (Amouzou et al., 2020; Faye et al., 2020).

Regardless of how urbanicity is defined, a largely consistent pattern emerges where compared to rural areas, progress in decreasing under-5 mortality over the past 30 years has been slower for residents in the capital city of Nairobi (National Bureau of Statistics, 2014b), urban informal settlement residents (Fotso et al., 2007; Kimani-Murage et al., 2014), and urban populations overall (Kimani-Murage et al., 2014; National Bureau of Statistics, 2014b). Nairobi, home to one of the world's largest urban informal settlements (Kibera), has an NMR higher than the country's as a whole, rural areas, and other urban areas (39 per 1,000 live births vs 19-25 per 1,000 live births, respectively) (National Bureau of Statistics, 2014a). Nairobi versus other urban and rural area comparisons indicate this relationship exists despite greater or similar coverage of important maternal and neonatal health interventions including antenatal care (ANC), tetanus vaccinations, skilled birth attendance, and facility births (Mberu et al., 2016). This "capital city advantage" in coverage is observed in nearly all sub-Saharan African countries with low national levels of the co-coverage index (CCI) (Faye et al., 2020). The extent of intra-urban (and intra-capital city) variation in coverage of neonatal health interventions delivered immediately after

birth, however, remains unclear, and can contribute to our understanding of high neonatal mortality in densely populated urban areas.

Interventions in this study

The proposed research focuses on coverage of five interventions: health facility delivery (HFD), skilled birth attendance (SBA), early postnatal care (ePNC), skilled provider of postnatal care (sPNC), and early breastfeeding initiation (eBFI). HFD offers several potential benefits over non-health facility births. Women and newborns have increased odds of survival through access to equipment, supplies for the routine and emergency management of deliveries, and referrals to higher-level facilities (UNICEF, 2021a). Policymakers, researchers, and academics can track progress towards providing timely and quality care to those who need it using facility-based data collection tools which are shown to be more valid than other tools (Day et al., 2021a). SBAs (providers who are trained to handle normal deliveries safely) increase chances of neonatal survival by recognizing danger signs for complications (UNICEF, 2021a) and providing immediate postpartum care to neonates. ePNC for neonates by a skilled provider (sPNC) improves survival because it increases the likelihood that a newborn will receive all essential newborn care, including eBFI, complications will be detected, and newborns have access to routine and emergency care in a timely manner (UNICEF, 2021c). Below is a review of the evidence for the benefit of these interventions on neonatal survival and possible explanations of some of the mixed findings, when relevant.

Health facility delivery

Impact of HFD on neonatal survival

Chinkhumba and colleagues (2014) conducted a systematic review of population-based prospective cohort studies examining the risk of perinatal mortality (death of the infant between seven months gestation to 7 days of life) by place of delivery in sub-Saharan Africa (Chinkhumba et al., 2014a). Although perinatal mortality includes deaths that occur before the neonatal period (stillbirths), there are seven overlapping days with deaths captured in the neonatal death period (defined as early neonatal mortality), so some perinatal mortality studies are included in this review. Of the 9,115 births considered in the analysis, home births ranged from 16.7% in Tanzania to 78.3% in the Democratic Republic of Congo (DRC). The pooled crude odds of mortality were higher for home delivery compared to facility delivery (OR 1.21, 95% CI 1.02-1.46), but the effect was no longer significant in a random effects model (OR 1.21, 95% CI 0.79-1.84) and therefore should be viewed with caution (DerSimonian & Laird, 1986; Garg et al., 2008).

Individual study-level findings in the Chinkhumba et al (2014) review revealed a mixed picture as well (Chinkhumba et al., 2014a). Results from two of the studies (Tanzania (Schmiegelow et al., 2012) and DRC (Matendo et al., 2011)) showed protective effects for home deliveries, one showed no effect (Burkina Faso (Diallo et al., 2010)), and three were in favor of facility delivery [Tanzania (GE et al., 1995), Uganda (Nankabirwa et al., 2011), and Malawi (McDermott et al., 1996)]. The weighted perinatal mortality ratio (PMR) was 70 per 1,000 births (95% CI 57-86) for home deliveries and 56 per 1,000 births (95% CI: 44-69) for facility-based deliveries.

The authors conclude that an expected 14 perinatal deaths per 1,000 births could be averted if deliveries are pushed to facilities and out of homes; this corresponds to a 21% (95% CI 6-40) risk reduction for home births. Sub-analyses looking at differences between stillbirth and early neonatal death were not reported.

Several studies reviewed in this chapter use data from the Global Network's (GN) Maternal and Newborn Health Registry (MNHR) (NICHD Global Network for Women's and Children's Health, 2021), a prospective, population-based surveillance study of pregnancies and their outcomes in six countries: DRC, Guatemala, India, Pakistan, Bangladesh, Zambia, and Kenya. The health outcomes of all pregnant women in participating clusters are tracked until six weeks after delivery. The Kenya site is in Eldoret in the Western region and covers the rural counties of Busia, Bungoma, and Kakamega.

Goudar and colleagues (2020) analyzed the relationship between HFD and neonatal mortality in MNHR data from 413,377 births in India, Guatemala, Kenya, Pakistan, and Zambia from 2010 to 2018 (Goudar, et al., 2020). HFD increased across all study sites. Each site saw reductions in neonatal mortality, but this change was only significant for the Zambian, Pakistani, Guatemalan, and one of the Indian sites. The partial correlation coefficients between HFD and neonatal mortality rates for these sites were negative and the odds ratio less than one, suggesting lower neonatal death with higher HFD. Overall, the associations were small. Among the participants from the Kenya site, most had a primary or secondary education (92%), an infant that weighed $\geq 2,500$ g (96%), and at least one ANC visit (98%). The proportion of HFDs increased from 35.8% in 2010 to 86.7% in 2018 and the neonatal mortality rate

decreased from 19 per 1,000 live births (95% CI 13.3 to 27.0) to 11.8 (8.4 to 16.5) in the same period. The adjusted linear trend p-value was 0.1419, indicating an insignificant change in NMR over time. The partial correlation coefficient for the HFD rate with neonatal mortality was -0.18 ($p=0.0414$), suggesting that NMR decreased when the HFD rate increased. The authors concluded that, despite the large increase in facility deliveries, there was not a significant association between HFD rates and neonatal mortality in the Kenyan site.

Kunkel and colleagues (2019) analyzed data from 37,375 deliveries between 2009-2013 in the MNHR to examine temporal trends in place of birth and perinatal mortality (Kunkel et al., 2019a). Facilities were categorized as higher level (i.e., hospitals) that provide higher level care, and lower level (i.e., health centers) that provide lower-level care that refer patients with high risk and complications to higher level facilities. Thirty-nine percent of deliveries occurred in a facility (hospital or health center), 60% at home, and 1% in other locations. Of the 1,085 perinatal deaths, 700 (65%) were stillbirths and 385 (35%) were early neonatal deaths. The PMR was 29.8 deaths per 1,000 deliveries overall, 68.2 for hospital deliveries, 29.6 for health center deliveries, and 21.9 for home deliveries (chi-square $p<0.001$). The proportion of deliveries occurring in all health facility types increased from 38.4% to 47.6% over the sample time frame ($p=0.004$, $R^2=0.41$) while perinatal mortality fluctuated from a low of 13.7 deaths per 1,000 deliveries in quarter 1 (Q1) of 2009 to a high of 43.2 in Q1 of 2013 (linear trend $p=0.10$). The odds of perinatal mortality were higher in hospital deliveries compared to home deliveries (adjusted OR [aOR] 1.79, 95% CI 1.26 to 2.53) and in any facility type than in home deliveries (aOR 1.41, 95% CI 1.11

to 1.80) (Kunkel et al., 2019a). This finding was also consistent when considering only singleton (single baby birth) normal-birthweight (>2,500g) infants (aOR 1.83, 95% CI 1.19 to 2.83) and deliveries referred from lower-level facilities or home (aOR 2.83, 95% CI 1.46 to 3.89). There were no differences in the odds of perinatal mortality between deliveries in health centers and homes.

Data from 13,989 singleton live births between 2010-2013 in the MNHR study were analyzed to evaluate the effect of eight essential, WHO-recommended, newborn care practices at the time of delivery (care at delivery, CAD) on early neonatal mortality (days 0-6 of life) (Patel et al., 2020b). These indicators, coded yes/no, were: CAD1: hospital delivery (vs clinic), CAD2: skilled birth attendance, CAD3: fetal heart rate assessment, CAD4: new gloves used for delivery, CAD5: clean razor used to cut cord, CAD6: early initiation of breastfeeding (within 1 hour after birth), CAD7: skin-to-skin practiced immediately after birth, and CAD8: bathing delayed for >6 hours after birth). Women who delivered at a health facility (hospital or clinic) for whom data on all eight indicators were available were included. Three percent were born age <34 weeks' gestation, <1% weighed <1,500g, and 7% had at least one neonatal condition. Early neonatal mortality between days 0 and 6 was 11.7 per 1,000 live births (95% CI 9.9 to 13.4), between days 0 and 1 was 8.7 (7.2 to 10.3), and between days 2 and 6 was 3.0 (2.1 to 3.9). Coverage of CAD1 was 30%, CAD2 was 4%, CAD3 was 95%, CAD4 was 100%, CAD5 was 100%, CAD6 was 87%, CAD7 was 81%, and CAD8 was 64%. Only 1% of neonates received all 8 indicators, 3% received all 5 intrapartum and between 0 and 2 postpartum indicators, and 97% received some other combination of indicators. The early NMR was highest in infants

that received all five intrapartum and 0-2 post-partum (56 per 1,000 live births), second highest in those that received all eight CAD (14), and lowest in those that received some other combination of indicators (10). The association between individual CAD indicators and neonatal mortality was not examined for Kenya alone, but Kenyan data contributed to a pooled analysis along with four other low-income countries (Zambia, Guatemala, India, and Pakistan). Results indicate increased risk of early neonatal mortality when the delivery is attended by a physician (RR 1.10, 95% CI 1.04 to 1.16, $p=0.0013$).

Data from the DHS present similarly mixed or weak associations. Fink and colleagues (2015) analyzed a sample of 1,473,226 live births in surveys conducted between 1990 and 2012, representing countries in Central and South America, Central, Southern, and Eastern Asia, and sub-Saharan Africa (Fink et al., 2015b). In the pooled sample, the unadjusted odds of early neonatal mortality were 18% lower for HFD (all types) compared to home deliveries (OR 0.818, 95% CI 0.80-0.84) and weaker in rural areas (OR 0.90, 95% CI 0.88-0.93) compared to urban areas (OR 0.82, 95% CI 0.77-0.85), but the protective effect was not confirmed after adjusting for maternal age, education, household wealth, sex of child, and multiple births. Examination of adjusted associations at the country level revealed a substantial degree of heterogeneity. HFD is protective in 16 countries, associated with increased odds in 10 countries, and not significantly associated with early neonatal mortality in the remaining 41 countries. The aOR of neonatal mortality among HFDs in Kenya was 1.31 (95% CI 1.07-1.60). They further examined differences by type of place of delivery (home, public medical sector, and private medical sector) and risk level (high

risk was defined as women age <20 or ≥ 35 years or having a low birthweight infant). Early neonatal mortality was lower in all facility types as compared to home deliveries in the unadjusted models, but only private facilities showed a protective effect in the adjusted models (aOR 0.88, 95% CI 0.84-0.91). Women with age-related risk had 10.6% lower odds of early neonatal mortality if they delivered at a health facility (any type) compared to those who delivered at home, whereas women without age-related risk had slightly increased odds of early neonatal mortality (aOR 1.06, 95% CI 1.02-1.10).

Several studies have found that HFD increases the likelihood that other recommended interventions are provided, which themselves are associated with increased survival rates. For example, Kunkel and colleagues (2019) found that mothers delivering in facilities were primarily supported by SBAs (99%), and their infants were more likely to have their fetal heart rates assessed, be resuscitated, and placed on mother's chest (Kunkel et al., 2019a). Mothers delivering at home were primarily attended by traditional birth attendants (TBAs) or family members (98%), were more likely to be bathed within six hours, have received late ANC, and ANC by a TBA (Kunkel et al., 2019a).

Interpretation of findings

The findings suggest that coverage of HFD alone is not sufficient to reach targets in reducing neonatal deaths (Souza et al., 2013). Several potential explanations are presented in the literature for the mixed findings on the survival benefit of delivering in a health facility. First, lack of detailed data on pregnancy-related risk factors in studies with mixed or unexpected findings makes it difficult to estimate

how much of a role risk levels and referral bias are playing (Kunkel et al., 2019a). The DHS and MNHR, for example, collect limited data on the health and pregnancy history of mothers prior to conception and delivery (Fink et al., 2015b; NICHD, n.d.). Second and related, it is reasonable to assume that high-risk mothers (for e.g., those with known pre-existing conditions or poor past birth outcomes) and mothers experiencing complications during pregnancy are more likely to deliver at or are referred to health facilities than low-risk mothers and mothers not experiencing any complications, biasing mortality outcomes against facilities (Fink et al., 2015b; Kunkel et al., 2019a).

Over the past two decades, policy, program, and project level efforts to reduce the global burden of neonatal morbidity and mortality have focused on increasing SBA (O. M. Campbell & Graham, 2006; United Nations Secretary-General, 2010), and that has resulted in increased HFD rates in all regions (Montagu et al., 2014). Two of the studies reviewed by Chinkhumba and colleagues (2014) (GE et al., 1995; Schmiegelow et al., 2012) examined efforts to arrange facility referrals for high-risk pregnancies, resulting in a home birth group that was relatively lower risk than the facility group (Chinkhumba et al., 2014a).

A third potential explanation is poor quality of care health facilities (Bhutta et al., 2014; UNICEF, 2015; Wall et al., 2010). This encompasses available infrastructure, supplies, management, and an adequate, competent and enabled health workforce to provide routine and life-saving interventions (Tunçalp et al., 2015). Globally, an estimated 18 million additional healthcare workers are needed to meet the SDGs, with a majority of the gap concentrated in LMICs (World Health

Organization, 2016). Kenya has among the highest number of pregnancies in sub-Saharan Africa while simultaneously having among the highest healthcare worker to pregnancy ratio in the region (Koblinsky et al., 2016; UNFPA et al., 2014). This is true for obstetricians and gynecologists (0.26-0.50 per 1,000 pregnancies) as well as midwives, auxiliary midwives, and nurse midwives (<2 per 1,000 pregnancies) (Koblinsky et al., 2016). The total human resources for health ratio in Kenya is also less than 2 per 1,000 pregnancies (Koblinsky et al., 2016) and much lower than WHO's global recommendation of 4.45 (Aiga, 2020).

Quality of care can also be approximated by facility readiness to provide services. The 2010 Kenya Service Provision Assessment (SPA), which uses direct observation in health facilities to capture care provision, found low overall quality of delivery care and the lowest quality in the most impoverished areas (Sharma et al., 2017). Quality of delivery care was operationalized using the Donabedian framework (Donabedian, 1988), creating an index comprising items covering infrastructure, staffing, and equipment and supplies. Only 8% of poor women and 17% of all women had access to adequate delivery care. Service Delivery Indicator surveys from Kenya and other countries in the region also show poor clinical knowledge, high rates of absenteeism (habitual absence from work) in healthcare providers, and low availability of essential drugs used in the treatment of conditions that account for a large share of child mortality in sub-Saharan Africa (Martin & Pimhidzai, 2013). Finally, poor consistency in findings across countries might reflect meaningful differences in the healthcare and country settings that impact quality of care and delays in reaching care (Kunkel et al., 2019a).

Qualitative research with mothers in Kenya finds a poor overall experience at health facilities. Women in Western Kenya report providers in health facilities are less flexible about what position to deliver in, they are supervised by trainee nurses or students with little or no follow up by health facility staff, and they are expected to buy or arrange their own supplies (e.g., gloves and bathing water) (Liambila & Kuria, 2014).

Skilled birth attendance

The next intervention I included is the presence of an SBA during labor and delivery. First, it is important to establish a definition. I draw primarily from the two described below.

The WHO 2004 definition of skilled birth attendance is (WHO et al., 2004): *“a skilled attendant is 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 (uncomplicated) pregnancies, childbirth and the immediate postnatal period and in the identification, management and referral of complications in women and newborns”*.

This definition was updated in 2018 to (WHO, 2018a): *“Skilled health personnel, as referenced by SDG indicator 3.1.2, are competent maternal and newborn health (MNH) professionals educated, trained and regulated to national and international standards. They are competent to: (i) provide and promote evidence-based, human-rights based, quality, socioculturally sensitive and dignified care to women and newborns; (ii) facilitate physiological processes during labor and delivery to ensure a clean and positive childbirth experience; and (iii) identify and*

manage or refer women and/or newborns with complications. In addition, as part of an integrated team of MNH professionals (including midwives, nurses, obstetricians, pediatricians, and anesthetists), they perform all signal functions of emergency maternal and newborn care to optimize the health and well-being of women and newborns. Within an enabling environment, midwives trained to International Confederation of Midwives (ICM) standards can provide nearly all of the essential care needed for women and newborns. (In different countries, these competencies are held by professionals with varying occupational titles.)”

Impact of SBA on neonatal survival

Globally, there is a strong association between high SBA and low neonatal mortality rates, but this association is weakest in countries with high neonatal mortality (UNICEF, 2015). An analysis of DHS surveys from 20 countries in sub-Saharan Africa (excluding Kenya) between 2010 and 2014 found no effect of SBA on risk of death on days 0-1 of life, but did find that infants born with SBA were 16% less likely to die in the first 2 to 27 days of life (OR 0.84, 95% CI 0.71 to 0.99) (Carvajal-Aguirre et al., 2017). Singh and colleagues (2014) assessed the extent to which SBA is associated with early neonatal mortality in three regions: Latin America/Caribbean (Bolivia, Haiti, Honduras), Asia (Bangladesh, Indonesia, Nepal, and Africa (Ghana, Uganda, Zambia) using the most recent DHS waves available at the time of analysis (Singh et al., 2014). The pooled, adjusted results showed no survival benefit of SBA on death in the first week or first day of life. Compared to Latin America/Caribbean, the aOR for death in the first week for SBA deliveries in

Africa was 2.49 (95%CI 1.42-4.36) and 3.61 (95% CI 1.52-8.52) for death on the first day.

Bellizzi and colleagues (2016) analyzed the relationship between reported complications at birth, presence of a SBA, and place of birth on early neonatal mortality in DHS data from Bangladesh, Colombia, Honduras, Indonesia, Mali, Niger, Peru, Philippines, and Sao Tome and Principe (Bellizzi et al., 2017). After adjusting for obstetric complications and sociodemographic characteristics, no difference in the odds of early neonatal mortality between home births with and without an SBA was observed in any country or in the pooled analysis. A protective effect of facility birth compared to home births without an SBA was observed, however (aOR 1.3, 95% CI 1.1-1.5) (Bellizzi et al., 2017).

Interpretation of findings

Several potential explanations are provided in the literature for the mixed findings on the association between SBA and neonatal survival. Coverage of SBA measures contacts with the healthcare system, not content or quality of care provided by the SBA. Provision of interventions by SBAs may be limited by inadequate equipment and resources (Carvajal-Aguirre et al., 2017) and lack of knowledge and skills (Martin & Pimhidzai, 2013; Olenja et al., 2009). SBA-identified factors that affect the quality-of-care they provide include insufficient preservice education and/or training and high workloads at understaffed facilities (Sulemana et al., 2019). High stress levels caused by work-related risk-taking, poor compensation, and poor living conditions were identified as barriers to providing good care (Sulemana et al.,

2019). Some SBAs report poor management at health facilities and feeling unsupported as well.

The study examining the survival benefit of SBA in 20 countries in sub-Saharan Africa also estimated the average annual deliveries per skilled health professional by country if SBA coverage was 100%. Numbers ranged from 20 deliveries per skilled health professional per year in Nigeria to 320 in Niger. The authors acknowledge that these estimates do not account for high levels of within-country variation but suggest that the levels are not so high as to overwhelm the healthcare system (Carvajal-Aguirre et al., 2017). No survival benefit of SBA in the first day of life suggests a large proportion of SBAs are not adequately skilled to prevent death and/or that health facilities are not equipped to save high risk newborns (Carvajal-Aguirre et al., 2017).

SBAs are more likely to see women with obstetric complications than non-skilled providers (Paul & Rumsey, 2002; Ronsmans et al., 2010). Singh and colleagues (2014) found a protective effect of SBA on neonatal survival in Latin America/Caribbean but not in Africa or Asia, suggesting the region's stronger health infrastructure plays a role (Singh et al., 2014). Additionally, more births are attended by SBAs in Latin America/Caribbean overall, whereas in some Asian and African contexts, only complicated births are more likely to seek skilled care (Bazant, 2008; Edmond et al., 2008; Izugbara et al., 2009; Paul & Rumsey, 2002). In a case-control study of 583 deliveries in Western Kenya, women who experienced at least one complication in the intrapartum or postpartum period (cases) were more likely to have had a SBA in a health facility as compared to women with no reported complications

(controls), and controls were more likely to have an un-skilled attendant present at birth, however this association did not persist after adjusting for sociodemographic characteristics (Liambila & Kuria, 2014).

Issues with measuring of SBA and areas for improvement

There are several challenges with measuring and reporting SBA accurately and consistently across time, and between and within countries.

Definition

During the MDG era (1990-2015) (United Nations, 2015), many countries adopted a task-shifting strategy that trained lower-level cadre and/or created new cadres with skills to increase SBA coverage (Deller et al., 2015). Cadres reported to be SBA across countries differ in their job descriptions, responsibilities (Lehmann, 2008), names, training, and functions performed (Adegoke et al., 2012). In a review of cadres that qualify as SBA per the WHO definition, Adegoke and colleagues (2012) found no direct correlation between total number of cadres and availability of emergency obstetric care (Adegoke et al., 2012). This is further complicated by a lack of standardization of content and requirements of training programs across and within countries for qualifying as a SBA, as well as low country capacity to practice and adhere to national and international guidelines (Hobbs et al., 2019). The expansion of the 2018 WHO definition of SBA to include additional personnel who can provide antenatal and intrapartum care such as anesthesiologists and midwives (WHO, 2018a) introduced an additional layer of complexity measuring SBA coverage consistently over time.

How coverage is captured in surveys

Despite its widespread use in the DHS and MICS programs, SBA items were not initially validated in several settings (Lozano et al., 2011). Measuring the category of provider at birth is insufficient as it assumes the providers' knowledge, skill levels, and access to equipment and supplies (Blanc et al., 2016b) while also assuming mothers' awareness of the title of their providers in healthcare settings, which is often low for mothers with low education (Blanc et al., 2016a; McCarthy et al., 2016). The DHS and MICS document women's self-reports of the skill level of their care provider without verifying their education, training, or competencies, and do not in fact measure whether the provider had the qualifications and skills (National Bureau of Statistics, 2014a; UNICEF, 2020). Further, survey items to capture SBA differ between DHS and MICS (Carvajal-Aguirre et al., 2017), and there is inconsistency in the cadres considered skilled between and within countries (Amouzou et al., 2017).

Maternal awareness and recall

When compared to direct observation, women underreport less skilled providers (e.g., student nurses) and overreport highly skilled providers (e.g., obstetricians) (Blanc et al., 2016b). This suggests that perceptions of who the primary provider is might be influenced either by who provided the most care or the senior-most provider, regardless of the duration of their engagement (Blanc et al., 2016b). Aspects of care which are concrete, observable, and which reflect pain or concern, such as having a cesarean section or a support person present during the birth, are reported with higher accuracy than others (Blanc et al., 2016b). Qualitative research conducted by DHS with women in Bangladesh and Malawi finds that women tell

coherent birth experience stories, including when the baby's health was checked (Yoder et al., 2010).

Early and skilled postnatal care

The next two interventions I include are ePNC and sPNC for the newborn. The WHO definition of early postnatal care is: *“care provided during the first 24 hours for both facility and home births; this should be followed by additional contacts on day 3, between 7 and 14, and six weeks after birth; babies born in health facilities should receive a check immediately after birth and a full clinical examination between an hour after birth and before discharge (which should occur ≥ 24 hours after birth)”* (WHO, 2013). Every Newborn Action Plan (ENAP) defines it as: care provided during the first two days after birth (WHO & UNICEF, 2014), and the Global Strategy for Women's, Children's, and Adolescent's Health (2016-2030) defines it as: care in the facility for at least 24 hours after an uncomplicated vaginal birth (Every Woman Every Child, 2015).

The 2009 WHO-UNICEF postnatal care (PNC) recommendation stipulates that a range of healthcare workers can provide effective PNC, including community health workers, though they acknowledge that skilled providers are better suited (WHO & UNICEF, 2009). For this reason, the global indicator counts PNC by providers with any skill level, but DHS and MICS disaggregate by provider type in their reports (Moran et al., 2013). WHO guidelines from 2016 stipulate that: *“the skilled birth attendants and support staff have appropriate competence and skills mix to meet the requirements of labor, childbirth and the early postnatal period”* (WHO, 2016a).

Global Strategy defines PNC in a facility as occurring at least 24 hours after an uncomplicated vaginal birth that includes: immediate drying and thermal care, neonatal resuscitation with bag and mask, hygienic cord and skin care, initiation of prophylactic antiretroviral therapy for babies exposed to HIV, KMC, presumptive antibiotic therapy for newborns at risk of bacterial infection, management of newborns with jaundice, and detection and management of genetic conditions (Every Woman Every Child, 2015). Though not explicitly stated, it is implied that a provider trained in providing this care would qualify as skilled as some of these competencies fall under the old (WHO et al., 2004) and new (WHO, 2018a) WHO definitions of skilled health personnel providing care during childbirth.

Impact of ePNC and sPNC on neonatal survival

The WHO recommendation for healthy mothers and newborns to remain in facilities at least 24 hours after birth is classified as “weak”, based on low quality evidence (WHO, 2013). The recommendation is based on studies that compare discharge within 24 or 48 hours of birth versus later on neonatal and maternal readmissions, neonatal morbidities, and breastfeeding practices at six weeks and six months postpartum. In a randomized controlled trial (RCT), the risk of neonatal readmission was not different between the two groups (within 24 hours vs later discharge, RR=0.61, 95% CI 0.15 to 2.53) (Bueno et al., 2005), while the pooled results of two cohort studies showed increased risk of neonatal readmissions for earlier discharge (RR=1.20, 95% CI 1.11 to 1.30) (WHO, 2013). The most common reasons for readmissions were jaundice, dehydration, and symptoms of congenital gastrointestinal and cardiac defects. One RCT found no evidence that later discharge

times positively influenced breastfeeding at six weeks (RR=0.67, 95% CI 0.41 to 1.09) and found borderline evidence of increased risk that mothers would not be breastfeeding at six months postpartum for earlier discharge times (RR=1.26, 95% CI 1.00-1.60) (Bueno et al., 2005).

In comparing the effect of discharge within 48 hours vs later, pooled estimates from four RCTs (RR=0.91, 95% CI 0.49 to 1.71) and three cohort studies (RR=1.08, 95% CI 0.73 to 1.59) found no evidence of lower risk of neonatal readmissions (WHO, 2013). Pooled results from six RCTs found that mothers were more likely to be breastfeeding at six weeks postpartum if they were discharged earlier versus later (0.87, 95% CI 0.76 to 0.99) (WHO, 2013). Pooled results from three RCTs found a borderline effect on the risk of stopping feeding by six months in newborns discharged earlier versus later (RR=1.06, 95% CI 0.95 to 1.18). One observational study found no effect, however (Mandl et al., 1997). The overall quality of evidence was graded to be very low to low.

A study in Bangladesh found that, compared with infants who received no visit, those that survived the first day and received a visit on day one had 67% lower neonatal mortality, and those that survived the first two days and received a visit on the second day had 64% lower mortality. First visits after the first 48 hours were not associated with reduced mortality (Baqui et al., 2009).

There is little published research on the effect of a skilled PNC provider on neonatal survival. Studies examining the role skilled PNC providers play in delivering routine interventions, such as breastfeeding, find mixed evidence. In a study in Bangladesh for example, specially trained peer counselors increased the odds of early

initiation of breastfeeding (Haider et al., 2000). A 2017 review of evidence from sub-Saharan African countries found that PNC provided by unskilled healthcare workers is associated with higher odds of pre-lacteal feeds (PLFs) (Khan et al., 2017), while an earlier review from 2002 found that skilled healthcare providers were a barrier to early initiation of breastfeeding and less likely to provide quality information and counseling of breastfeeding (Dennis, 2002). There is currently no consensus on which type of PNC provider is most effective at improving newborn feeding outcomes (Khan et al., 2017).

Interpretation of findings

Similar to SBA, researchers suggest that in studies that do not find a survival benefit associated with skilled PNC providers, the explanation is likely, in part, that families seek skilled care for neonates late and/or with more severe illnesses (Baqui et al., 2009). Another explanation is that measuring PNC contacts alone is insufficient as they do not provide information on quality or content of care. As such, items to capture common practices at first PNC checks (i.e., infant weighed and breastfeeding observed) have recently been added to the DHS and MICS (WHO, 2015b).

Issues with measurement of ePNC and sPNC and areas for improvement

During PNC contacts, additional interventions are recommended for the routine monitoring of healthy neonates which include checking the weight, umbilical cord, examining the body for danger signs, and counseling the primary caregiver about thermal care and breastfeeding (The Partnership for Maternal, 2006). When these quality measures (sometimes referred to as content of visits) are added to the measurement of PNC coverage by counting the number performed during contact,

estimates of coverage decrease, suggesting contact alone is an insufficient indicator of care received by newborns (Marchant et al., 2015b). Recently there has been a shift in the MNH community towards measuring quality of contacts (Marchant et al., 2015b), and the newest DHS and MICS data collection tools reflect this effort through the addition of items that measure cord examination, weight and temperature measurement, and counseling on breastfeeding and newborn warning signs (UNICEF, n.d.-a), (DHS Program, 2020). However, they still do not capture PNC quality for non-facility births (Carvajal–Aguirre et al., 2017) and some studies find that healthcare providers rarely inform women about the care they provide to newborns during PNC checks (Z et al., 2015).

Issues with defining and capturing the timing of a true PNC check add an additional layer of complexity to understanding the relationship between ePNC and neonatal survival. Among researchers, there is not consensus on when the intrapartum period ends and when the postnatal period begins (Carvajal–Aguirre et al., 2017), nor clear evidence for a specific timing for the check (WHO, 2015b). As a result, studies have defined the timing of a PNC check differently, ranging from minutes to days (Moran et al., 2013). The PNC items in the DHS and MICS are not completely comparable either (Carvajal–Aguirre et al., 2017). MICS attempts to capture checks on the newborn’s health immediately after birth and subsequent checks separately (for facility births, the difference is marked by discharge from the facility and for home births, the difference is marked by when the birth attendant leaves) (DHS Program, 2020), whereas DHS does not systematically make this distinction (UNICEF, n.d.-a). PNC coverage estimates in the DHS are, on average, higher than in

the MICS, suggesting they are not in fact measuring the same thing (Carvajal–Aguirre et al., 2017).

Measurement validity is another area of improvement. Concerns include what mothers know about neonatal care provided after delivery, ability to recall events from several years prior, and question comprehension (Moran et al., 2013). In one study, maternal recall for observable or concerning aspects of care (such as low birthweight) had high accurate recall at 13-15 months postpartum, but low recall for events related to provider hygiene and care during the immediate postnatal period (evidenced by proportion of “don’t know” responses) (McCarthy et al., 2016). Relatedly, mothers’ recall about care received prior to labor (e.g., to induce labor) was more accurate than care received following birth (e.g., uterotonic for preventing hemorrhage), the latter of which had high “don’t know” responses. Studies in Mozambique and rural China that compared maternal reports with direct observations of PNC contacts and content have found between unacceptable to moderate levels of validity (Liu et al., 2013b; WHO, 1998) and studies in Malawi and Bangladesh found that many women did not understand what was meant by a “health checkup” (the DHS phrase) to measure PNC contact and required further explanation (Yoder et al., 2010).

Conveying a clear understanding of the timing of PNC to survey respondents is important for its accurate measurement (Carvajal–Aguirre et al., 2017). Qualitative research suggests women are actually reporting on routine intrapartum care rather than PNC (Yoder et al., 2010), resulting in possible overestimation of coverage in the DHS and MICS (Carvajal–Aguirre et al., 2017). There are other issues with self-

reports. Women who have cesarean sections are less likely to report accurately on aspects of immediate newborn care, such as whether the newborn was dried or wrapped in a towel immediately after birth, evidenced by high “don’t know” responses to these questions (Blanc et al., 2016b).

Early initiation of breastfeeding

The final intervention I included is early initiation of breastfeeding. The Baby-friendly Hospital Initiative recommends that mothers should be supported to initiate breastfeeding within the first 30 minutes of birth (WHO, 1998) and the Global Strategy defines eBFI as being initiated within the first hour (Every Woman Every Child, 2015).

Impact of eBFI on neonatal survival

There is strong and consistent evidence of the benefit of breastfeeding and its early initiation on neonatal morbidity and mortality, with some mixed findings for the benefit of partial versus exclusive breastfeeding, though this is not the focus of the breastfeeding indicator in this study. A 2006 study of 10,947 neonates in Ghana who survived the first 48 hours found a strong dose-response relationship between higher neonatal mortality risk with delays in breastfeeding initiation from one hour to day seven (Edmond et al., 2006). Initiation after day one was associated with a 2.4-fold increased risk in neonatal mortality; the effect size was similar even after adjusting for morbidities (e.g., congenital abnormalities). Additionally, the risk of neonatal death was four times higher in neonates who were partially breastfed compared to exclusively breastfed.

Pooled estimates from five studies using data from 136,047 infants also found a dose response relationship between timing of initiation and neonatal survival (Smith et al., 2017). There was a 2.19-fold (95% CI 1.73 to 2.77) increased risk of neonatal mortality in infants who initiated ≥ 24 hours after birth and a 33% (95% CI 13 to 56) increased risk in those who initiated between 2-23 hours after birth compared to those who initiated within the first hour. A systematic review of 18 studies from predominately LMICs found lower risk of all-cause neonatal mortality in all live births (RR=0.56, 95% CI 0.40 to 0.79), in babies with low birthweights (RR=0.58, 95% CI 0.43 to 0.78), and in infection-related neonatal mortality (RR=0.55, 95% CI 0.36 to 0.84) for early initiated babies (<24 hours) compared to later (Debes et al., 2013).

Early initiation of breastfeeding is associated with skin-to-skin contact with the mother (WHO, 2015a), which is itself a recommended intervention to reduce neonatal mortality (Boundy et al., 2016; Darmstadt et al., 2005). PLFs, any liquids other than breastmilk given to the newborn before initiating breastfeeding, are against the recommended practices for newborn care unless medically necessary (WHO, 1998), and are negatively associated with initiating breastfeeding within the first hour (El-Gilany et al., 2012). They are also associated with insufficient maternal milk production, diarrhea in the newborn (Lakati et al., 2010), and exposure to infection through consuming contaminated food and liquids that increase rates of infection, one of the leading causes of neonatal mortality (Bhutta et al., 2014).

Interpretation of findings

There is strong evidence that early initiation of breastfeeding is associated with reduced morbidity and mortality and increases in other behaviors that promote neonatal health (e.g., skin-to-skin contact).

Issues with measurement of eBFI and areas of improvement

The ENAP technical consultation group calls for improving the specificity of breastfeeding indicators (WHO, 2015b) as this has been found to be low for early breastfeeding initiation in validation studies of household surveys (Stanton et al., 2013b). Cognitive interviews with mothers in Ethiopia found high comprehension of questions that ascertained early initiation, but probing revealed they were often reporting time to the newborn actually receiving breastmilk rather than the first attempt to initiate breastfeeding (Salasibew et al., 2014). Establishing temporality with respect to illness onset and breastfeeding initiation strengthens our understanding of the potential benefits to neonates dying within the first 48 hours (Debes et al., 2013).

Why focus on these five neonatal health interventions?

Several global health agencies, initiatives, and networks share the common goal of supporting efforts towards reducing neonatal mortality in LMICs. Through various processes, they have identified key indicators that measure progress towards this goal, including the five interventions that are the focus of this dissertation. Below is a brief overview of four such efforts (see Table 2 for list of interventions by initiative/effort it is monitored by).

Countdown to 2030, originally known as Countdown to 2015, is a collaboration of academics from across the world, United Nations (UN) agencies, the World Bank, and civil society organizations that track progress of life-saving Reproductive, Maternal, Newborn, Child and Adolescent Health and Nutrition intervention coverage (Countdown 2030, 2021). The Countdown Initiative generates evidence to support efforts to increase equitable intervention coverage and has an approach that is aligned with the SDG Global Strategy for Women's, Children's and Adolescents' Health 2016-2030 (Every Woman Every Child, 2015).

The Global Strategy for Women's, Children's, and Adolescent's Health (2016-2030) (Global Strategy), launched by former UN Secretary-General Ban Ki Moon in 2010, aims to ensure that every woman, child, and adolescent realizes their right to attain the highest standard of health (Every Woman Every Child, 2015). The Strategy builds on the success of earlier versions that were designed to accelerate MDGs and is in line with the SDGs (UNICEF, 2016a).

The Every Newborn Action Plan (ENAP), launched in 2014 and endorsed at the 67th World Health Assembly, sets a vision for how to improve newborn health, and supports country leaders and policymakers in reaching the goal of 10 or less neonatal deaths per 1,000 live births by 2035 (WHO & UNICEF, 2014). The Plan supports the planning and implementation of newborn-specific actions within the context of country-specific strategies and works in collaboration with key stakeholders. Development of the Plan was informed by The Lancet Every Newborn series (*Every Newborn: Series from the Lancet Journals*, 2014), technical

consultations with UN Member States, and several organizations and individuals (WHO & UNICEF, 2014).

Finally, UNICEF, an agency of the UN, works in 190 countries and territories to promote the health and wellbeing of children (UNICEF, n.d.-b). Since 1980, UNICEF has published its annual flagship report, The State of the World’s Children Report (SOWC) (UNICEF, 2021b), in which it reports on a number of indicators used to measure child health outcomes, drawing on data from the DHS and MICS.

Table 2. Intervention by organization, agency, or plan it is monitored by					
Source	Intervention				
	HFD	SBA	ePNC	sPNC	eBFI
Countdown to 2030	Yes	Yes	Yes	Yes	Yes
ENAP	No	Yes	Yes	No	Yes
UNICEF’s SOWC	Yes	Yes	Yes	Implied	Yes
Global Strategy	Yes	Yes	Yes	Implied	Yes
ENAP: Every Newborn Action Plan; UNICEF: United Nations Children’s Fund; SOWC: State of the World’s Children; Global Strategy: Global Strategy for Women’s, Children’s, and Adolescents’ Health (2016-2030); HFD: health facility delivery; SBA: skilled birth attendant; ePNC: early postnatal care; sPNC: skilled PNC provider; eBFI: breast feeding initiation					

Universal recommendations for improved measurement

Most of the evidence on the survival benefit of neonatal health interventions covered in this review is weak or inconclusive, and one explanation for this is poor measurement of intervention coverage. Household surveys require further validation studies (Carvajal–Aguirre et al., 2017); robust data on quality care at birth is scarce in many settings (Marchant et al., 2016; Moxon et al., 2015; Munos et al., 2017b); global guidance on best measurement practices (Moran & Marchant, 2017) and consensus on definitions. Tracking HFD, SBA, ePNC, and sPNC offers an assessment of contacts between newborns and care without any indication of content or quality of care delivered (Bryce et al., 2013).

There is a widely recognized need for a more robust system to capture MNH intervention coverage in the global health community (Grove et al., 2015). Increasingly, more attention is being paid to measuring quality of care (content) at health facilities, in addition to contacts (Kruk et al., 2018), making it important to identify which global indicators can be accurately measured with existing tools and how they can be improved (Brizuela et al., 2019). Several principles guide progress towards achieving the goal of improved measurement: (1) selection of approximately 15 core indicators to capture effective coverage of MNH interventions that governments, major donors, and international agencies agree upon while maintaining relevance to local settings; (2) development of new technologies such as biomarkers and mobile phone applications to collect data; (3) linking household surveys with facility assessment tools; (4) use of composite measures to estimate coverage along the continuum of care (Grove et al., 2015); and (5) investment in innovative data collection methods through community health workers (WHO & UNICEF, 2014). Successes in child immunization and the fights against malaria, diarrheal disease, and HIV/AIDS were made possible by a combination of data sources (Moran & Marchant, 2017), and systematic measurement of coverage at frequent intervals at multiple levels (Grove et al., 2015).

Strengths and weaknesses of household surveys compared to other data collection tools

Nationally representative household surveys are essential data sources for monitoring MNH indicators and have the unique advantage over other data collection

tools of identifying inequities in intervention coverage at the regional, national, and sub-national levels (Carvajal–Aguirre et al., 2017; Moran & Marchant, 2017). Across DHS, MICS and other similar surveys, there is a high level of standardization in question framing and interview technique (but not identical), making results highly comparable across various contexts (Day et al., 2021a). The disadvantages of these surveys include: large time and cost requirements to collect data at regular intervals from nationally representative samples (Moxon et al., 2015); they rely on women's self-reports of care they and their newborns received around the time of birth and for most indicators, reports are not triangulated (ICF, 2020; UNICEF, n.d.-a); and self-reports are more accurate for care experienced directly by mother, and as a result often produce less valid results for care provided to newborns (Day et al., 2021a).

The main advantage of exit surveys (surveys of patients exiting health facilities) over household surveys is the shorter time interval between when care was provided and reported on, reducing the potential for recall bias. However, exit surveys have been found to have low accuracy for specific clinical interventions, except for KMC after admission to a KMC ward (Day et al., 2021a). Further, health professionals tend to provide better care on days when exit interviews are being conducted outside their facility as compared to days when they are not, resulting in an overestimation of coverage levels (Leurent et al., 2016).

Unlike household surveys, facility registers (records maintained by health facility personnel) can provide information on input indicators such as levels of staffing, availability of equipment, and service readiness at facilities (Moxon et al., 2015). The data they collect can be routinely incorporated into health management

information systems (HMIS) and is more accurate than survey data overall, but there is some variation by indicator (Day et al., 2021a). However, HMIS data cannot produce population-based coverage estimates; they only capture data on individuals who receive care from formal healthcare systems, representing a subset of the total target population for MNH interventions by excluding those who receive care from other sources (Maïga et al., 2019). Additionally, in the context of overburdened and under-resourced healthcare systems in LMICs, HMIS struggle with incomplete and inconsistent reporting (Maternal and Child Survival Program, 2018), errors in manual calculation, and reporting and aggregating data at regular intervals (Stanton et al., 2013a). Third-party facility assessment tools, such as the SPA, measure input as well as process indicators of MNH care (Brizuela et al., 2019) and offer similar advantages to household surveys. SPA and similar tools are most comprehensive of input measures (Brizuela et al., 2019), but these are considered only part of the data matrix and do not provide complete insight on quality of care (Leslie, Sun, et al., 2017).

Chapter 3: Methods

This chapter will describe the quantitative and qualitative components of the dissertation separately. The quantitative component includes a description of the data sources, the universe of analysis, and the research question along with its aims, hypotheses, and analysis plans. The qualitative component includes the aim, sample design and rationale, recruitment and screening procedures, study instruments, data collection training, data collection, analysis plan, and ethical considerations and protection of human subjects.

This dissertation addresses the following two research questions:

1. How does maternal and newborn health intervention coverage in informal settlements compare with other urban sub-populations in Kenya?
2. How can data quality from household surveys about delivery and neonatal care be improved?

Quantitative component

Data sources

The following data sources were drawn upon to answer Research Question 1: (1) the 2014 KDHS (National Bureau of Statistics, 2014a) and (2) the 2014 wave of the PAMANECH study (Bakibinga et al., 2014). The 2014 KDHS used the Phase VII Woman's Questionnaire (National Bureau of Statistics, 2014a) to collect data in-person with women of reproductive age (15-49 years old) in randomly selected households; birth histories were collected from those who had a pregnancy that resulted in a live birth in the five years preceding data collection. These data were

used to describe coverage at the urban level in 2014. The PAMANECH study used the 2013 Baseline Women's Questionnaire to collect data from randomly selected women of reproductive age (12-49 years old) residing in Korogocho and Viwandani, Nairobi, Kenya (APHRC, 2015). These data were used to describe intervention coverage in informal settlements in 2013.

Kenya Demographic and Health Survey

The DHS Program collects and disseminates nationally representative data on population health and nutrition in LMICs (DHS Program, n.d.). DHS data are collected every five to six years when possible and are used to inform policy decisions, by researchers, and by healthcare providers. The most recent available KDHS is from 2014. Data collection for the next wave was completed in 2022 but were not available at the time of writing this dissertation (The DHS Program, 2021). A two-stage cluster design sampling technique was used to identify eligible households in the 2014 KDHS using the sampling frame developed by the Fifth National Sample Survey and Evaluation Programme (NASSEP V) which conducts household surveys across Kenya (National Bureau of Statistics, 2014a). To balance the sample size requirements to produce nationally representative estimates with the time and resource requirements to interview many households, shortened questionnaires were used in half of the households. The shortened versions retained survey items required to develop estimates of priority indicators only at the county level (priority status of an indicator was determined by a group of stakeholders). Data collected in the long version can produce estimates at the national, urban, and rural, levels, however only data collected in the short version can produce estimates at the

county level. Though the short-length questionnaires include information on delivery care, they do not include variables required to construct a composite measure related to postnatal care and breastfeeding.

This study, then, used the half of the DHS sample that was surveyed with the long questionnaire to describe coverage of interventions around the time of birth. Women were eligible to participate in the survey if they were of reproductive age (15-49 years old) and had stayed in the participating household the night before the field visit. A total of 36,430 households (99% response rate) participated; of them, 19,030 households and 15,317 women were selected for long questionnaires with 98.8% and 96.2% response rates, respectively.

Partnership for Maternal, Newborn and Child Health (PAMANECH) Project

The PAMANECH project was implemented by APHRC in Korogocho and Viwandani beginning in 2013 (APHRC, 2015). PAMANECH sought to strengthen healthcare delivery for women and their children in informal settlement settlements through public-private partnerships (Bakibinga et al., 2014). Intervention activities included: (1) upgrading six private not-for-profit health facilities in Korogocho and Viwandani, (2) training facility-based healthcare providers in updated MNH practice guidelines, (3) capacity building of local county and sub-county health authorities, (4) establishing a network of 180 existing community health volunteers (CHVs) to create linkages with private providers and the public sector, (5) mobilizing young men from pre-existing youth groups as escorts for women seeking urgent medical care for themselves or their children at night, (6) establishing ambulance services to serve each informal settlement exclusively, and (7) running outreach clinics for women and

children. Preliminary results from an external evaluation found that participating healthcare facilities provided better quality services, a substantial increase in MNH service utilization, ties between public and private sector facilities had strengthened, and that CHVs and healthcare providers developed partnerships (Bakibinga et al., 2021).

Baseline surveys were conducted with women of reproductive age (12 to 49 years) randomly selected from the NUHDSS sampling frame after restricting to households with eligible women and children under five years of age. The NUHDSS is a longitudinal surveillance platform that measures the effects of urban residence on social, physical, and economic wellbeing (Beguy et al., 2015a). Since 2002, it has conducted annual household surveys with approximately 65,000 individuals in 24,000 households in Korogocho and Viwandani. It also serves as a platform to launch additional and external projects such as PAMANECH. Women were invited to participate in face-to-face interviews conducted in Kiswahili by trained field workers. A total of 849 women were surveyed in 2013.

Universe of analyses

Inclusion criteria for the total analytic sample were: being a woman between the ages of 15 and 49 at the time of the survey, having had a pregnancy that resulted in a live birth within two years prior to the survey, and having no missing data on sociodemographic variables. The PAMANECH study included women outside this age range, however they were excluded from this study to increase comparability with the DHS sample which includes only women ages 15-49. Infants that do not survive the first two days of life do not have the opportunity to receive neonatal

interventions within the recommended timeframe, so their intervention coverage estimates may have low accuracy. If, for example, an infant died within the first day, it would not have been possible to have a postnatal check within the first two days. At the same time, excluding them from the analysis could introduce survivorship bias to the results. This was addressed in a sensitivity analysis while the main analysis focused on infants that survived the first two days.

The sociodemographic variables (predictor data) selected for this study were: maternal age, educational attainment, and partnership status. Selection of these variables was based on two important considerations: 1) the wealth of literature describing the relationships between MNH intervention coverage and each variable (Barros & Victora, 2013a; Bobo et al., 2021; Fotso et al., 2009a) and 2) availability of these data points across both datasets.

Research Question 1

How does MNH intervention coverage in informal settlements compare with other urban sub-populations in Kenya?

Aim 1.1

Aim 1.1 (process aim): To identify women in the KDHS who lived in formal towns, formal cities, informal towns, and informal cities (settlements) and had a live birth in 2012-13 that survived the first two days of life.

The UN-Habitat defines a “informal settlement” (which we refer to as informal settlement) household as one that lacks any one of the following five elements (or standards): access to improved water source, access to improved sanitation, durability of housing, sufficient living area, security of tenure (UN-Habitat, n.d.). The DHS can

facilitate measuring all these elements except security of tenure. In this study, improved water, improved sanitation, durability of housing, and sufficient living space were defined according to the UN-Habitat (2007). When applied to 73 DHS countries, 70% of urban households (Fink et al., 2014) and 94% of 2014 KDHS urban households fit the criteria for informal household. A more conservative approach suggests increasing the threshold from failing to meet one standard to failing to meet two (Günther & Harttgen, 2012; Fink et al., 2014). This study used the latter approach, which begins with the DHS categorization of urban vs rural place of residence (DHS variable name: hv026) and distinguishes between town and city within urban areas, as described below:

- **City (referred to as formal city in this dissertation):** cluster located in urban place of residence and the UN population estimate for 2011 exceeds 1 million
- **Town (formal town):** cluster located in urban place of residence and the UN population estimate for 2011 is under 1 million
- **City informal settlement area (informal city):** cluster located in a city in which at least 75% of households failed to meet the UN Habitat standards in two or more of the following amenities: water, sanitation, building material, crowding
- **Town informal settlement area (informal town):** cluster located in a town in which at least 75% of households failed to meet the UN Habitat standards in two or more of the following amenities: water, sanitation, building material, crowding.

Aim 1.2

Aim 1.2: To describe coverage of neonatal health interventions (individually) for mother-child pairs (identified in Aim 1.1) across formal towns, formal cities, informal towns, informal cities, and Korogocho and Viwandani.

The following five interventions were examined: HFD, SBA, ePNC, sPNC, and eBFI. Interventions were chosen if they met any of the following three criteria: (1) they are used to monitor progress toward universal health coverage of maternal and child healthcare by several multi-country, multi-disciplinary efforts including the Countdown to 2030 Initiative (Countdown 2030, n.d.), ENAP (WHO, 2015b), and UNICEF (UNICEF, 2016b); (2) they represent a subset of interventions mother-child pairs should receive along the MNH continuum according to guidelines by the WHO and other global health agencies (Kerber et al., 2007); and (3) data on intervention coverage were available across the KDHS and PAMANECH datasets. The operational definitions for these variables are provided in Table 3 below.

Table 3. Outcome variables and operational definitions		
Variable		Operational definition
1	Health facility delivery (HFD)	A woman gave birth in a public or private health facility. Deliveries occurring at home or “other” locations are considered non-HFDs.
2	Skilled birth attendance (SBA)	A skilled health professional, such as a doctor, nurse, or midwife was present during the delivery. Births assisted by non-medical personnel, including auxiliary midwives, Community Health Volunteers, and traditional birth attendants, are considered non-SBA.
3	Early postnatal care (ePNC)	An infant’s health was checked on time if it occurred within 48 hours after birth. The PNC check was late if it occurred between 48 hours and six weeks after birth. A PNC check did not occur if the baby’s health was never checked or was checked for the first time after six weeks of birth.
4	Skilled PNC provider (sPNC)	A skilled health professional, such as a doctor, nurse, midwife, or auxiliary midwife, provided the PNC check. PNC checks provided by any other type of personnel are considered non-skilled.
5	Early breastfeeding initiation (eBFI)	A neonate initiated on breastfeeding on time if it occurred within the first 60 minutes after birth. Initiation was late if it occurred after the first hour and was never initiated for those neonates whose mothers never provided their breastmilk.

Hypothesis 1.2: In line with findings from the 2000 and 2012 waves of the NCSS (APHRC, 2002, 2014), coverage of all interventions is higher in informal settlements compared to any other geographic level.

Questions pertaining to each intervention were phrased slightly differently across each survey instrument. The options in the surveys that enumerators used to mark responses also varied. Survey questions, response options, and how they were coded to ensure comparability for the purposes of this dissertation are provided in Table 4.

For HFD, the KDHS asked, “Where did you give birth to (NAME)?”, referring to a respondent’s youngest child. Response options were: home, public sector, private medical sector, and all other. If a respondent indicated she gave birth at any type of public or private medical sector facility, the birth was considered “HFD”. If she indicated she gave birth at home or at any other type of location, the birth was considered “non-HFD”. The PAMANECH survey asked the same question, but response options were: district hospital, health center, dispensary, hospital, clinic, health center, dispensary private, pharmacy/chemist, traditional practitioner/herbalist, community health worker (CHW), TBA, shop, church/pastor/prayers, home, and other. The last column in Table 4 classifies these locations into “HFD” and “non-HFD”. The SBA and sPNC variables were constructed in a similar way.

The variable on ePNC was created using two survey items from each data source. For example, in the KDHS, the first question (Part A) was: “In the two months after (NAME) was born, did any health care provider or a traditional birth attendant check on his/her health?”. Response options were “yes”, “no”, “don’t

know”. The second question (Part B) was: “How many hours, days or weeks after the birth of (NAME) did the first check take place?”. Enumerators recorded responses in hours, days, or weeks after birth, or “don’t know” was entered. A check was defined as ePNC if the answer to Part A was “yes” and to Part B was between 0 and 48 hours. An ePNC was defined as not being provided if the answer to Part A was “no” or “don’t know”, or if the answer to Part A was “yes” and to Part B was >48 hours. The variable on eBFI was constructed in a similar way.

To capture eBFI, the first question in the KDHS (Part A) was: “Did you ever breastfeed (NAME)?” Response options were “yes” and “no”. The second question (Part B) was “How long after birth did you first put (NAME) to the breast?” and responses were recorded in hours, days, or entered as “immediately”. Breastfeeding initiation was considered to have been done early if the answer to Part A was “yes” and to Part B was ≤ 60 minutes. It was considered not to have been done early if the answer to Part A was “no”, or if the answer to Part A was “yes” and to Part B was >60 minutes.

Table 4. Translation of original questions and response options in the Kenya Demographic and Health Survey and the Partnership for Maternal and Child Health Survey to outcome variables in this study				
Outcome variable	Data source	Original question	Original response options	Translation from original response options to outcome variable
Health facility delivery (HFD)	KDHS 2014	“Where did you give birth to (NAME)?”	(1) Home (including participant’s home or some other home), (2) public sector (including government hospital, government health center, government dispensary, other public sector), and (3) private medical sector (including mission hospital/clinic, private hospital/clinic, nursing/maternity home, other private medical sector), (4) all other	2-3 = HFD 1 & 4 = non-HFD
	PAMANECH 2013		(1) District hospital, (2) health center, (3) dispensary, (4) hospital, (5) clinic, (6) health center, (7) dispensary private, (8) pharmacy/chemist, (9) traditional practitioner/herbalist, (10) CHW, (11) TBA, (12) shop, (13) church/pastor/prayers, (14) home, (15) other	1-7 = HFD 8-15 = non-HFD
Skilled birth attendance (SBA)	KDHS 2014	“Who assisted with the delivery of (NAME)?”	(1) Health personnel (doctor or nurse/midwife), (2) other persons (CHW, TBA, relative/friend, or other), (3) or no one	1 = SBA 2-3 = no SBA
	PAMANECH 2013		(1) Health personnel (doctor, nurse/midwife, or auxiliary midwife), (2) other persons (TBA, relative/friend, or other), (3) no one	1 = SBA 2-3 = no SBA
Early postnatal care (ePNC)	KDHS 2014	Part A: “In the two months after (NAME) was born, did any health care provider or a traditional birth attendant check on his/her health?” Part B: “How many hours, days or weeks after the birth of (NAME) did the first check take place?”	Part A: (1) Yes, (2) no, (3) don’t know Part B: Time was recorded in hours, days, or weeks after birth, or “don’t know” was entered.	Part A: 2-3 = not done Part B: 0 to 48 hours = done ≥3 days or don’t know = not done
	PAMANECH 2013	Part A: “After (NAME) was born, did a health professional or traditional birth attendant check on your health and that of your newborn baby?” AND Part B: “How many days or weeks after the delivery did the first check take place?”	Part A: (1) Baby only, (2) mother only, (3) both, (4) neither, (5) don’t know Part B: Time was recorded in days or weeks. A “00” was entered if the check was the same day and “don’t know” was entered if participant did not know.	Part A: 2, 4 & 5 = not done Part B: 00 & 0 to 2 days = done ≥3 days or don’t know = not done

Skilled PNC provider (sPNC)	KDHS 2014	“Who checked on (NAME)’s health at that time?”	(1) Health personnel (doctor, nurse/midwife), (2) other person (CHW or TBA), (3) other	1 = skilled provider 2-3 = non-skilled provider
	PAMANECH 2013	“Who checked on your/baby’s health at that time?”	(1) Doctor, nurse/midwife, (2) clinical officer, (3) TBA, (4) other	1-2 = skilled provider 3-4 = non-skilled provider
Early breastfeeding initiation (eBFI)	KDHS 2014	Part A: “Did you ever breastfeed (NAME)?” Part B: “How long after birth did you first put (NAME) to the breast?”	Part A: (1) Yes, (2) No Part B: Time was recorded in hours, days, or entered as “immediately”.	Part A: 2 = never breastfed Part B: Immediately and 0-1 hours = done ≥1 hour or never breastfed = not done
	PAMANECH 2013	Part A: “Did or is (NAME) breast feeding?” Part B: “How soon after birth did you start breastfeeding?”	Part A: (1) Yes, (2) No Part B: Responses were recorded in hours and days and entered as: (1) immediately/<30 minutes, (2) 30 minutes to 1 HR, and (3) don’t know	Part A: 2 = never breastfed Part B: 1 hour and/or options 1 & 2 = done >1 hour, any number of days, don’t know, or never breastfed = not done
Note: CHV: community health volunteer; CHW: community health worker; KDHS: Kenya Demographic and Health Survey; PAMANECH: Partnership for Maternal and Child Health; TBA: traditional birth attendant				

Aim 1.2 Analysis

Descriptive statistics were reported for coverage of each intervention individually for formal towns and cities, informal settlements in towns, informal settlements in cities, and Korogocho and Viwandani.

Aim 1.3

Aim 1.3 (process aim): To develop a composite measure of coverage of five neonatal health interventions.

Composite measures balance the need to monitor and compare progress towards MNH targets across geographies with the large number of MNH interventions recommended for routine care (Barros & Victora, 2013a). The co-coverage index, proposed first in 2005 as a simple sum of preventive interventions received by individual mother-child pairs out of a set of eight (see Table 5 for list) (Victora et al., 2005). Specifically, the interventions are ANC visits with a skilled provider, tetanus toxoid (TT) vaccine during pregnancy, SBA, vitamin A supplementation in the child, BCG, DTP3, and measles vaccinations, and an improved drinking water source (insecticide-treated bed nets are also included for relevant countries). The initial aim of the co-coverage index was to assess how key child survival intervention coverage varied by socioeconomic characteristics (Victora et al., 2005). Co-coverage is often reported as the percentage of children in a population who received some number of interventions stratified by wealth quintiles and is used in cross-country comparisons of intervention coverage (Barros & Victora, 2013a). Borrowing from this methodology, this study developed a composite measure

that is a simple sum of recommended interventions mother-child pairs should receive out of a set of five.

Table 5. Definition of interventions included in the Co-Coverage Index by recipient		
Recipient	Intervention	Definition
Child	BCG vaccination	Child received at least one dose of BCG either recorded on the vaccination card or reported by mother/caretaker
	DPT3 vaccination	Child received at least three doses of diphtheria-pertussis-tetanus either recorded on the vaccination card or reported by mother/caretaker
	Measles vaccination	Child received at least one dose of measles either recorded on the vaccination card or reported by mother/caretaker
Mother	Vitamin A supplement	Mother received a dose in the 6 months before the interview, either recorded on the vaccination card
	TT vaccination	Mother received two or more doses that were recorded or reported
	Antenatal care	Mother received four or more visits during pregnancy
Household	Skilled attendant at delivery	A skilled attendant was defined as a doctor, nurse, midwife, or auxiliary nurse or midwife
	Access to safe water	A family reported using a safe source with a round-trip time of <30 minutes for collection. Safe water sources included piped water, water from an open well, covered well or borehole, tanker truck or vendor, and bottled water.
Note: This list of indicators and their definitions were sourced from C. G. Victora, B. Fenn, J. Bryce, and B. R. Kirkwood, "Co-coverage of preventive interventions and implications for child-survival strategies: evidence from national surveys," Lancet, vol. 366, pp. 1460–66, 2005. DPT3: Diphtheria, Tetanus & Pertussis; BCG: Bacillus Calmette-Guérin		

Below (Table 6) is the breakdown for number of points assigned to each mother-child pair by intervention receipt status, with a score of 0 indicating the intervention was not received, and a score of 1 indicating the intervention was received.

Table 6. Points assigned to each intervention by if and when they were provided		
Intervention	1 point	0 points
Health facility delivery (HFD)	Any public or private sector location	Home, other location
Skilled birth attendance (SBA)	Doctor, nurse, midwife	Traditional birth attendant (TBA), community health worker (CHW), relative, friend, other, no one
Skilled PNC provider (sPNC)	PNC check by doctor, nurse, or midwife	No PNC or PNC by TBA, community/village health worker, or other
Early postnatal care (ePNC)	Postnatal care check by a doctor, nurse, or midwife ≤ 48 hours after birth	No PNC, PNC by any other person, or check by a healthcare provider or TBA > 48 hours after birth
Early breastfeeding initiation (eBFI)	Breastfeeding initiated ≤ 1 hour after birth	Never breastfed or initiated > 1 hour after birth

Constructing a measure that is comparable across the DHS and the survey conducted in Korogocho and Viwandani allowed for an assessment of how intervention coverage varies within urban areas.

Aim 1.4

Aim 1.4: To describe the composite measure of coverage of neonatal health interventions for mother-child pairs in formal towns, formal cities, informal towns, informal cities, and Korogocho and Viwandani.

Hypothesis 1.4: Given higher neonatal mortality in densely populated Nairobi (National Bureau of Statistics, 2014a), I hypothesized that informal settlement coverage was lower than anywhere else.

Aim 1.4 analysis

Means and standard deviations for the coverage score are reported by geographic level.

Aim 1.5

To examine the contributions of maternal sociodemographic characteristics (age, education, partnership status), health seeking behaviors (early and skilled antenatal care, antenatal iron supplementation, use of antenatal anti-malarial drugs, completed

tetanus vaccination), and maternal health history (parity, prior pregnancy and infant loss, and pregnancy wantedness) in predicting intervention coverage in each urban type of area (excluding Korogocho and Viwandani).

To attempt to isolate the effect of place on intervention coverage, the analysis controlled for potential sources of selection bias. Women who demonstrate reproductive and antenatal healthcare seeking behaviors and do so from skilled providers are likely to also seek formal delivery and neonatal care. Health seeking behaviors were addressed using early and skilled antenatal care, iron supplementation, use of anti-malarial drugs, and completed tetanus vaccination status. Prior experience with pregnancy can also impact intervention coverage. Women who have had few or no prior pregnancies or who experienced pregnancy or infant loss may be more likely to seek care compared to women who have had several pregnancies with positive birth outcomes. Further, women who did not want to become pregnant may be less motivated to seek care compared to women who did. These maternal health history variables were also controlled for in the analysis. Finally, given the well-documented associations between maternal sociodemographic characteristics and intervention coverage, the analyses controlled for maternal age, education, and partnership status.

Hypothesis 1.5: The odds of coverage will be higher in formal areas after controlling for sociodemographic characteristics compared to informal settlement areas.

Aim 1.5 analysis

Coverage (dependent variable) was coded as binary and control variables (independent variables) were analyzed in groups: maternal sociodemographic

characteristics, health seeking behaviors, maternal health history. Logistic regression analysis was used to estimate the unadjusted association between place type and coverage in the KDHS only (model 1). Model 1 was adjusted for each explanatory variable group individually to estimate their contributions individually (models 2-4). Variable groups that yielded significant ($p \leq 0.05$) results were used to adjust the final model (model 5). All KDHS results were weighted to account for the multi-stage sampling design. All analyses were done using Stata/SE 17.0.

Qualitative component

How can data quality from household surveys about delivery and neonatal care be improved?

Aim 2

To conduct interviews with 20 mothers of young children and 12 facility-based healthcare providers in Korogocho and Viwandani, toward a better understanding of: (1) comprehension of DHS/MICS questions that capture MNH interventions, (2) and social norms surrounding reporting of MNH interventions.

Validity concerns documented in the literature specific to mother's reporting of postnatal care include women's knowledge or awareness about care provided to their infants after delivery, maternal recall, question comprehension (Moran et al., 2013) and social desirability bias (BosireRose et al., 2016). To begin to understand these concerns in the context of informal settlements, interviews were conducted with 20 mothers of children between six weeks and 18 months old, and with 12 facility-based obstetric care providers in Korogocho and Viwandani. This sample size was appropriate for a medium-size study using thematic analysis to provide enough

richness to answer the research question (Braun & Clarke, 2021). Other exploratory studies in sub-Saharan Africa on this topic have used a similar sample size (Downe et al., 2018).

Cognitive interviewing is an iterative research method that can improve validity of survey data by providing an understanding of how questions are interpreted, how well they align with how they were intended, potential problems with question wording, and appropriateness in the given context (Collins, 2003a; Jobe & Mingay, 1989; Nápoles-Springer et al., 2006). One of several techniques that fall under the cognitive interview umbrella is verbal probing (Jobe & Mingay, 1989), where participants are asked to share their interpretation of a survey item, rephrase it, and/or comment on its wording. This was incorporated in the interview guides.

The study of social norms often involves measuring an individual's perceptions of how common and appropriate behaviors are within their reference group or groups (Cialdini & Trost, 1998). Members of an individual's reference group are those whose opinions, beliefs, and actions might impact that individual's own behavior (Geber & Hefner, 2019). This study probed on participants' perceptions of the beliefs of a range of potential reference groups about each intervention.

Sample Design and Rationale

Healthcare provider interviews

Interviews were conducted with a purposive sample of 12 healthcare providers. Sampling was stratified by settlement (Korogocho and Viwandani) and facility type (public and private) (see Table 7 for breakdown).

Eligibility criteria:

- Was a doctor or nurse that routinely managed childbirth and the immediate postnatal period
- Was practicing in a healthcare facility that served Korogocho or Viwandani residents at the time of the interview
- Had provided delivery and neonatal care in informal settlement settings for at least one year at the time of the interview

Rationale: Research comparing public and private health facilities in Kenya finds substantial differences in women's perceived quality of care (Oluoch-Aridi et al., 2020) and objective measures of quality of care (Diamond-Smith et al., 2016). As one of the factors in survey data validity includes aspects of care quality, and quality of care is influenced by the resources available at a health facility, it is important to understand perspectives from providers that operate in a range of facility types that presumably have varying capacities to provide care. Residents of Korogocho and Viwandani are served by three nearby public facilities, and several private facilities, so the sample was drawn from both facility types. Recruiting providers from facilities that serve Korogocho and Viwandani residents allowed the data to reflect experiences of people in those areas; having at least one year of experience practicing in or near informal settlement settings allowed for richness of responses to questions that should have been based upon knowledge and experience of providing care to women during labor, delivery, and in the immediate postpartum period.

Sample size: 12 providers; 6 from each facility type; 5 from facilities that serve Korogocho and 7 from facilities that serve Viwandani

Interviews with facility-based healthcare providers employed cognitive interview techniques to understand their perceptions of how well their patients would comprehend survey questions about five MNH interventions (see Appendix A for interview guide).

Qualitative interviewing is a technique that allows for in-depth understanding of a particular topic. Further, a provider may respond differently to questions about their own clinical practice compared to in a group setting (such as a focus group discussion) compared to in a one-on-one interview. Interview guides underwent pre-testing ahead of field work (further detail is provided below).

Mother interviews

Interviews were conducted with a sample of 20 mothers stratified by place of residence (Korogocho and Viwandani), education levels, and number of children.

Eligibility criteria:

- Had a living child that was at least six weeks-old
- Gave birth to said child at a health facility located in Korogocho or Viwandani
- Lived in Korogocho or Viwandani for at least one year prior to giving birth

Exclusion criteria:

- Under age 18
- Had a caesarean section
- Experienced postpartum hemorrhaging or loss of consciousness (maternal complications)
- Had an infant who required neonatal resuscitation or have any birth defects (neonatal complications)

Rationale: Stratifying by place of residence allowed for the data to capture the range of perspectives from women in these categories. Selecting women with infants at least six weeks ensured that participants had a decent amount of time to recover from childbirth. Mothers who had a caesarean section or experienced postpartum complications require care that might preclude them from initiating breastfeeding within the recommended time frame. Complications might also impact patient-provider communication about care provided to newborns. Neonates who experience complications that require specific care may delay the provision of other routine interventions. For example, a mother with a low-birthweight infant requiring neonatal intensive care might not be able to initiate breastfeeding within the first hour after birth. Eligibility was limited to women and neonates having no delivery or postnatal complications so that data would reflect the experiences of mother-child pairs who could have received all the interventions in this study.

Enrollment numbers: 20 mothers; 10 from Korogocho and 10 from Viwandani; 12 delivered at a private facility and 8 delivered at a public facility (see Table 7 for breakdown).

To understand the potential influence of social desirability on responses to survey questions, mothers were asked to talk about how they think their peers, family, and community members feel about each of the interventions (see Appendix A for interview guide). This was followed by a cognitive interview (CI) guided by the DHS survey questions used to collect data on the five interventions from Research Question 1. After each DHS survey question was asked and answered, follow up questions were used to probe on the validity concerns mentioned above. For example,

a participant was asked, “Who assisted with the delivery of [name of baby]?” (DHS question), then, “What does it mean for someone to ‘assist with delivery’?” (CI probe). This facilitated a comparison of answers to the DHS survey questions with their explanation for what they understood by the question and why they answered the way they did.

Table 7. Sample by study population characteristics		
Characteristic	Participant type	
	Providers (n=12)	Mothers (n=20)
Place of residence (mothers) or occupation (providers), n		
<i>Korogocho</i>	5	10
<i>Viwandani</i>	7	10
Education*, n		
<i>Some or complete primary</i>	-	11
<i>Some or complete secondary</i>	-	9
Mean age in years (SD)	-	30.4 (5)
<i>Private</i>	6	12
<i>Public</i>	6	8
*n=1 missing		

Recruitment and screening procedures

I benefited from APHRC’s longstanding relationship with the community covered by the NUHDSS to help identify and invite individuals to participate in interviews. APHRC has operated in Korogocho and Viwandani since 2003 and has an existing and extensive infrastructure to assist with identifying participants. Dr. Pauline Bakibinga, Associate Research Scientist at APHRC and project manager for PAMANECH, had kindly agreed to support this research. Over the course of the project, she unfortunately suddenly passed away (may she Rest in Peace). She helped identify a project coordinator and two junior RAs who supported the project. In

addition, two CHVs were hired to support data collection efforts in Korogocho and Viwandani.

Two CHVs who worked with APHRC, were residents of Korogocho and Viwandani, and regularly conducted home visits to manage mothers and newborns at the community level were hired to identify and invite mothers to participate in this study based on eligibility criteria provided by the research team. The CHVs also shared with the research team their estimate of the four most common public and private facilities (two each) that women residing in Korogocho and Viwandani delivered at. Based on this information, the project coordinator secured permission from the heads of said four facilities to recruit provider participants. The project coordinator shared the eligibility criteria with the head and asked them to identify an equal number of junior and senior level faculty for her to invite. Interested providers contacted the project coordinator to schedule a time for the interview at the facility.

Eligible and interested mother participants were informed of the meeting location, date, and time. Prior to beginning the interview, the RA asked initial set of questions to confirm their eligibility (see Appendix B for all eligibility surveys). Once eligibility was confirmed, they were consented, and asked an additional set of eligibility questions. The interview proceeded if the participant met all eligibility criteria. Eligible provider participants were screened in a similar manner. Prior to the start of the interview, the RA asked a short list of questions to confirm their eligibility. Once eligibility was confirmed, they were consented, and the interview began.

Study instruments

Development of interview guides

I initially developed the interview guides in English through a process of reviewing the literature on validity concerns for each intervention and writing questions informed by social norms (Cialdini & Trost, 1998) and cognitive interviewing (Collins, 2003a; Jobe & Mingay, 1989; Nápoles-Springer et al., 2006) research techniques. Questions were developed to address (1) perceptions that people in the community have about each intervention (social norms), and (2) mothers' interpretation of the DHS questions that are used to measure their coverage, understanding of key terms, sources of information used to respond to questions, and ways of determining time to event (when relevant).

Questions were organized by method such that all social norms-related questions were completed before shifting to the cognitive interview portion (see Appendix A). The pattern of cognitive interview questions was similar across participant type and varied slightly for each intervention. For example, we asked mothers to first answer the DHS question, "Where did you give birth to [NAME]?", with reference to their youngest child, the RA probed for facility type (public or private), and then asked them how they knew the answer to this question. In provider interviews, the RA asked participants to describe how well they thought a mother would understand the same DHS question and how she might know the difference between facility types. Providers were not asked questions about social norms.

Data collection training

A three-day training was conducted to prepare the research team for field work. During this training, I introduced the study objectives, research question, study design, ethical considerations, data handling, logistics, and quality control measures. A half-day was dedicated solely to reviewing and discussing ethical conduct of research with human subjects. The RAs were oriented on maintaining the confidentiality of the data they collect. The principles of respect for persons, beneficence and justice were explored to emphasize the importance of striving to do no harm as they collected data, ensuring that they would express to participants and adhere to expectations that participation was completely voluntary, and participants could withdraw at any time. I also spent time reviewing the process of obtaining informed consent. To ensure a common understanding of these concepts, I asked the RAs to describe them to me in their own words once the training was complete and we clarified any misunderstandings.

We then covered the interview guides and updated them iteratively during discussions about the intention behind each question. The guides were then translated to Kiswahili by the research team, back translated to English, pre-tested with two eligible participants, and further refined before going to the field.

Data collection

Mother interviews were conducted in a private rented space in their place of residence (Korogocho or Viwandani) in Kiswahili (as they indicated was their preference) and provider interviews were conducted in their offices at health facilities

in English. Interviews ranged from 45 to 70 minutes in length. Participants were remunerated for their time. All interviews were audio-recorded, and the RAs took notes on paper to supplement the audio-recordings. Prior to starting the interview, RAs created a test recording on the recording device and played it back to confirm it was working. RAs had a backup recording device in case of technical issues with the main one.

Data analysis plan

Data were transcribed verbatim by a team of two bilingual (English and Kiswahili), experienced transcribers who were not involved in data collection. The primary transcriber on half the interviews checked for completeness and accuracy on the other half by comparing them with original recordings to correct any errors. Kiswahili transcripts were then translated to English. All English transcripts were uploaded to Atlas.ti version 23 for analysis. I discussed the meaning of portions of transcripts that were unclear with the project coordinator (who is bilingual) who cross-referenced the transcript with the audio to support interpretation.

Data were analyzed using thematic analysis (Braun & Clarke, 2021). Initial deductive code lists (one per interview type) were developed with corresponding definitions, guided by the study objectives, and applied to four transcripts (two per type). Additional inductive codes with corresponding definitions were developed based on emergent concepts. Analysis began with an inter-rater reliability check: two members of the primary co-author group (including one native Kiswahili speaker) coded three interviews each and reviewed them together to resolve discrepancies in the interpretation and application of codes. Coders were assigned a subset of

transcripts and met regularly to discuss findings. A continuous consultative approach was employed by the primary co-author group to update codes and their definitions, and to reflect on the findings and concepts. After coding was completed, the primary author generated initial themes for each intervention across participant type (mother and provider), identified cross-cutting sub-themes, discussed them with the group, and further refined, defined, and named them.

Ethical Considerations and Protection of Human Subjects

Ethical Review

Ethical review approval was obtained from multiple sources, including the University of Maryland (UMD) Institutional Review Board (IRB), Daystar University Ethical Review Board (DU ERB), the National Commission for Science, Technology & Innovation (NACOSTI), and the Nairobi Metropolitan Services (NMS) which was required by the DU ERB (see Appendix C for all approvals). Sr Professor Agnes Lando of Daystar University in Nairobi served as the in-country co-investigator on the project. Her role primarily consisted of supporting me in obtaining ethical permission from NACOSTI and NMS.

All data were de-identified. At no time over the course of the study was it possible for individuals outside the research team to determine the identity of any participant included in the data collection activities.

Consent Process

Information was provided to participants in consent forms to make sure their decision to partake in data collection was an informed one. All consent processes included an information sheet detailing the purpose of the research broadly, the

interview they were invited to participate in, the criteria which determined their eligibility, a description of procedures that were expected to be followed during the interview, a description of potential risks and benefits to their participation and contact information in case of any questions or concerns following their participation (see Appendix B). Additionally, the sheet emphasized the voluntary nature of participation in the research and that the participant could decline to answer any question they did not wish to and could withdraw from the research at any time. Language in both the consent form and information sheet was at or below the 8th grade reading level to help ensure potential participants understood what was being said. The consent forms were translated into Swahili for those who were not be able to read or understand English. For respondents who were illiterate or visually impaired, the consent form was read out loud to them. Participants were given the opportunity to ask any questions before deciding about participating. All participants were asked to provide their signature or thumbprint to indicate they had provided their informed consent to participate. Finally, participants were asked to consent to participation in the activity and to the use of an audio recorder, separately.

Participation of Vulnerable Populations

The National Institutes of Health Code of Federal Regulations classifies pregnant women, human fetuses, neonates, children, and prisoners as vulnerable populations (*Vulnerable and Other Populations Requiring Additional Protections | Grants.Nih.Gov*, n.d.). Young mothers are not considered a vulnerable population.

Risks versus benefits

There were no direct benefits to participants in this study. Data collection efforts around maternal and neonatal healthcare coverage may benefit from the results of this work, as the project aimed to identify gaps in comprehension of standard survey questions, and possible solutions, toward increasing mothers' awareness and accuracy about the care they and their neonates receive at healthcare facilities. A final report describing findings will be provided to APHRC.

There were risks to participation in the event of breach of confidentiality. This risk was minimal as research team members were selected based on references from APHRC, team members participated in a three-day-long training that covered the importance of confidentiality, and during data collection they took several steps toward ensuring confidentiality protections. As mentioned above, all data were de-identified and any identifying information on consent forms were kept separate from the data with no way of matching such identifiers to the resulting transcript. All databases were password-protected, and access to de-identified data was restricted to the RAs and me. There were also minimal psychological risks to participation in this study for all participants as I did not include women who had complications during pregnancy or delivery.

Anonymity

Participants' names and any names and places mentioned in interviews were changed to protect participants' identities. This limited the likelihood of linking individual responses with their identities.

Confidentiality

As described above, numerous protections were put in place to minimize the risk of breach of confidentiality for all participants. These included collecting identifying information only on consent forms, ensuring consent forms were kept separate from any other material, creating a coding mechanism to uniquely identify participants, and ensuring audio files and transcriptions are stored on password-protected computers. In addition, all data collection activities were conducted in a private setting on site at the health facility or in a nearby space where a private room or privacy was available.

Once the consent forms were signed, they were stored separately from other study documents to maintain the confidentiality and anonymity of the study participants. Digital audio recordings of interviews were stored on the project coordinator's encrypted and password protected computer while in the field and removed from the digital recording device each evening. Following transcription, verification of the transcription, and complete analysis, the transferred audio file be deleted. Transcripts were anonymized using unique study codes. Study data were transferred on my laptop and will be stored there for seven years before being destroyed.

Chapter 4: Manuscript 1: Informal settlement residence and neonatal health intervention coverage in urban Kenya

Abstract

Background: Rapid urban population growth in Kenya has been accompanied by deteriorating maternal and neonatal health (MNH), particularly in the capital, Nairobi, where the urban advantage once held over rural areas has reversed. Part of the explanation may be differences in MNH intervention coverage in rapidly expanding impoverished urban informal settlements as compared to planned urban communities. We address this question by examining intra-urban variation in coverage of five neonatal health interventions using data from the most recent Kenya Demographic and Health Survey (KDHS) and data from the 2014 wave of the Nairobi Urban Health and Demographic Surveillance System (NUHDSS) collected in two known urban informal settlements in Nairobi, Kenya: Korogocho and Viwandani. **Methods:** We identified households that lacked >2 of the following features: improved water source, improved sanitation, durable housing material, and sufficient living space and defined DHS clusters where $>50\%$ of households lacked ≥ 2 features as being in informal settlements and all others as being in formal ones. We distinguished between settlements in cities and towns, and used NUHDSS data to validate the results. We then compared coverage of health facility delivery (HFD), skilled birth attendance (SBA), early postnatal care (ePNC), skilled PNC (sPNC), and early initiation of breastfeeding (eBFI) among 1,058 mother-child pairs from the KDHS across place of residence. We examined unadjusted and adjusted associations between coverage of each intervention and place of residence controlling for maternal sociodemographic

characteristics, health history, and antenatal care. **Results:** 89.2% of urban residents live in informal settlements. There was little variation in coverage of HFD and SBA across place of residence. Coverage of sPNC and ePNC was highest in formal areas (60.6% and 75.4%, respectively) followed by informal cities (49.6% and 68.1%, respectively). Informal town areas had the lowest coverage of all interventions except for eBFI, where it was the highest (62.2%). eBFI was low in all areas, ranging from 54.4% in formal areas to 62.2% in informal towns. No differences were observed in the unadjusted or adjusted associations between coverage of HFD, SBA, sPNC or eBFI and type of place. Compared to formal areas, neonates in informal towns were less likely to have ePNC and this association remained after adjusting for all confounder groups (aOR: 0.49, 95% CI 0.26, 0.92). **Conclusion:** Results from this study find high urban inequality with respect to place of residence and limited intra-urban variation in coverage, which is inconsistent with the patterns of variation we see in neonatal mortality. Possible explanations are poor quality data and poor quality of care at facilities in informal settlement areas. Higher odds of ePNC in formal areas suggests that quality-adjusted measures of intervention coverage would offer evidence of intra-urban variation.

Introduction

Despite significant gains in child survival over the last three decades, progress has been slowest for newborns (UNICEF et al., 2020). Of all under-5 deaths, nearly half occur within the first 28 days of life and most of these occur in low- and middle-income countries (LMICs) (de Bernis et al., 2016; Goudar, et al., 2020; Lawn et al., 2016; Oza et al., 2014). Modeled estimates suggest high (>90%) coverage of recommended maternal and neonatal health (MNH) interventions has the potential to prevent 71% of neonatal deaths per year (Bhutta et al., 2014). Nationally representative estimates from Kenya show an overall increase in MNH intervention coverage, including in urban areas (National Bureau of Statistics, 2014a), thanks, in part, to government-led initiatives to increase demand for, and access to, care by skilled providers at health facilities (Amendah et al., 2013; Gitobu et al., 2018). Yet for the first time since the Demographic and Health Survey (DHS) program began collecting data on neonatal survival in Kenya in 2003, the neonatal mortality rate (NMR) in urban areas surpassed that of rural areas in 2014 (Central Bureau of Statistics (CBS) [Kenya] et al., 2004; Kenya National Bureau of Statistics (KNBS) & ICF Macro, 2010; National Bureau of Statistics, 2014b), reversing the long-standing advantage urban residents had over their rural counterparts (Gould, 1998; Kimani-Murage et al., 2014). Nairobi's NMR is 39 per 1,000 live births, the highest of any other region in Kenya (National Bureau of Statistics, 2014a). Nairobi and other urban areas in Kenya also have a large and growing population living in unplanned, informal settlements (UN-HABITAT, 2010). Therefore, it is important to understand more about what explains this urban disadvantage.

Kenya has followed global LMIC patterns with respect to rural-to-urban migration and subsequent increases in informal settlement growth. In sub-Saharan Africa (sSA), rapid urbanization has been occurring against a backdrop of regional economic stagnation or decline (Fotso, 2007). These conditions impacted local and national governments' already strained capacity to meet the needs of rapidly expanding urban populations (Brockhoff & Brennan, 1998), leaving the urban poor with limited affordable and adequate housing options. This contributed to the rapid expansion of informal settlements (UN Habitat, 2016b) which continue to grow along with rising populations and increasing rural to urban migration (UNDP, 2019). In 2014, 6.4 million people, more than half of Kenya's urban population, lived in informal settlements (UN Habitat, 2016a) predominantly served by health infrastructure that was designed for people living in relatively less concentrated, formal settlements (Bazant et al., 2009; Ziraba et al., 2009a).

Historically, urban residents have enjoyed a comparative advantage over their rural counterparts with respect to health outcomes and factors that influence health such as healthcare access and utilization (Hug et al., 2019a; Yaya et al., 2019), water and sanitation infrastructure, and housing quality (Lalou & LeGarnd, 1997; Sastry Rand, 1997). Urban places of residence offer increased availability of and proximity to formal and high quality healthcare (Fotso, 2007; Galea & Vlahov, 2005; Munga & Mæstad, 2009; Rao et al., 2012; Soucat & Scheffler, 2013; Vlahov et al., 2005), which should result in better health outcomes. However studies suggest that as urban informal settlements become more populated, and intra-urban wealth inequality increases, health disparities between the urban poor and non-poor are widening

(Fotso, 2006) and the “urban advantage” has likely disappeared completely (Gould, 1998; Kimani-Murage et al., 2014). Progress in rural areas has exceeded that of urban areas on several indicators in the last few decades, reversing a long-standing pattern of urban advantage. The neonatal mortality rate (NMR) in urban Kenya is 24% higher compared to rural areas (National Bureau of Statistics, 2014a), and is declining at a slower rate compared to rural areas (Mberu et al., 2016). Simple urban versus rural comparisons do not tell the complete story, however. Intra-urban heterogeneity with respect to mortality, morbidity, housing conditions, wealth, and other sociodemographic characteristics is often masked and priority populations within urban areas are often forgotten (Jones-Smith & Popkin, 2010).

The urban-rural dichotomy is considered inadequate (Champion & Hugo, 2016; McDade & Adair, 2001; Vlahov & Galea, 2002; Yach et al., 1990) because, there are no universally agreed upon definitions of “urban” or “rural” (Deuskar, 2015; Vlahov & Galea, 2002), it is unable to capture temporal shifts in what is and is not considered “urban” (Dahly & Adair, 2007), and it is unable to utilize characteristics of contemporary human settlements in describing geographies (Dorélien et al., 2013). Urban-ness, or urbanicity, on a continuum has been used to address these shortcomings, but it too lacks a standard measure. Regardless of how urbanicity is defined, a largely consistent pattern emerges highlighting reversed and growing patterns of inequality between rural and urban areas, as well as increasing inequalities within urban spaces. Compared to rural areas, progress in decreasing under-5 mortality over the past 30 years has been slower for residents in the capital city of Nairobi (National Bureau of Statistics, 2014b), urban informal settlement residents

(Fotso et al., 2007; Kimani-Murage et al., 2014), and urban populations overall (Kimani-Murage et al., 2014; National Bureau of Statistics, 2014b). Nairobi, home to one of the world's largest urban informal settlements (Kibera), has an NMR higher than the country's as a whole, rural areas, and other urban areas (39 per 1,000 live births vs 19-25 per 1,000 live births, respectively) (National Bureau of Statistics, 2014a). Nairobi versus other urban and rural area comparisons indicate this relationship exists despite greater or similar coverage of important maternal and neonatal health interventions including antenatal care (ANC), tetanus vaccinations, skilled birth attendance, and facility births (Mberu et al., 2016). This “capital city advantage” in coverage is observed in nearly all sub-Saharan African countries with low national levels of CCI (Faye et al., 2020). The extent of intra-urban (and intra-capital city) variation in coverage of neonatal health interventions delivered immediately after birth, however, remains unclear, and can contribute to our understanding of high neonatal mortality in densely populated urban areas.

As urban populations continue to grow, and more individuals make informal settlements their long-term places of residence, so too does the importance of understanding the effects of place on coverage of interventions key to the survival of newborns. Intra-urban inequities in morbidity, mortality, and healthcare utilization suggest a misallocation of urban resources (Magadi et al., 2003), and progress towards achieving health equity relies on identifying who is left behind (Faye et al., 2020). An assessment of the health needs of urban informal settlement residents as compared to those of other sub-populations will allow for more targeted programming and intervention approaches towards improving neonatal health

outcomes (Faye et al., 2020). We examine these health needs in recognition of factors that influence health outcomes across macro-, community-level, household- and individual-levels according to the Holistic Conceptual Framework for Maternal, Late Fetal and Newborn Survival and Health (Singh et al., 2022).

This paper focuses on interventions around the time of birth for three main reasons. First, interventions during labor and birth are more impactful than those provided at any other time in preventing neonatal deaths (Bhutta et al., 2014). Second, decades of research have contributed to a large evidence base for available interventions and strategies to end preventable neonatal deaths in low- and middle-income countries (LMICs) (Bhutta et al., 2014). Appropriate care and neonatal resuscitation at birth, kangaroo mother care, scale up of antenatal steroids, and clean postnatal care practices address three major causes of neonatal mortality (intrapartum, prematurity, and infection-related deaths), and can be delivered during contacts with formal healthcare systems (Bhutta et al., 2014). Third, several global health agencies, initiatives, and networks sharing the common goal of reducing neonatal mortality in LMICs through various processes have identified key indicators that measure progress towards this goal (Countdown 2030, 2021; Every Woman Every Child, 2015; WHO & UNICEF, 2014; UNICEF, 2021b), including the five interventions that are the focus of this study. The purpose of this study, therefore, is to assess whether and the extent to which maternal and newborn health intervention coverage varies by level and type of urban settlement across urban Kenya.

Methods

Data sources

This study uses two sources of data. The first is nationally representative 2014 Kenya Demographic and Health Survey (KDHS), the most recent available. The KDHS utilized a two-stage stratified sampling design. In the first stage, clusters were identified from enumeration areas with equal probability, and counties were stratified into urban and rural strata. In the second stage, 25 households from within clusters were selected. To balance sample size and resource requirements, the full questionnaire (containing items on all five interventions in this study) was used in every other household and a shortened version containing items on only two of the five interventions were used in the remaining. Postnatal care (PNC) data were collected for live births occurring within two years preceding the survey. This study, then, only uses data from the long version and from reports on live births within two years of the survey.

The second data source is the Nairobi Urban Health and Demographic Surveillance System (NUHDSS), a longitudinal surveillance platform implemented by the African Population Health and Research Center (APHRC). The NUHDSS collects data annually on demographic events and household amenities in Korogocho and Viwandani, two known urban informal settlements in Nairobi (Beguy et al., 2015a). They are located within 10 kilometers of the Nairobi's Central Business District, comprise approximately 28,500 households and 72,000 residents (Mberu et al., 2015), and are characterized by poor health outcomes (Ziraba, et al., 2009b),

environmental conditions and infrastructure, and poor access to health services due to inability to afford them, and reliance on unregulated and poor quality health services (Zulu et al., 2011).

Measures

Our measures are guided by the Holistic Conceptual Framework for Maternal, Late Fetal and Newborn Survival and Health (Singh et al., 2022). Per the framework, distal factors such as the macro- and community-level context influence proximate factors and impact through two categories of intermediate factors: program and service lever outputs and individual contextual factors such as women's health status. We use type of place of residence as a distal factor. Under intermediate factors, we use antenatal care as measures of program and service levers and maternal health history as measures of individual context. Our primary outcome is intervention coverage and is a proximate factor in the framework that ultimately influences survival (impact).

Outcome variables

Coverage of health facility delivery (HFD), skilled birth attendance (SBA), skilled postnatal care provider (sPNC), early postnatal care (ePNC), and early breastfeeding initiation (eBFI) are reported individually and as a composite score that captures the total number of interventions a mother-child pair received out of a set of five. Each intervention was coded as a dichotomous variable (0 if it was not received, 1 if it was) with a possible score range of 0-5 (see Table 8 for breakdown and definitions). The composite score method of describing coverage in this study is adapted from the co-coverage index approach which is a simple sum of interventions

received by mother-child pairs out of a set of eight across the maternal child health continuum (Victora et al., 2005). Co-coverage is reported as the percentage of mother-child pairs who received some number of interventions and is used to compare coverage across different populations (Barros & Victora, 2013a). Mother-child pairs with missing values for 1-4 interventions were retained in the analytic sample and were assigned a score based on available data.

Table 8. Breakdown of points assigned to mother-child pairs for each intervention by response		
Intervention	1 point	0 points
Health facility delivery (HFD)	Any public or private sector location	Home, other location
Skilled birth attendance (SBA)	Doctor, nurse, midwife	Traditional birth attendant (TBA), community health worker (CHW), relative, friend, other, no one
Skilled PNC provider (sPNC)	PNC check by doctor, nurse, or midwife	No PNC or PNC by TBA, community/village health worker, or other
Early postnatal care (ePNC)	Postnatal care check by a doctor, nurse, or midwife ≤ 48 hours after birth	No PNC, PNC by any other person, or check by a healthcare provider or TBA > 48 hours after birth
Early breastfeeding initiation (eBFI)	Breastfeeding initiated ≤ 1 hour after birth	Never breastfed or initiated > 1 hour after birth

Defining urban informal settlements in the Demographic and Health Surveys (DHS)

The UN-Habitat operationally defines a “slum” (which we refer to as informal settlement) household as one that lacks at least one of the following five features (UN-Habitat, n.d.):

1. Access to improved water: enough water for family use, at an affordable price, available to household members without being subject to extreme effort, especially on the part of women and children.
2. Access to improved sanitation: an excreta disposal system, either private or shared publicly with a reasonable number of people, is available to household members.

3. Durable housing: a house built on a non-hazardous location with a structure permanent and adequate to protect its inhabitants from extreme weather conditions (including rain, heat, cold, and humidity).
4. Sufficient living area: not more than three people share the same room.
5. Secure tenure: documented evidence that can be used as proof of secure tenure status or when there is either de facto or perceived protection against forced evictions.

Three main limitations of this definition are: (1) when used alone, it identifies houses, not informal settlement areas or neighborhoods; (2) it ignores the spatial dimension generally associated with “informal settlements” by not accounting for neighborhood-level characteristics, and (3) when applied, it appears to over-estimate the number of informal settlement households (Fink et al., 2014; Günther & Harttgen, 2012). For example, over 70% of urban households in 73 DHS countries, half of which are in SSA (Fink et al., 2014), and 94% of urban households in the 2014 KDHS, fit the criteria for informal settlement household. Given these limitations, the UN-Habitat definition was extended in this study, as described below, to include a more conservative, neighborhood-based approach with guidance from Günther & Harttgen (Günther & Harttgen, 2012) and Fink et al (Fink et al., 2014).

In the first step, urban area of residence was identified according to the DHS standard recode variable *hv025: type of place of residence*. The DHS does not collect data that measures security of tenure, so our definition is limited to the first four above-mentioned features. A variable was generated to count the number of features an urban household lacked. A score of 4 indicates a household lacked all four features

and a score of 0 indicates a household had all four features. Access to improved water was defined as drinking water that is piped onto the premises. Access to improved sanitation was defined as private (i.e., not shared) and any type of flush toilet, a ventilated improved pit latrine, pit latrine with slab, or a composting toilet. A house was considered durable if it was made of durable floor (palm/bamboo, parquet/polished wood, vinyl/asphalt strips, ceramic tiles, cement, or carpet), wall (cement, stone with lime/cement, bricks, cement blocks, covered adobe, or wood planks/shingles), and roof (asbestos sheet, concrete, or tiles) materials. Sufficient living area was defined as having three or fewer de jure household members per room used for sleeping. Households with missing data were retained in the analytic sample and were assigned a score based on available data.

In the second step, a variable was generated to classify urban clusters as being in informal settlements if the proportion of households in the cluster that lacked two or more features exceeds 50 percent, and all others as formal settlements (Günther & Harttgen, 2012). To check whether this set of conditions was relevant to the Kenyan context, three sensitivity analyses were conducted. First, we applied the two-feature cutoff to the 2014 wave of NUHDSS to compare characteristics of households of two known informal settlements with those households identified as being in informal areas in the KDHS. Second, in order to examine the distribution of informal settlement clusters across the two most populous cities in Kenya, Nairobi and Mombasa, we increased the threshold from 50 to 75 percent, where there are known informal settlements (Muraguri, 2011). Third, we compared the associations between place of residence (i.e., informal vs formal settlement) and intervention coverage

using both the 50 and 75 percent cut-offs to explore whether coverage differed by a higher versus lower percent cut-off.

In the final step, an explicit distinction between large, densely populated urban centers and smaller urban areas was made as was done by Fink, Günther, & Hill (2014). In their study of the effect of place on child survival in 73 LMICs, they found differences in mortality risk for children living in city compared to town informal settlements (Fink et al., 2014), suggesting there may be important differences in intervention coverage that could explain the differences in mortality risk between those two types of areas. Therefore, we make the distinction between cities and towns by classifying urban counties in the KDHS that had a population estimate that exceeded 1 million in 2014 as “cities” and those that had a smaller population as “towns”.

Exposure variable in the DHS

Type of place of residence (place type) was coded as: (1) formal urban: city and town households in clusters where 50 percent or less lacked two features of formal housing, (2) informal town: town households in clusters where more than 50 percent lacked two features of formal housing, and (3) informal city: city households in clusters where more than 50 percent lacked two features of formal housing.

Individual-level explanatory factors

Potential confounders were analyzed in groups. Maternal sociodemographic characteristics (group 1) included: age in years (continuous), educational attainment (none, any primary, any secondary or higher), and partnership status [single (never in union, widowed, divorced, separated) or partnered (married or living with partner)].

Antenatal care for the last pregnancy (group 2) included: having a skilled ANC

provider (yes/no), having the first ANC within four months of pregnancy (yes/late or no ANC), taking iron supplements (yes/no), taking antimalarial drugs (yes/no), and neonatal tetanus protection (full protection at time of birth/partial or no protection). Maternal health history (group 3) included: any stillbirths or neonatal loss in the five years preceding the survey (yes/no), number of children ever born (continuous), and pregnancy wantedness (wanted then/wanted later or never).

Analyses

Intervention coverage was estimated at the urban formal (city and town were combined due to small sample sizes), informal city, and informal town levels using the 2014 KDHS. Logistic regression analysis was used to estimate the unadjusted association between place type and coverage (model 1). Model 1 was adjusted for each explanatory variable group one by one to estimate their contributions individually (models 2-4). Variable groups that yielded significant ($p \leq 0.05$) results were used to adjust the final model (model 5). Analysis was restricted to mother-child pairs who had complete outcome data. All KDHS results were weighted to account for the multi-stage sampling design. All analyses were done using Stata/SE 17.0.

Results

Table 9 shows mothers' (N=1,058) household characteristics across place type using the >50% threshold for households in a cluster that lacked two or more features. The >50% cut-off was found to correctly identify 99.8% (N=23,183) of households in the NUHDSS as being in informal settlements. Raising the threshold to >75% resulted in zero informal households or clusters in Mombasa where there are known

informal settlements. Because the objective of this study was to examine MNH coverage in informal settlements across Kenya and not just in Nairobi, we used the >50% threshold to identify mother-child pairs living in informal settlements and conduct further analyses.

A large proportion (89.2%) of mother-child pairs in the KDHS live in informal areas. Most informal city homes lacked improved sanitation (90.6%) and durable housing material (92.0%) while only some lacked an improved water source (61.8%) and sufficient living area (55.0%). Informal towns followed a similar pattern with more homes lacking improved sanitation (78.5%) and durable housing material (98.7%) and relatively fewer lacking an improved water source (66.3%) and sufficient living area (42.6%). Formal areas lacked the fewest number of features compared to informal areas.

Table 9 also shows background characteristics among mother-child pairs by place type. Mean maternal age was 26.4 years; most women in formal areas had completed secondary education or higher (75.6%) and were partnered (77.6%). Fewer women in informal areas had completed secondary or higher education (34.3% in towns and 37.3% in cities) whereas more women were partnered (86.0 and 84.5%, respectively) compared to formal areas. More women had a history of stillbirths or neonatal loss in informal cities (3.1%) compared with other areas (though the difference was not statistically significant). Skilled ANC was high ($\geq 97.3\%$) across place type. Coverage of early ANC, iron supplementation, and neonatal protection was lower in informal compared to formal areas.

Table 9. Percentages of women ages 15-49 by characteristic and type of place of residence who had a pregnancy that resulted in a live birth within two years preceding the survey				
	All urban	All formal	Informal town	Informal city
N (%)	1,058 (100.0)	118 (11.2)	825 (78.0)	115 (10.9)
Household features				
Lacked improved water source	57.3	16.8	66.3	61.8
Lacked improved sanitation	75.0	33.0	78.8	90.6
Non-durable house material	93.0	74.3	98.7	92.0
Insufficient living area	43.6	26.1	42.6	55.0
Number of features household lacks				
0	2.6	15.3	0.4	0
1	15.8	49.5	11.4	6.2
2	40.9	20.9	45.2	43.4
3	36.1	13.5	36.0	48.7
4	4.5	0.7	7.1	1.7
Maternal characteristics				
Education				
<i>none/incomplete primary</i>	18.9	12.1	22.4	15.6
<i>complete primary/incomplete secondary</i>	39.6	12.4	43.4	47.1
<i>complete secondary/higher</i>	41.5	75.6	34.2	37.3
Partnership status				
<i>single</i>	15.6	22.4	14.0	15.1
<i>partnered</i>	84.4	77.6	86.0	84.9
Age, mean (SD)	26.4 (5.4)	27.78 (5.8)	26.03 (5.6)	26.23 (4.4)
Maternal health history				
Had any stillbirths or neonatal loss:				
yes	2.29	2.1	1.9	3.1
Children ever born, mean (SD)	1.5	1.3	1.7	1.3
Wanted pregnancy when it occurred:				
yes	68.3	74.2	64.4	72.8
Antenatal care				
Skilled ANC provider: yes	98.4	99.7	98.6	97.3
Early ANC: yes	27.5	41.8	22.4	29.4
Took iron supplements during pregnancy: yes	77.0	86.5	74.3	77.0
Took antimalarial drugs during pregnancy: yes	23.2	14.2	25.2	24.2
Protected against neonatal tetanus: yes	75.9	89.8	72.7	74.7

Table 10 shows percent intervention coverage by place type. The difference in coverage of HFD and SBA between formal and informal city areas was <1.3%.

Coverage of sPNC and ePNC was highest in formal areas (60.6% and 75.4%,

respectively) followed by informal cities (49.6% and 68.1%, respectively). Informal town areas had the lowest coverage of all interventions except for eBFI, where it was the highest (62.2%). eBFI was low in all areas, ranging from 54.4% in formal areas to 62.2% in informal towns. The mean coverage score for all the interventions was highest in formal areas (3.70, SD: 1.1) and lowest in informal towns (3.37, SD: 1.2).

Table 10. Percent intervention coverage by type of place of residence in women ages 15-49 who had a birth in the preceding 2 years					
	All urban	All formal	Informal town	Informal city	p-value
Intervention coverage					
health facility delivery (HFD)	86.9	90.6	84.5	89.6	0.22
skilled birth attendance (SBA)	87.0	88.9	85.0	90.1	0.32
early postnatal check (ePNC)	46.0	60.6	40.1	49.6	0.03
skilled postnatal care provider (sPNC)	67.7	75.4	65.3	68.1	0.38
early breastfeeding initiation (eBFI)	60.0	54.4	62.2	58.7	0.54
coverage score*, mean (SD)	3.48 (1.3)	3.70 (1.1)	3.37 (1.2)	3.56 (1.3)	<0.01
*Possible range: 0-5					

The logistic regression models in Table 11 show unadjusted and adjusted associations between individual intervention coverage and place of residence. No differences were observed in the unadjusted or adjusted associations between coverage of HFD, SBA, sPNC or eBFI and type of place. Compared to formal areas, neonates in informal towns were less likely to have ePNC and this association remained after adjusting for all confounder groups (aOR: 0.49, 95% CI 0.26, 0.92).

There were no differences in the associations between coverage and place type using the >50% threshold for identifying households informal settlement clusters compared to the >75% threshold except for ePNC (results not shown here). The odds of neonates receiving ePNC in informal towns using the >75% threshold were 10 percent greater (aOR: 0.59, 95% CI 0.37, 0.94) compared to the >50% threshold.

Table 11. Associations between intervention coverage and place of residence in women in the 2014 KDHS ages 15-49 who had a pregnancy in the 2 years preceding the survey, OR (95 % CI)

	All formal	Informal town		Informal city	
		OR	95% CI	OR	95% CI
4.1 Health facility delivery					
Unadjusted association	ref	0.57	0.26, 1.24	0.89	0.33, 2.36
Maternal sociodemographic characteristics	ref	0.78	0.33, 1.85	1.14	0.41, 3.20
Antenatal care	ref	0.65	0.29, 1.46	1.10	0.42, 2.92
Adjusted for: Maternal health history	ref	0.72	0.33, 1.56	0.89	0.36, 2.23
Fully adjusted	ref	-	-	-	-
4.2 Skilled birth attendance					
Unadjusted association	ref	0.71	0.34, 1.47	1.13	0.44, 2.93
Maternal sociodemographic characteristics	ref	0.87	0.43, 2.15	1.44	0.54, 3.86
Antenatal care	ref	0.82	0.39, 1.73	1.41	0.54, 3.67
Maternal health history	ref	0.91	0.43, 1.89	1.16	0.47, 2.88
Fully adjusted	ref	-	-	-	-
4.3 Early postnatal care					
Unadjusted association	ref	0.44*	0.23, 0.83	0.64	0.30, 1.37
Maternal sociodemographic characteristics	ref	0.48*	0.25, 0.90	0.68	0.32, 1.47
Antenatal care	ref	0.47*	0.24, 0.90	0.69	0.32, 1.49
Maternal health history	ref	0.43**	0.23, 0.82	0.49*	0.26, 0.92
Fully adjusted	ref	0.49*	0.26, 0.92	0.73	0.35, 1.59
4.4 Skilled postnatal care					
Unadjusted association	ref	0.61	0.32, 1.18	0.70	0.31, 1.56
Maternal sociodemographic characteristics	ref	0.63	0.33, 1.20	0.70	0.31, 1.57
Antenatal care	ref	0.71	0.37, 1.38	0.79	0.35, 1.77
Maternal health history	ref	0.62	0.33, 1.20	0.70	0.32, 1.57
Fully adjusted		-	-	-	-
4.5 Early initiation of breastfeeding					
Unadjusted association	ref	1.38	0.81, 2.34	1.19	0.61, 2.34
Maternal sociodemographic characteristics	ref	1.22	0.71, 2.08	1.09	0.55, 2.15
Antenatal care	ref	1.29	0.74, 2.24	1.17	0.58, 2.35
Maternal health history	ref	1.35	0.79, 2.31	1.21	0.61, 2.39
Fully adjusted		-	-	-	-

Ref: reference group; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$
 Maternal sociodemographic characteristics: age, educational attainment, partnership status. Antenatal care: skilled ANC provider, early ANC, antenatal iron supplementation, antenatal antimalarial drugs, neonatal tetanus protection. Maternal health history: stillbirth or neonatal loss, number of children ever born, pregnancy wantedness.

Discussion and Conclusion

In this study, we identified mother-child pairs living in informal settlements using household- and neighborhood-level characteristics to then measure inequalities in coverage of five MNH interventions within urban spaces. We sought to understand

intra-urban variation in coverage to add to the literature that explores factors that contribute to the reversal in urban versus rural advantage in health outcomes as well as the high neonatal mortality rates within densely populated urban centers like Nairobi. We focus on recommended MNH interventions provided during a time period in which care to mothers and newborns has the greatest potential for reducing neonatal mortality compared to any other time period along the MNH continuum (Bhutta et al., 2014). Although we found large inequalities with respect to formal versus informal areas of residence, we found limited evidence of variation in coverage across urban sub-populations, suggesting type of place of residence does not explain intra-urban variation in neonatal health outcomes in Kenya.

This study found that 89% of the urban population resides in informal settlements, highlighting extreme inequalities with respect to neighborhood-level housing characteristics within urban spaces in Kenya. This estimate is considerably higher than that derived from the 2009 Kenya Census which estimates 15% of the urban population lived in informal settlements (Kenya National Bureau of Statistics (KNBS), 2012). Though similar, the approaches used to develop the Census-based estimate and the KDHS-based estimate differ in ways that might explain the large difference. First, the 2014 KDHS data were collected 4-5 years after the 2009 Census was conducted. Given the rapid pace of urbanization and urban population growth, it is reasonable to expect estimates to increase, at least somewhat, over time. Second, the Census-based approach used all five of the household features in the UN-Habitat definition (UN-Habitat, n.d.) whereas the 2014 KDHS did not collect information on security of tenure (which provides evidence of protection against forced evictions).

Our estimate is based on only four household features and might over-estimate the proportion of households located in informal settlements. At the same time, our estimate should be considered an independent and external-to-the-government assessment of urban population distributions in Kenya. Third, the Census-based approach does not consider neighborhood-level characteristics which is a strength in our approach as it is informed by the literature that acknowledges its impacts on behavioral and health outcomes (Patrick et al., 2016). The large difference in estimate of population of informal settlements underscores the need for careful consideration of what constitutes an informal settlement, the need to be able to adequately identify and sample them in nationally representative household surveys like the DHS, and the need for external assessments of urban population distributions in Kenya. Regardless of the definition, findings from this study point towards geographic areas that require specific resources (e.g., increased access to sanitation in informal areas) to improve overall housing and neighborhood quality.

With respect to intervention coverage, this study found no difference in odds of coverage of HFD, SBA, sPNC, or eBFI amongst urban mother-child pairs, regardless of place of residence. These findings can be interpreted in three ways: (1) recent policy efforts have been successful; (2) contacts with healthcare institutions impact mother-child pairs differently by place of residence; (3) there is variation in the quality of care mother-child pairs access based on their place of residence. The 2006 Safe Motherhood Voucher program offered women who purchased low-cost vouchers access to subsidized maternity services at accredited facilities (Amendah et al., 2013), and the 2013 Free Maternity Services (FMS) policy removed user fees for

antenatal, delivery, and postnatal care at public health facilities (Gitobu et al., 2018). In 2016, the FMS was rebranded as the Linda Mama program and expanded access to benefits beyond the public sector (Orangi et al., 2021). Findings from evaluation studies suggest that these efforts have been successful in increasing overall coverage in urban areas, including for lower-income groups (Bellows et al., 2013; Dennis et al., 2019; Calhoun et al., 2018; Owuor & Amolo, 2019).

Under Amouzou et al's (2019) Coverage Cascade Framework for the Measurement of Effective Coverage, 'crude' coverage is defined as the proportion of the target population who receive a needed health intervention and 'contact' is defined as the proportion among the target population who visit a health service (Amouzou et al., 2019). HFD, SBA, and sPNC qualify under this framework as contact or crude measures and does not measure content or quality of care provided. Despite similar coverage across urban sub-populations, the state of neonatal health in Nairobi and overall urban areas is worse compared to other areas (National Bureau of Statistics, 2014a). This might be explained by contacts with healthcare systems having unequal impacts on different populations, raising concerns about health equity for populations such as those living in informal settlements. Improving overall neonatal survival, then, requires an approach that targets informal settlement residents with strategies appropriate to their unique needs that go beyond removing user fees.

In addition to targeted approaches, the quality of care at facilities that serve these communities requires further investigation. Four out of five of the interventions in this study are contact or crude measures and do not measure quality of care. There is limited data available in the 2014 KDHS to measure quality, but studies in other

settings and on related indicators have documented large gaps between crude or contact measures and quality-adjusted indicators along the MCH continuum (Hodgins & D'Agostino, 2014; Kanyangarara et al., 2017; Leslie, et al., 2017; Marchant et al., 2015a; Nesbitt et al., 2013) (though only one study we are aware of reports on PNC indicators) (Marchant et al., 2015a). This gap might be especially pronounced in urban informal settings where the urban poor are often served by unregulated facilities that offer obstetric care below minimum standards by poorly trained providers and are ill-equipped to offer emergency care (Essendi et al., 2011; Ziraba, et al., 2009b). Quality-adjusted estimates of MNH intervention coverage are highly correlated with mortality outcomes and, one would expect, more likely to map to patterns of neonatal mortality compared to those measures which are more widely available, captured in large-scale surveys, and used in the current analysis.

Under Amouzou and colleagues' framework (Amouzou et al., 2019), ePNC can be considered a measure of quality-adjusted postnatal care, offering explanation for why this was the only intervention we examined that newborns are less likely to receive if they are born in informal areas compared to formal ones. Cities (population ≥ 1 million) offer proximity to healthcare institutions that towns (population < 1 million) may not have, and this might explain why mother-child pairs in informal towns have the lowest coverage score compared to every other area.

Breastfeeding begins with early initiation and is considered one of the most effective ways of promoting child survival (World Health Organization, n.d.-b). This study finds low rates of early initiation (55-62%) as has been well-documented in previous studies across urban settings (Kimani-Murage et al., 2011), but research on

factors associated with early initiation in urban settings is limited and inconclusive (Patrick et al., 2016). Barriers include poor maternal health post-delivery (Kimani-Murage et al., 2011) and the belief that colostrum is dirty (Wanjohi et al., 2016). A study in Kibera found that most mothers knew that newborns should drink colostrum (96%) and initiate immediately after birth (98%), but few indicated awareness about initiating within 30-60 minutes of birth (19%) yet many (75%) reported initiating within the recommended time (Patrick et al., 2016). Further research on social norms relating to early initiation is merited. The Every Newborn Action Plan technical consultation group calls for improving the specificity of breastfeeding indicators (WHO, 2015b) as this has been found to be low for early breastfeeding initiation in validation studies of household surveys (Stanton et al., 2013b), suggesting that actual eBFI rates are even lower than the estimates in the DHS.

This study has several limitations and related research and policy implications. One, because the poorest urban areas are often not surveyed by the DHS (Moreno, 2003), the true population living in informal areas might be greater than what was estimated in this study. The DHS should consider providing detailed information on areas it excludes from its sampling frame so studies such as this one may make informed interpretations about the extent to which findings are generalizable. Two, the 2014 KDHS offers limited ways to measure quality of care mother-child pairs received related to the five interventions in this study. Subsequent DHS survey phases have added measures that can be used as proxies for measuring care such as skin-to-skin contact and content of postnatal care (DHS Program, 2018). Using quality-adjusted measures of coverage in the next KDHS wave will likely

produce estimates that vary across place type. Third, the politics of ethnicity have historically had implications for resource allocation in Kenya, where government funds and international aid has flowed more frequently to areas where the majority ethnicity matched that of sitting or campaigning political leaders compared to those of different ethnicities (Briggs, 2014). Future work examining the relationship between place of residence and intervention coverage should control for majority ethnicity at the district or cluster level for analysis. Four, the directions of the effects of place on intervention coverage in this study, though they did not reach statistical significance for four out of five interventions, were generally consistent across each intervention. This suggests a possible effect that the study was under-powered to detect. Given rapid population growth concentrated in urban areas, the DHS should consider prioritizing sampling informal settlements so research may produce estimates of key health indicators for these populations. Five, this study used household survey data that rely on mothers' self-reports which have well-documented concerns with validity (Day et al., 2021a; Stanton et al., 2013c; Blanc et al., 2016a; Moran et al., 2013). Lower question comprehension among mothers with lower levels of education likely produce estimates that are less accurate compared to surveys with mothers with higher levels of education. Given the lower levels of education among mothers in informal areas in this study compared to formal areas, it is possible that informal settlement estimates have low accuracy.

The findings in this study add to a growing body of mixed or weak evidence for the survival benefit of HFD (Chinkhumba et al., 2014b; Fink et al., 2015a; Goudar et al., 2020; Kunkel et al., 2019b; Patel et al., 2020a) and SBA (UNICEF, 2015)

(Carvajal-Aguirre et al., 2017; Singh et al., 2014; Bellizzi et al., 2017), the role of skilled PNC providers (Haider et al., 2000; Khan et al., 2017; Dennis, 2002) and the optimal timeframe for PNC (WHO, 2013b; Bueno et al., 2005; Mandl et al., 1997) for the delivery of routine and recommended interventions and points to several avenues of future research and work that center around measurement. First, linking facility register with household survey data (Bhattacharya et al., 2019) will allow for a better understanding of the role of high risk pregnancies in biasing mortality outcomes against facilities (Fink et al., 2015b). Second, linking existing service provision assessment efforts (such as those by the DHS) with household survey data will allow for investigation of the role quality of care plays in biasing mortality outcomes against facilities and skilled birth attendants (who are most often facility-based) (Wall et al., 2010) while accounting for neighborhood-level characteristics. Third, efforts to improve data quality from household surveys on intervention coverage should focus on (1) increasing awareness amongst mothers about care they and their newborns should receive so they may report more accurately and (2) validating existing and new survey items that measure quality-adjusted intervention coverage across diverse settings.

Chapter 5: Manuscript 2: The influence of social desirability bias and survey question comprehension on neonatal health intervention coverage measurement validity: A qualitative study in two urban informal settlements in Nairobi, Kenya

Abstract

Background: Population-based household surveys provide a significant portion of the data used to track progress towards achieving Sustainable Development Goals related to neonatal mortality. Validity concerns with respect to data that capture neonatal health intervention coverage have been noted. This study aims to identify potential social influences and factors related to comprehension impacting the validity of mothers' responses to survey questions used to measure coverage of five neonatal health interventions, specifically: health facility delivery, skilled birth attendance, early and skilled postnatal care, and early breastfeeding initiation. **Methods:** Semi-structured interviews were conducted with 20 mothers and 12 healthcare providers in two urban informal settlements in Nairobi, Kenya. Data were analyzed using content and thematic analysis. **Results:** We found that most mothers (1) associate payment with private facilities, (2) generalize the term "hospital" to other facility types, (3) generalize the term "doctor" and "nurse" to other facility-based employees, (4) determine provider cadre based on role, uniform color, and gender, (5) understanding of the meaning of 'assisting with delivery' and 'postnatal care check' as intended, (6) report the timing of a range of postnatal checks, and (7) did not provide concrete

descriptions of how they identify time to initiation of breastfeeding or first postnatal check. Findings from interviews about social influences suggest that on household surveys, women in these communities might: (1) indicate they delivered at a private facility to appear to be wealthier than their peers, (2) indicate they had a skilled birth attendant if their true attendant was a TBA, and (3) over-report breastfeeding.

Conclusion: A qualitative understanding of the social context from which data are collected can support the interpretation of research that uses them. Further work is needed across more settings to explore the substantive understandings women have of survey questions that measure intervention coverage.

Introduction

Most neonatal deaths in low- and middle-income countries (LMICs) occur soon after birth (de Bernis et al., 2016; Goudar et al., 2020; Lawn et al., 2016; Oza et al., 2014), with a third occurring within six hours and just under half occurring within the first 24 (Baqui et al., 2016). Existing interventions, such as appropriate care and neonatal resuscitation at birth, kangaroo mother care, and clean postnatal care (PNC) practices, address three major causes of neonatal mortality (intrapartum-related, infection-related, pre-term related direct complications) (Bhutta et al., 2014). High coverage (>90%) of maternal and newborn health (MNH) interventions can prevent an estimated 71% of neonatal deaths per year (Bhutta et al., 2014). Current efforts to reduce neonatal mortality in LMICs involve increasing coverage of key interventions (Countdown 2030, 2021; Every Woman Every Child, 2015; WHO & UNICEF, 2014), and progress is tracked by monitoring percent coverage at the population level (Radovich et al., 2019). In addition to being used to inform progress towards Sustainable Development Goals (WHO, 2016b), coverage data are used by policymakers to allocate resources, and by academics to identify trends, research gaps, and intervention impact (Carvajal–Aguirre et al., 2017; Moran & Marchant, 2017). A large portion of the data used to track MNH intervention coverage in LMICs is sourced from mothers' self-reports in the Demographic and Health Surveys (DHS) (DHS Program, n.d.) and the Multiple Indicator Cluster Surveys (MICS) (UNICEF, n.d.-a). Additional sources of coverage data for monitoring include routine data from facility registers stored in health management information systems (HMIS) and those collected in demographic surveillance systems.

The DHS and MICS offer several advantages over these other sources. HMIS data cannot reliably produce population-based coverage estimates; they only capture data on individuals who receive care from formal healthcare systems, representing a subset of the total target population for MNH interventions by excluding those who receive care from other sources (Maïga et al., 2019). Additionally, in the context of overburdened and under-resourced healthcare systems in LMICs, HMIS struggle with incomplete and inconsistent reporting (Maternal and Child Survival Program, 2018), errors in manual calculation, and reporting and aggregating data at regular intervals (Stanton et al., 2013a). Demographic surveillance systems often produce high quality data but for small geographic areas and are therefore not generalizable (Hancioglu & Arnold, 2013). DHS and MICS are population-based surveys that produce nationally representative estimates of coverage and have been consistent with collecting data at regular intervals in most LMICs (DHS Program, n.d.). They also collect sociodemographic data on respondents necessary for tracking inequities in intervention coverage (Barros & Victora, 2013b). While there are several reasons for relying on data from large household surveys, concerns about their validity with respect to interventions delivered around the time of childbirth have been raised in the literature that have important implications for how they are used towards improving neonatal survival (Blanc et al., 2016; McCarthy et al., 2016; Munos et al., 2017a; Stanton et al., 2013a).

Direct observation in clinical settings is often used as the gold standard in studies measuring the validity of data collected from self-reports (Day et al., 2021b; Tahsina et al., 2021). Compared to direct observation, women's reports in household

and exit surveys produce results with less accuracy for most interventions (Day et al., 2021a). Self-reports are more accurate for care directly experienced by a mother (e.g., kangaroo mother care (Day et al., 2021a)), those related to her care seeking behaviors (e.g., place of delivery (Stanton et al., 2013c)), and events that reflect pain or concern (e.g., experience of hemorrhage (Blanc et al., 2016a)) as compared to care provided to newborns immediately after birth (e.g., newborn was dried (Stanton et al., 2013c)) and care that can be provided without her knowledge or awareness (e.g., provision of antibiotics for neonatal infection (Day et al., 2021a)), often resulting in less valid results for care provided to newborns (Day et al., 2021a).

Inaccurate self-reports can be attributed to lack of mothers' awareness about care provided to their infants after delivery, issues with maternal recall, poor question comprehension (Moran et al., 2013), and social desirability bias (BosireRose et al., 2016). For example, a mother may not have asked or been informed about the qualification level of the healthcare provider (awareness), may forget this information soon after the birth (recall), and in the case of being asked whether a postnatal check was provided, may not understand what is meant by a "check" (comprehension). A mother may also feel pressure to claim breastfeeding was initiated (ever or early) given efforts to promote it in some contexts (BosireRose et al., 2016). High proportions of "don't know" responses in household questionnaires could indicate women were not provided the information, that their ability to recall information from two years prior to the survey, and even within a few days, is poor for some indicators (Day et al., 2021a), resulting in an underestimation of care coverage.

We examine concerns with household-based survey measures of five neonatal health interventions delivered around the time of birth, specifically: health facility delivery, skilled birth attendance, early and skilled postnatal care, and early initiation of breastfeeding. First, interventions provided during this time period are more impactful than those provided at any other time in reducing neonatal mortality (Bhutta et al., 2014), so it is important to determine how well they are being captured to identify gaps in coverage. Second, they are measured in the DHS and MICS which, as mentioned above, provide a large portion of the data to track progress in this area. Third, they are used by various global health agencies and initiatives to track progress towards improving neonatal survival, including Countdown to 2030 (Countdown 2030, 2021), the Global Strategy for Women's Children's, and Adolescent's Health (2016) (Global Strategy) (Every Woman Every Child, 2015), the Every Newborn Action Plan (ENAP) (WHO & UNICEF, 2014), and UNICEF in its annual flagship State of the World's Children Report (UNICEF, 2021b) and, consequently, are the subject of a wealth of research on this topic. Finally, there is a growing body of research that presents mixed findings on the survival benefit of some interventions provided around the time of birth (Goudar et al., 2015; Kunkel et al., 2019a; Patel et al., 2020b) which might be explained, in part at least, by low data validity (Lohela et al., 2012). This research, therefore, explores: (1) social desirability bias related to reporting type of place of delivery (public vs private vs home), birth attendant, postnatal care, and breastfeeding, (2) respondents' understanding of the terms: health check, breastfeeding, and supervised birth, and (3) sources of information on (or ways

of knowing) type of place of delivery, cadre of birth attendant, postnatal care health check, and timing of postpartum care and breastfeeding initiation.

We conduct this research in two informal settlement communities of Nairobi, Kenya: Korogocho and Viwandani which is an ideal setting for addressing these questions. Research on the health status of the urban poor and informal settlement residents suggests that they fare worse than any other population on several outcomes (National Bureau of Statistics, 2014a; Ziraba et al., 2009b; Patrick et al., 2016). Alongside efforts to promote neonatal health in these communities, it is likewise important to understand how survey questions capturing intervention coverage are being understood, and if this aligns with the original intention of the questions. Further, little is known about coverage of neonatal health interventions in these communities, and this work can contribute towards broader efforts to measuring coverage accurately in a population that is under-represented in the DHS. Finally, the African Population and Health Research Center (APHRC) has implemented the Nairobi Urban Health and Demographic Surveillance System (NUHDSS) in Korogocho and Viwandani since 2002 and routinely collects data on vital demographic events (e.g., births, deaths, migrations), household characteristics (e.g., assets), and residents' individual characteristics (e.g., educational attainment, marital status) (Beguy et al., 2015a). Two authors of this research article have an on-going research relationship with APHRC and facilitated introductions for the primary author with its senior leaders. APHRC's research infrastructure and previously established relationships with the community in Korogocho and Viwandani were then leveraged to obtain permission from local chiefs to conduct this work, to identify experienced

data collectors, and to identify community health volunteers (CHVs) who supported recruitment efforts (explained in more detail below).

Korogocho and Viwandani are home to approximately 65,000 residents from 24,000 households (Beguy et al., 2015a) and are characterized by poor sanitation, limited access to healthcare, low-quality housing, and poverty (Wamukoya et al., 2020). Most residents migrated from rural areas in search for better economic opportunities, only about one-fifth of the households are food secure, under-5 mortality was higher among children born in Korogocho or Viwandani compared to those born elsewhere between 2003-2007 (Beguy et al., 2015b), and maternal mortality is estimated at 706 per 100,000 live births (Ziraba et al., 2009b), 146 deaths higher than the national average (WHO et al., 2007). Prior research suggests that most facilities that serve mothers from these communities lack basic equipment, have high patient to qualified provider ratios, and are generally unregulated (Fotso et al., 2009b).

Purpose of the present study

The purpose of the present study was to extend existing research on the validity of survey questions that capture five MNH interventions and focus specifically on the urban informal settlement context. The study's specific objectives were to, from the perspectives of both mothers and providers: (1) describe mothers' comprehension of DHS questions and related key terms (e.g., 'assist with delivery'), (2) describe local bases of knowledge to the DHS questions (e.g., facility type), and (3) describe ways in which mothers estimate time to an event (e.g., postnatal care check). An additional objective was to explore social influences on mothers'

responses to DHS questions by exploring their perceptions of how people in their community and reference groups (e.g., friends, family, neighbors) feel about the behaviors involved in each intervention (e.g., breastfeeding) (Cialdini & Trost, 1998).

Methods

This research was carried out by a small research team over six weeks in June and July 2022. The research team comprised two research assistants and one project coordinator, all of whom are Kenyan and two of whom used to live in the communities where the study was taking place. The work was led by the primary author of this paper who is a Canadian-Pakistani maternal and neonatal health researcher and practitioner, with 11 years of experience working in other LMIC contexts. Research activities were conducted in consultation with the project coordinator and senior researchers from Daystar University and APHRC.

Interview methods and sample size

We conducted semi-structured interviews with 20 mothers of children <24 months and 12 providers that offer maternity care. Mother interviews included questions to ascertain comprehension of DHS survey questions as well as key terms within them. Development of this portion of the interview guide was informed by cognitive interviewing techniques (Collins, 2003b). Table 12 shows the DHS questions and main comprehension questions we asked mothers and providers by intervention (not all follow-up questions are listed here). For example, for health facility delivery, the DHS question was “Where did you give birth to [NAME]?”. In interviews with mothers, we first asked them to answer the question with reference to

their most recent delivery, and then asked additional questions listed under the “mother interview questions” column. In interviews with providers, we asked participants to read the DHS question off a piece of paper, then asked the additional questions under the “provider interview questions” column.

Table 12. Main comprehension questions asked in interviews with mothers and providers

Measure	DHS question	Mother interview questions	Provider interview questions
Health facility delivery or place of delivery	Where did you give birth to [NAME*]? <i>Probe on facility type (public/private).</i>	How did you learn that this facility was [type of place mentioned above]? Which of these options best describes your answer to this question: <i>Public options: hospital, health center, dispensary, public other. Private options: mission hospital/clinic, private hospital/clinic, nursing/maternity home, private other.</i>	How would she know if it is a public, private, or other type of facility?
Skilled birth attendance	Who assisted with the delivery of [NAME]? Anyone else?	How did you come to know this person was a [skill level of person mentioned above]? What does it mean for someone to ‘assist with delivery’?	What is the process by which a woman would come to know the skill level of the person who assisted with the delivery?
Postnatal care	In the two months after [NAME] was born, did any healthcare provider or a traditional birth attendant check on his/her health?	What does ‘healthcare provider’ mean to you? What does it mean for a baby’s health to be checked? What are all the things that should be examined during a check?	How do you think a typical mother would understand the meaning of this question? What do you think a ‘check’ means to mothers? How would a mother come to know if their baby’s health was checked while they were at the facility in a normal, uncomplicated pregnancy and delivery case?
Early postnatal care	How many hours, days, or weeks after the birth of [NAME] did the first check take place?	What helped you remember the answer to this question?	For checks that occur before discharge from the hospital, how accurate do you think mothers’ responses to this question are? Why?
Skilled postnatal care	Who checked on [NAME]’s health at that time?	How did you come to know this person was a [skill level of person mentioned above]? Who are all the people you consider to be a healthcare provider? Imagine a traditional birth attendant (TBA) visited your neighbor’s baby a few days after birth. Would you consider this to be a health check? Why or why not?	Assuming a mother knows their baby had a postnatal check...how would they know the skill level of the person who performed it?
Breastfeeding	Did you ever breastfeed [NAME]?	What all counts as breastfeeding?	What do women usually define “breastfeeding” as?
Early initiation of breastfeeding	(If ever breastfed) How long after birth did you first put	What helped you remember the answer to this question?	How might a woman know and remember the answer to this question?

	[NAME] to the breast?		
*Referring to the name of the mother's youngest child.			

Table 13 shows the main questions about mothers' perceptions of how people in their community and reference groups feel about behaviors involved in each of the interventions.

Table 13. Main social desirability bias questions asked in interviews with mothers		
Intervention	Related behavior	Question
Health facility delivery	Where a mother delivers her baby	Where do most people in this community think it is best to deliver their baby? Why?
Skilled birth attendance	Who a mother has as a birth attendant	Who do most people in this community think it's best to attend/supervise births? Why?
Postnatal care	A mother having her newborn's health checked	How do most people in this community view postnatal health checks for the baby?
Breastfeeding	Breastfeeding	What do people in this community think about breastfeeding?
Early initiation of breastfeeding	Initiating within 60 minutes	How do people feel about initiating early, that is, within the first 60 minutes after giving birth?

Sample and recruitment

Mothers were recruited through convenience sampling. Two CHVs who have worked with APHRC, are residents of Korogocho and Viwandani, and conduct regular home visits to manage mothers and newborns at the community level were hired to identify and invite mothers to participate in this study based on eligibility criteria provided by the research team. The CHVs also indicated their estimate of the four most common public and private facilities (two each) that women residing in Korogocho and Viwandani delivered at. Based on this information, the project coordinator secured permission from the heads of these facilities to recruit provider participants.

The sample of mothers was stratified by place of residence (Korogocho and Viwandani) and type of place of delivery (private or public) to achieve a range of perspectives across settings. Mothers were eligible if they had a baby at least six

weeks old, lived in Korogocho or Viwandani for at least one year prior to giving birth, were 18 years of age or older, had not had a cesarean section, and did not require care for peri- or postpartum complications for themselves or their newborns. Selecting women with infants at least six weeks old ensured that participants had adequate time to recover from childbirth. Requiring emergency care might preclude newborns from receiving a routine immediate postnatal check and mothers from initiating breastfeeding within the recommended time frame. These cases were not eligible so the data would reflect the experiences of mother-child pairs who could have received all the interventions in this study. The sample of providers was stratified by type of place of employment (private or public facility) and informal settlement it catered to (Korogocho or Viwandani). Providers were eligible if they routinely managed childbirth and the immediate postnatal period in their work, currently practiced medicine in a healthcare facility that served Korogocho and Viwandani residents and had at least one year of work experience in this setting. Recruiting these providers allowed for richness of responses based on knowledge and experience serving the target population during labor and delivery.

Data collection

During a three-day training to prepare for fieldwork, interview guides were updated iteratively during a review by the in-country research team, translated to Kiswahili, back translated to English, pre-tested with two eligible participants, and further refined before going to the field. Data were collected in June and July 2022 by a research team of trained interviewers comprising two women with extensive prior qualitative research experience in Korogocho and Viwandani. Mother interviews

were conducted in Kiswahili (as participants indicated was their preference) in a private rented space in Korogocho or Viwandani and provider interviews were conducted in English in participants' offices at health facilities. Interviews ranged from 45 to 70 minutes in length and were audio-recorded.

Analysis

Data were transcribed verbatim by a team of two bilingual (English and Kiswahili), experienced transcribers who were not involved in data collection. The primary transcriber of half the interviews checked for completeness and accuracy on the other half by comparing them with original recordings to correct any errors. Kiswahili transcripts were then translated to English. All English transcripts were uploaded to Atlas.ti version 23 for analysis. The primary author discussed the meaning of portions of transcripts that were unclear with the project coordinator (also bilingual) who cross-referenced the transcript with the audio to support interpretation.

Content analysis (Stemler, 2001) techniques were used to analyze data on comprehension of questions and key terms to allow for both qualitative and quantitative assessments of the results. Data were reduced for analysis using matrices that summarized responses across participants and then analyzed using emergent codes. This process involved reviewing the data and developing a list of initial codes, refining and updating them through consultation with the second author, and then applying them to the data during a subsequent review, recording the existence and frequency of codes as appropriate. Data on social influences on responses were analyzed using thematic analysis (Braun & Clarke, 2021). An initial deductive code list was developed with corresponding definitions, guided by the study objectives,

and applied to four transcripts. Additional inductive codes with corresponding definitions were developed based on emergent concepts. Analysis began with an inter-rater reliability check: two members of the primary co-author group (including one native Kiswahili speaker) coded three interviews each and reviewed them together to resolve discrepancies in the interpretation and application of codes. Coders were assigned a subset of transcripts and met regularly to discuss findings. A continuous consultative approach was employed by the primary co-author group to update codes and their definitions, and to reflect on the findings and concepts. After coding was completed, the primary author generated initial themes for each intervention, identified cross-cutting sub-themes, discussed them with the group, and further refined, defined, and named them.

Ethical approval

This study was approved by the University of Maryland College Park Institutional Review Board, Daystar University Ethical Review Board, the National Commission for Science, Technology and Innovation, and Nairobi Metropolitan Services. All participants in the study provided voluntary and written informed consent.

Results

Results are organized into three sections. The first describes participant characteristics (5.1), the second describes findings concerning comprehension and sources of information (5.2), and the third describes mothers' perceptions of community members' values and beliefs about each of the interventions (5.3).

Participant characteristics

We conducted interviews with 20 mothers and 12 providers (Table 14). There was equal or near equal representation across mothers' places of residence and education levels. The mean age of mothers was 30.4 years and of their youngest child 13.6 months. Most mothers were married or in a partnership and more participants delivered at a private facility compared to public. An equal number of providers was sampled across facility type; most were nurses and together with clinical officers they averaged 11.5 years of clinical experience.

Table 14. Mother and provider participant characteristics			
Mothers, N=20		Providers, N=12	
Place of residence, %		Informal settlement served by place of employment, %	
<i>Korogocho</i>	50.0	<i>Korogocho</i>	41.7
<i>Viwandani</i>	50.0	<i>Viwandani</i>	58.3
Education*, %		Type and level of facility employed at, %	
<i>Some or complete primary</i>	55.0	<i>Private clinic/nursing home</i>	50.0
<i>Some or complete secondary</i>	45.0	<i>Public health centers (n=2)</i>	50.0
Mean age in years, SD	30.4 (5)	Current role, %	
Relationship status, %		<i>Clinical Officer</i>	16.7
<i>Married or partnered</i>	75.0	<i>Nurse*</i>	83.3
<i>Single or separated</i>	25.0	Mean years of clinical experience, SD	11.5 (12)
Mean years of residence in informal settlement, SD	7.9 (6)	*Including two in managerial roles	
Type of facility delivered at			
<i>Private clinic/nursing home</i>	60.0		
<i>Public health centers</i>	40.0		
Mean age of youngest child in months, SD	13.6 (6)		
*n=1 missing			

Comprehension and sources of information

Below we describe findings from the content analysis of interviews with mothers and providers related to comprehension of survey questions and key terms

within them, as well as the sources of information mothers draw on while answering survey questions.

Place of delivery

In the DHS, mothers are asked, “*Where did you give birth to [NAME]?*” and are probed on facility type (public or private) and level (hospital, center, clinic, or other lower level). We cross-checked their responses and explored question comprehension and ways of knowing the answer from mothers’ and providers’ perspectives.

Facility type

Mothers were asked where they delivered their youngest child and to indicate the facility type. We compared their answers with publicly available records and found that each participant accurately identified the facility as either public or private. When asked about their basis for knowing whether they delivered in a public or private facility, mothers tended to associate facility type with payment. About half of mothers and half of providers indicated that mothers associate private facilities with payment and public facilities with free services. As one provider put it,

“[They know from] the billing side. In a government hospital like ours, mothers, they don't pay anything, but in a private hospital, you are told you have to pay this amount of money.” – Nurse #12, public facility

Mothers who described payment as an indicator of facility type all said something similar to the following:

“I paid money in that facility but in public you don’t pay.” – Mother #18

Private facilities, such as those run by NGOs, may offer free services while public facilities may require out-of-pocket (OOP) payments. Since 2004, the Kenyan government has passed a series of pro-poor maternity reforms, the most recent of which is the “Linda Mama” program which removed user fees at all public health facilities for pregnant women and their newborns for one year (Kenya Ministry of Health, 2015). However, implementation studies have found that in some counties, between 9 and 52% of Linda Mama beneficiaries are still making OOP payments and that some routine services (e.g., newborn care) were not being offered free of charge in accordance with the program (Brault et al., 2017; Orangi et al., 2021). In this context, mothers who rely solely on payment as an indicator of facility type might over-report delivery at private facilities. Access to Linda Mama was expanded beyond the public sector and is currently available in 42 facilities in Nairobi County (Matara, 2022). Mothers who deliver at facilities that offer Linda Mama and do not require OOP payments, or at NGOs and charity-funded healthcare facilities that offer free services might over-report delivery at public facilities. The implication for reporting on facility type for place of delivery is that those who rely on payment as the determining factor might be inaccurate.

Participants raised the topic of payment in other ways, too. Three providers, all of whom worked at private facilities, described how mothers are informed they are at a private facility when they first arrive. As one provider described it:

“...when they come in, we usually tell the mother this is a private facility. You know they have to...they are used to public hospitals. So, when they come here, we tell them, so they know.” – Nurse #4, private facility

Relatedly, another provider said that if a mother does not know the facility type, she will ask,

“If a patient just walks in and they don’t know, they will ask if it is a public or not.” – Clinical Officer #2, private facility

Patients likely inquire and providers likely inform patients when the facility is private to avoid scenarios where patients face unanticipated costs for services provided at the end of their stay. Interestingly, participants who described aspects of care quality and resource availability as indicators of facility type did so in contradictory ways. A couple of providers described how mothers would be able to know facility type by observing low availability of supplies at public hospitals relative to private ones. As one nurse who worked in a public facility described it:

“...I think there is a very big difference between a public and private hospital. A very big one... supplies. In our government [hospitals] the supplies are minimal but in private hospitals you’ll have the supplies there. If a patient is for example prescribed for a medication she will get. In a government hospital when you’re prescribed for a medication you don’t get.” – Nurse #9, public facility

This same nurse also described the provider to patient ratio as an indicator of facility type for mothers:

“In a private hospital you find that even the staff...okay I won’t say many, but they are many compared to a public hospital. Because in a public hospital you may come and find only one nurse. In a private hospital you’ll find maybe in a ward there are like 5 or 4 nurses.” – Nurse #9, public facility

In contrast to this perspective on mothers associating resource availability with private facilities, one mother described how public hospitals have several providers and short wait times,

“I mean, you just understand services in public hospital. We have many providers who attend to everyone at a go, it is not like you are waiting. There are many providers...who you will not pay. So, when I got there, I saw mothers being attended to by more than four doctors.” – Mother #9

Mixed perceptions about service availability are not surprising considering findings from the Kenya’s Service Availability and Readiness Assessment Mapping Report found comparable rates of essential health service availability (including for maternal and newborn care) across public and private facilities (World Health Organization, 2013).

Facility level

Responses about facility level present a mixed picture. Using response options listed in the KDHS, we asked mothers who indicated they delivered at a public facility to choose which of the following best described their response: hospital, health center, dispensary, and public other. Those who delivered at a private facility were asked to choose from: mission hospital/clinic, private hospital/clinic, nursing/maternity home, and private other. We cross-checked mothers’ responses to these questions using publicly available facility records. Among 20 mothers, seven participants’ responses matched the level ascertained from public records, six participants’ responses did not match, three did not respond, and four changed their answer when the question was repeated to them. For example:

“I: Is it a government hospital, health center, or dispensary? Where does it fall?”

R: Government hospital.

I: Let me read again; is it a government hospital, health center or dispensary?

R: They call it a health center.” – Mother #3

Not all providers commented on how mothers would be able to differentiate between facility levels, but those who did feel that making the distinction between facility levels within the private sector would be difficult. As these providers put it:

“If you ask [a mother] where [they gave birth], they will tell you they gave birth in a hospital and if you want to be specific, I hope there is a supporting question to that. Because if you ask them where they gave birth, they will tell you in a hospital and then they will tell you [name of a private health center]. They won’t know much about if it is faith-based, for them it is either private or public unless for the knowledgeable one who understands there is faith-based, private and public.” – Clinical Officer #2, private facility

“...distinguishing between whether it’s a public or private/non-governmental organization (NGO)...that would be easy but knowing that it’s funded by an NGO would be hard. But when it’s public or private, that is easy.” – Nurse #9, public facility

Findings from interviews with mothers support the notion that the question about facility level is a difficult one. Of the four facilities at which the mothers in this study delivered, both public facilities were health centers, and the private facilities

were a maternity home and a clinic, yet 10 mothers described them as hospitals. In a discussion about the survey question that captures skilled birth attendance (discussed in detail below), a provider said,

“[Women in this community] will tell you it was a doctor. That is the overall term. I gave birth at the hospital, and I was assisted by a doctor. Basically, that is the information that you will get.” – Nurse #11, public facility

A tendency to generalize the term “hospital” to other types of healthcare facilities could result in an overestimation of hospital-based deliveries in comparison to other lower-level facilities.

Skilled birth attendance

The question in the DHS that captures skilled birth attendance asks, “*Who assisted with the delivery of [NAME]?*” We explored accuracy in identifying birth attendant’s skill level (or cadre), means of determining the birth attendant’s cadre, and mothers’ understanding of the term ‘assist with delivery’ from the perspectives of mother and provider participants.

Comprehension of ‘healthcare provider’ and ‘assist with delivery’

Mothers were asked to identify all the people they consider a ‘healthcare provider’, and nearly every mother said doctor and about half included nurses in their responses. Mothers described the meaning of ‘assisting with delivery’ using reference to key events that we would expect happen during the process, such as monitoring the baby in the womb and its position in the birth canal, support while pushing, removing the placenta, cutting the umbilical cord, and the overall care a mother is provided while in labor.

Sources of information on provider cadre

Nine providers had low confidence in mothers' ability to identify and recall the skill level of their birth attendant. The reasons they cited included: (1) mothers tend to assume all providers in hospital settings are doctors (or skilled) and (2) mothers tend not to distinguish between doctors, nurses, and clinical officers.

Providers describe these reasons below:

“Yeah, it would be a bit difficult for them to answer because let's say around here, most of them think anyone who works in a hospital is a doctor or a nurse. Most of them don't know that we have support staffs in the facility. [So] they will think generally all those people who are working at the hospital, all of them know what they are doing. All of them are medics. That's their view generally because sometimes when we do questionnaires, you'll hear them saying: “That doctor at the reception,” “That doctor at the kitchen.” – Nurse #7, private facility

“Basically, they just say a doctor. They don't know if it's a nurse or it's a doctor/clinical officer. They just say doctor, even if delivery was done by the nurses. – Nurse #8, public facility

“Mostly they will just say the doctor. They don't know the difference between the doctors, nurse, and somebody who cleans. As long as they are working in a hospital, they are doctors.” – Nurse #26, public facility

Mothers described their base of knowledge about their birth attendant's cadre based on their role as well. About half the mothers said they knew their provider's cadre because they were providing care.

"In my mind I know that nurses take care of those who give birth." – Mother #17

"I heard a nurse check on the patients and a doctor assists you in delivering."
– Mother #12

In one case, a participant recategorized her provider from midwife to doctor because she assisted with the delivery.

I: Who helped you give birth?

R: She was a midwife. A woman... They were two. A man and a woman.

Yeah... They were both midwives. That's why they were there.

I: How did you learn they were midwives?

R: It's obvious, no doctor can go to the delivery room if he/she isn't trained."

– Mother #20

The World Health Organization (WHO) definition of skilled birth attendants is personnel who *"are competent MNH professionals educated, trained, and regulated to national and international standards. They are competent to: (i) provide and promote evidence-based, human-rights based, quality, socioculturally sensitive and dignified care to women and newborns; (ii) facilitate physiological processes during labor and delivery to ensure a clean and positive childbirth experience; and (iii) identify and manage or refer women and/or newborns with complications. In*

addition, as part of an integrated team of MNH professionals (including midwives, nurses, obstetricians, pediatricians, and anesthetists), they perform all signal functions of emergency maternal and newborn care to optimize the health and well-being of women and newborns” (WHO, 2018a). While knowing if an individual provider meets these requirements seems difficult for any patient in any context, findings from our interviews suggest mothers in Korogocho and Viwandani may be assuming all facility-based employees providing delivery care are necessarily doctors or nurses and that they may not be distinguishing them from lower-level medical and non-medical facility-based staff (e.g., sonologists, sweepers). Health worker absenteeism (staff not present at facility when they are scheduled to work) in Kenya is high; the absence rates of doctors/clinical officers and nurses in primary and secondary care facilities are estimated to be 41 to 47%, respectively (Di Giorgio et al., 2020). In this context, colleagues sometimes compensate for staff shortages by performing tasks for which they are neither trained nor qualified (Deussom et al., 2012), resulting in unskilled individuals supervising births and mothers incorrectly assuming and reporting they are skilled.

Participants spoke about determining cadre based on gender, clothing, badges, what mothers hear other patients say, and what they were told by providers. Providers indicated that there is a general assumption that doctors are male, and nurses are female. As two providers described it:

“You see to [mothers], any male nurse is a doctor. The females are the nurses... When you are the two of you, you are with a man. They will always call him a doctor. Even if, my colleague who have checked what has he told

you how far are you? The doctor has checked me, and he said this and that. To them a male is a doctor and female is a nurse. So, they will tell you the doctor assisted me [to] deliver.” – Nurse #11, public facility

“Most likely they won’t be able to know [provider cadre]. Mostly they take female to be a nurse and male as doctors. They might not be able to know if it was a nurse or a clinician.” – Nurse-in-charge #1, private facility

Though this did not explicitly come up in mother interviews, in nearly every instance that a mother spoke about a doctor, it was a “he”, and in nearly every instance a mother spoke about a nurse, it was a “she”. That said, the gender distribution in Kenya across cadres is uneven; 65-70% of doctors/clinical officers are male and 65-74% of nurses are female (World Health Organization, 2013). The WHO indicator considers doctors, nurses, midwives, and other medically trained personnel (as defined by each country) as skilled health personnel (World Health Organization, n.d.-a), so mothers’ gender-based assumptions about doctors and nurses may not significantly impact skilled birth attendance estimates.

Seven providers said they introduce themselves to their patients at the beginning of their interaction and/or wore badges that women could read; two mothers mentioned being introduced to and two said they knew from the provider’s badge as well. A quarter of the mothers referred to providers’ clothing as a means of identification and they were consistent in reporting that doctors wore white, and nurses wore blue. While this is also consistent with what APHRC colleagues’ observations, the limited published literature we found that discusses uniform color in

Kenyan healthcare facilities refer to nurses wearing white uniforms (Brown, 2012; IntraHealth International, 2019).

Early postnatal care

Early and skilled postnatal care indicators are calculated using data from three DHS questions asked in the following sequence: (1) “In the two months after (NAME) was born, did any healthcare provider or a traditional birth attendant check on his/her health?”, if yes, (2) How many hours, days, or weeks after the birth of (NAME) did the first check take place?” and (3) “Who checked on (NAME)’s health at that time?” We asked participants the same questions and probed on their understanding of each.

Comprehension of ‘postnatal care check’

Mothers’ understanding about what a ‘postnatal care check’ means was mostly non-specific, though still consistent with the intention of the question; as mothers indicated that a provider “*checks if a baby is okay*”, “*if they have any health issues*”, and “*the way she is breathing*”, for example. Eleven mothers interpreted the question to refer to a longer period than the first two days, so responses reflected longer-term outcomes such as developmental progress.

When prompted to name specific things a provider should examine, 11 mentioned weight and between two to four mentioned the following as well: height, body temperature, and cord care. The current DHS Model Questionnaire (Phase 8) added questions that measure specific components of postnatal care, including: cord care, temperature checks, counseling on when a baby requires immediate medical attention, discussions about breastfeeding, and direct observation of breastfeeding to

the postnatal care module (DHS Program, 2018). While the inclusion of these components of care will allow for a quality-adjusted assessment of postnatal care, prior versions already asked about babies being weighed and few of the mothers in our study mentioned any of the other components. Mother #19 said, “*I don’t know what they do there,*” referring to when her baby was having a postnatal check. Quality-adjusted measures of postnatal care using data collected in the Phase 8 Questionnaire might under-estimate coverage due to lack of maternal awareness about care provided.

Comprehension of timing of ‘first’ postnatal care check

When asked about the timing of the ‘first’ postnatal care check, seven mothers said it happened 2-6 weeks after birth, but five of these participants changed their answer to immediately after birth when the interviewer emphasized that the question was about the first facility-based check, seven said it happened immediately or within two hours after birth, and six participants did not grasp the question or did not give a concrete answer (e.g., “*while I was still in my bed*”). An example of how this question is not easy to answer is captured in the following interaction:

I: How many hours, days, or weeks after the birth of [NAME] did the first check take place?

R: Three weeks.

I: Three weeks. What about the first check? The first day, it was after how many hours, weeks, or days?

R: One week ended with days.

I: You told me he was checked or not?

R: He wasn't checked.

I: He was not checked?

R: He was checked.

I: After how many hours, minutes...

R: Three, three minutes or three hours.

I: [So] was it three minutes or three hours?

R: It's three hours.

I: Three hours?

R: Mmhm" – Mother #14

The interviewer in our study repeated part of the question to prompt the participant to clarify her answer and in doing so may have confused the participant. Such an interaction may not be uncommon in household based surveys. Five providers felt mothers would remember the timing of the two-week visit accurately because they are counseled on the importance of the timing of this routine checkup multiple times throughout the antenatal period and prior to discharge. Five other providers felt it would be difficult to remember the timing of a pre-discharge check in hours. A couple of providers struggled to understand the question themselves and did not provide a clear response. What is meant by 'first' postnatal check was unclear to participants, and this is best demonstrated by the following conversation where a provider describes three distinct time points at which a postnatal check might occur, two of which might be considered 'first':

I: The next question is, “How many hours, days, or weeks after the birth of [NAME] did the first check take place? How easy do you think it would be for a typical patient of yours to answer this question?”

R: Mmhm, most of them would answer within two weeks. Two weeks after delivery... We don't even inform them about the first examination. We just do it and just record without even informing them. But I think it's something we are supposed to inform them, so, basically, they will talk about the two weeks.

I: And for checks that occur before discharge from the hospital, how accurate do you think women's responses to this question are?

R: Umm, before discharge means being...the vitals because we do the vitals. I think that one they will take note [off]... Yeah, they will give an accurate response to that.

I: And what makes it easier for them to give that accurate response at that particular time?

R: Because when you do the examination or the vitals, they are there, they are there watching and informing them. You can't do anything to the baby without their consent or without informing them.” – Nurse #8, public facility

According to this participant, mothers likely report the two-week postnatal check and the one prior to discharge accurately, but not those occurring immediately after birth. Data on timing and components of care are used to calculate the early postnatal care indicator, and there is mixed information in the literature about both. With respect to timing, the WHO (WHO, 2013) and the Global Strategy for Women's, Children's, and Adolescent's Health (2016-2030) (Every Woman Every

Child, 2015) define it as care within 24 hours and the Every Newborn Action Plan defines it as care within 48 hours (WHO & UNICEF, 2014). With respect to components of care and the timing of when they are provided, some make a distinction between immediate newborn care which includes resuscitation, thermal care, and breastfeeding initiation, and postnatal care for the newborn, which includes an assessment for abnormal signs, exclusive breastfeeding, and cord care.

Sources of information on timing of care

After asking mothers how long after birth the first postnatal check took place, we asked them to describe how they remembered the answer to the question. Some of the responses are presented below:

"What made me remember is because my first child is disabled so I was very keen because I wanted to know if he is okay". – Mother #1

"I: What made you remember?"

R: I always remember because a child is taken to the clinic when they are 6 weeks. That is 1 month." – Mother #18

Mothers did not succinctly describe how they remembered the timing of the first postnatal check. We recruited mothers with children under 24 months of age; this is the same age range mothers are asked to recall postnatal care events in the DHS.

Breastfeeding

The DHS question that captures time to breastfeeding initiation is asked in two parts. Women who respond "yes" to "Did you ever breastfeed [NAME]?" are then asked "How long after birth did you first put [NAME] to the breast?" Below we

describe mothers' definitions of 'breastfeeding' and the ways in which they described remembering time to initiation.

Comprehension of 'breastfeeding'

Fifteen mothers defined breastfeeding as when a baby suckles from the breast and milk reaches the stomach; they indicated that a baby who was put to the breast but did not suckle, suckled but did not drink, or drank breastmilk from a spoon or bottle was not considered to have been breastfed. This perception is captured in the following two excerpts:

"I: If a mother tries to breastfeed but the child is unable to suckle, has the child breastfed?"

R: No, if the baby didn't suckle, they didn't breastfeed." – Mother #2

"...R: Breastfeeding is the act of the baby suckling herself... Not taking it and putting it in a bottle like you are breastfeeding, that is not breastfeeding... You hold your baby so that she can feel your warmth as she breastfeeds.

I: Okay. [So], if I express, I'm not breastfeeding?"

R: No, you are not. You're completely not breastfeeding." – Mother #9

Five mothers had a broader definition of breastfeeding which included any method of breastmilk reaching the baby's stomach. One mother's definition expanded slightly as the conversation progressed:

"I: What counts as breasting...what is breastfeeding?"

R: A child suckling from the breast.

I: What if you place the baby on the breast but refuse to suckle, is that breastfeeding?

R: No, they have to suckle for it to be breastfeeding.

I: If you pump milk and then feed the child with a spoon or a bottle, is that breastfeeding?

R: Yes, you have breastfed the child because the milk came from the breast.”

– Mother #6

The WHO and UNICEF definition of early initiation within the first hour of birth only requires that a baby be put to the breast, not that it suckled or that milk was transferred from breast to infant (World Health Organization & UNICEF, 2021). The DHS survey question that measures this is specific about asking if the baby was put to the breast and findings from our interviews do not suggest mothers are misreporting this. We do find, however, that mothers’ definitions of breastfeeding are narrower than those used in other breastfeeding indicators. The survey instructs interviewers to skip questions that capture early initiation, pre-lacteal feeds, and exclusive breastfeeding for mothers who respond “no” to having ever breastfed. This phrasing and ordering of questions may be sub-optimal for the purposes of capturing breastfeeding behaviors as they are defined in public health, particularly among mothers who have a narrower definition of what constitutes breastfeeding.

Sources of information on timing of initiation

Some mothers reported time to breastfeeding initiation based on estimates of how long other events between birth and initiation took. These events included

delivering the placenta and bathing, which most mothers estimated took less than one hour. For example,

"I: What has helped you remember the answer to this question?"

R: After giving birth, they took the baby, I was taken to the bathroom, tea was served and then I was told to go help myself in the bathroom and then come breastfeed. That is how it was." – Mother #2

Other mothers did not describe how they knew how much time had passed between delivering the baby to initiating breastfeed. Instead, some of the responses were:

"I just remember it was after 30 minutes." – Mother #1

"I: What has helped you remember the one hour?"

R: You can't forget for all the children you have delivered.

I: Why won't you forget?"

R: Due to all the pain you experience." – Mother #5

"I don't know what to say, just my mind." – Mother #8

Our study was not designed to triangulate time to initiation from another source (e.g., facility records), so we cannot determine whether reports were consistent with external assessment. Given how mothers described their ways of remembering, however, there is likely some inconsistency especially considering no mothers mentioned checking the time themselves or being told the time by someone else at any point during the process.

Summary of findings from content analysis

Below is a table that summarizes the findings from the content analysis across each intervention.

Table 15. Summary of findings from content analysis		
Measure	Comprehension	Sources of information
Place of delivery: facility type	High accuracy	Payment, quality of care
Place of delivery: facility level	Low accuracy	Unclear
Skilled birth attendance	High accuracy of comprehension of ‘healthcare provider’ and ‘assist with delivery’	Role, gender, clothing
Early postnatal care	Mixed accuracy of comprehension of ‘postnatal care check’; low accuracy of comprehension of ‘first’ check	Unclear
Early breastfeeding initiation	Low accuracy of comprehension of ‘breastfeeding’	Unclear

Social influences on responses

We present three key themes that correspond to different perceived social influences on mother’s responses to questions about these interventions including: (1) social status associated with place of delivery, (2) negative sentiments about traditional birth attendants (TBAs), and (3) breastfeeding expectations.

Theme 1: Status associated with place of delivery

We explored social desirability bias in responding to the DHS question that captures place of delivery by asking mothers where people in their community think ‘good’ and ‘bad’ places were to give birth. Some participants noted that people judge a woman’s wealth status by where she gives birth. Women who deliver at private facilities are “*seen to have money*” and as people who want to “*show off*” by paying for care. Conversely, women who deliver at public facilities are seen as people who

“don’t have money” and “can’t even afford a private hospital”. Against this backdrop, several mothers suggested related response biases when answering questions about facility type. Perceived motivations for mothers to falsely indicate they delivered at a private facility included: to avoid embarrassment and being made fun of by peers and to elevate their status above others. As one mother put it,

“Most people lie because you will find people saying they gave birth at [name of private facility] or (some) other big hospital only to find out they gave birth at [name of public facility] ... There are those people who are proud and if they say they gave birth at certain place they will be embarrassed.” – Mother #2

Another mother described lying about place of delivery to avoid being laughed at,

“I: When mothers are asked where they delivered, do most people tell the truth?

R: Some they lie.

I: Why do you say so?

R: One will deliver at [name of public facility] and when asked they will mention an expensive private hospital so that people don’t laugh at them [because] they have delivered from a free hospital.” – Mother #12

This finding suggests that some women might find reason, at least when speaking with their peers, to over-report delivery in a private facility to benefit socially from its associated prestige.

Theme 2: Anti-traditional birth attendants

We explored the role of social desirability bias in responding to the DHS question about skilled birth attendance by asking mothers who people in their community considered to be ‘good’ and ‘bad’ birth attendants. All participants said the preferred provider was a doctor and/or nurse, and all comments about traditional birth attendants (TBAs) were negative. Reasons for disliking TBAs included their “old-fashioned ways,” lack of knowledge, and suggesting it would be nonsensical to deliver at home.

“[TBAs] discourage you from visiting the hospital. They insist on offering the same services offered by the nurses at the facility. It's risky for a TBA to help you with the delivery because they don't have medicine to administer to avoid bleeding. They will instruct you to take traditional herbal medicine and they are inconsequential...– Mother #16

“Hospitals are so many these days so at the time of birth going to look for a traditional birth attendant...those days are behind us. Maybe if you are in a bad place though I don't think it can happen because [name of private facility] and [name of public facility] are just nearby. People see it as bad thing to give birth at home.” – Mother #11

One participant suggested that women who deliver with TBAs at home would lie about it for the purposes of obtaining a birth certificate and other official documents. She described her experience with this.

“When you deliver at a TBA, she will not provide a birth notification card. Nowhere can she get that. The first thing when you’re applying for a birth certificate, they ask where the baby was born, especially at [name of public facility]. They will ask you why you didn’t go to the hospital, and you opted for TBAs. There are a lot of TBAs.... They always ask for birth notification when you are applying for a certificate and (if) you don’t produce it, they know automatically you delivered at TBAs... Maybe someone who gave birth at TBAs...she will forge all those cards and papers to lie that she delivered in a health facility, but she didn’t. I know three mothers who delivered at TBAs. When it was time to apply for a birth certificate, they took their children to their maternal mothers [so] that they can lie to and help them get those documents. I asked, where do you stay (live)? There was a hospital (nearby), why didn’t you visit there?” She said the moment labor pain started she rushed to a traditional birth attendant.” Mother #16

There was a strong anti-TBA sentiment that mothers described in discussions about ‘bad’ places to give birth and ‘bad’ birth attendants, but the number of births they said they had heard about, unprompted, that were TBA-supervised was not zero. Trends in TBAs assisting deliveries have shifted over time both at the national- and Nairobi-levels. Nationally, the prevalence decreased from 28% in 2003 (Central Bureau of Statistics (CBS) [Kenya] et al., 2004) and 2008 (Kenya National Bureau of Statistics (KNBS) & ICF Macro, 2010) to 19% in 2014 (National Bureau of Statistics, 2014a). In Nairobi, prevalence decreased from 9% in 2003 to 6% in 2008 and 2014

(National Bureau of Statistics, 2014a). While low in Nairobi, our findings suggest women may feel pressured to under-report home-based deliveries with TBAs.

Theme 3: Breastfeeding expectations

There were strong perceptions about breastfeeding suggestive of community expectations that a mother should and would breastfeed. Exclusive breastfeeding came up often even though it was not part of our protocol. The majority said people in the community felt that breastfeeding is very important; one participant commented that the consequences of not breastfeeding were increased likelihood of childhood morbidity and mortality. She said:

“[People in this community] know when you give birth you must breastfeed. If you don’t the baby can die, or the baby will be unhealthy...When you visit the hospital, they tell you the baby should breastfeed for six months and if you don’t, that baby will be unhealthy. The baby will be prone to diseases and even the baby can die.” – Mother #14

Another participant described how people in the community would view a mother who only breastfed her baby for three months:

“A stupid person. With this cold weather when you leave your baby in a day and left for work, the woman that you leave the child with is not concerned about the baby but just the money. She won’t cover the baby as I have done with mine. The baby will also be subjected to food very early because whenever she cries the mother is not there to breastfeed. [So] it is good for the mother to stay with the child for at least six months to allow the baby to breastfeed fully.” – Mother #7

Several mothers said people in the community would not only talk about a woman who was not breastfeeding to others but would also take action towards encouraging her to start. As one participant described what would happen if a mother decided not to breastfeed,

“If it is a little child, [people in this community] will ask you why you aren’t breastfeeding and start talking about you... They ask you and take you to the Chief’s office. If it is a small child, they must ask you why you are not breastfeeding.” – Mother #11

The Chief in this context is a well-regarded community leader. Mothers who do not breastfeed are suspected of not wanting the child, not being the child’s biological mother, being ill, or not wanting their breasts to sag. For example,

“I: What about a mother who has decided not to breastfeed?”

R: Maybe if the mother is sick, so people will start suspecting that she has a problem.

I: What if the mother is (not) sick but she has decided not to breastfeed, how will people view her?

R: They will think maybe the baby is not hers. [If it is hers] they will see her as murderer because you can’t give birth to child and not breastfeed (laughter). The baby will die of hunger.

I: What will they do?

R: They will force her.” – Mother #10

“I: How will people view a mother who gave birth and decided not to breastfeed?”

R: They will talk badly about her and guess that she is sick. Others will say that the mother is doing dirty things and is afraid of infecting the child.

I: What will they do?

R: Nothing. They will just talk. Some might inform a healthcare provider who will come and talk to her, try to convince her to breastfeed.” – Mother #12

“Yes. You will find someone who doesn’t want to breastfeed because they don’t want their breast to sag.” – Mother #13

Overall, mothers indicated that breastfeeding was very important to people in the community. This reflects positively on efforts to promote breastfeeding through increased awareness of its benefits amongst mothers. However, quantitative studies find that mothers over-report breastfeeding (Day et al., 2021b), and our findings suggest a possibility that social desirability in responding to questions about breastfeeding might play a role in over-reporting.

Discussion and Conclusion

Summary of findings

This study explored comprehension-related and social influences on women’s responses to questions in household surveys about five neonatal health interventions, namely: health facility delivery, skilled birth attendance, early and skilled postnatal care, and early breastfeeding initiation. We interviewed mothers and providers to

understand their perceptions of how well mothers comprehend the meaning of survey questions and key terms and the sources of information they draw on to answer them. We also explored social desirability bias about behaviors involved in each intervention with mothers.

Findings from the interviews suggest that most mothers: (1) associate payment with private facilities and consequently mis-report facility type in cases where private facilities offer free services and public services require out-of-pocket payments, (2) generalize the term “hospital” to other facility types, (3) generalize the term “doctor” and “nurse” to other lower-level, unskilled, facility-based employees, especially those who enter the delivery room, (4) make assumptions about provider cadre based on role, uniform color, and gender, (5) have an understanding about the meaning of ‘assisting with delivery’ and ‘postnatal care check’ that is shared with the intention of the survey questions (6) report the timing of a range of postnatal checks, some of which are not the true first postnatal check or consistent with the question, and (7) could not provide concrete descriptions of how they identify time to initiation of breastfeeding or first postnatal check.

Findings from interviews with mothers about social influences on responses to survey questions suggest there are reasons related to social desirability that might influence how accurately a mother responds to a survey question even when her comprehension of it aligns with the intended meaning. On household surveys, women in these communities may: (1) indicate they delivered at a private facility to appear to be wealthier to their peers, (2) indicate they had a skilled birth attendant if their true attendant was a TBA, and (3) over-report breastfeeding.

Implications for practice and research

Our findings support the interpretation of intervention coverage estimates in informal settlements like Korogocho and Viwandani where coverage rates do not correspond to expected health benefits for neonates. Overall, they suggest that the specific survey questions we examined in this study that are used to measure coverage might not be optimal for producing estimates for populations living in informal settlement communities for several reasons. The survey question that measures facility type and level is not well-suited to capture facility type and level in the context of a healthcare system that offers a range of funding models for maternity care may be resulting in inaccurate estimates of coverage. Current DHS data collection guidance prompts interviewers to record the name of the facility a mother gave birth at only if she is unable to determine if it was public, private, or NGO sector. We suggest interviewers consistently record facility name for verification of facility type by data entry officers (or other personnel) later as an approach to improve data validity for this indicator.

To the best of our knowledge, this is the first study that aims to understand potential social influences on mothers' responses to the survey question about where she gave birth. Prior research has focused on facilitators and barriers affecting women's decision-making processes (Adde et al., 2020) and whether women can accurately differentiate between facility sub-types (i.e., hospitals vs health centers) (Stanton et al., 2013c). Understanding the extent to which the social desirability biases identified in this study extend to the context of responding to household survey

questions with a stranger (i.e., not a community member) is worth considering in future research.

Other studies have documented instances where responses to questions about skilled birth attendance are improbable, such as having a cesarean section with an unskilled provider (Benova et al., 2017) or having a skilled provider in an unlikely setting (Campbell et al., 2016). This suggests low awareness of provider cadre (Radovich et al., 2019), which is most common in women with low levels of education (McCarthy et al., 2016). Our findings offer some context for this in urban informal settings in Nairobi, as several mothers indicated they assumed an individual is a doctor, nurse, or midwife based on their employment or presence at a facility. Other research has also found that women tend to determine birth attendant's cadre by the role they were performing (e.g., checking the fetal heartbeat) (Hussein et al., 2005; McCarthy et al., 2016) or by the type and color of their clothes (Hussein et al., 2005). Our findings add to this body of literature that women may also presume cadre based on gender. It is important for healthcare providers to identify themselves to their patients, both as part of respectful maternity care but also for improving reporting accuracy. Home-based records (HBR), patient-held documents that record the history of healthcare services women and children, are widely used in LMICs (Brown & Gacic-Dobo, 2015). Currently, DHS interviewers are instructed to verify women's responses about birth weight, vaccine history, and other indicators by asking to see HBRs. We suggest exploring the feasibility of expanding this practice to include verifying birth attendant cadre as well.

Responses from providers and mothers in our study indicate that what is meant by ‘first’ postnatal check is unclear. This lack of clarity is present across standard definitions of early postnatal care as well by the WHO (WHO, 2013), ENAP (WHO & UNICEF, 2014), and the Global Strategy (Every Woman Every Child, 2015). The implications of these varying definitions of what is meant by ‘first’ or ‘early’, along with findings from our study, suggest that current approaches to estimating early postnatal care likely capture care provided at a range of time points, not all of which are within the first 48 hours. The way in which questions about PNC are asked impacts the resulting estimates of PNC coverage, so ensuring a clear intention and validating the questions is very important. The MICS introduced survey questions that clearly distinguish between immediate checks (referred to in this paper as part of delivery care or intrapartum care) and PNC visits (post-discharge checks for facility deliveries) while the DHS still used a blended approach, asking about any checks in the first two months after delivery (Amouzou et al., 2017). A comparison of the two surveys found that MICS data estimated coverage of PNC in the two days to be higher than the DHS. One interpretation of this finding is that when asked to recall a visit in a two-month period, mothers in the DHS are likely recalling one that falls outside the two-day window. The updated approach to measuring this indicator in the DHS Phase 8 are likely to produce more accurate coverage estimates for care at both timepoints. We suggest future research should validate the new measures.

Our findings suggest that in the context of urban informal settlements, a strong cultural perception of the importance of breastfeeding might be playing a role in women’s reporting on (and practice of) breastfeeding. A study of cultural and

social influences on breastfeeding in Korogocho and Viwandani found that women held a range of beliefs, including that colostrum is ‘dirty’ or ‘curdled milk’, it is inappropriate to breastfeed while being in extra-marital romantic relationships, and that breastfeeding in public would invite the ‘evil eye’, but also that breastfeeding promotes a baby’s intellectual and physical development (Wanjohi et al., 2016). The strong positive perceptions about breastfeeding in our findings help contextualize quantitative research that finds women over-report breastfeeding (Day et al., 2021a), suggesting this may be a result of mothers feeling pressure to report it. Given our finding on varied understandings of what constitutes breastfeeding, we suggest that the DHS include a question to capture breast milk fed through a bottle or mechanism other than directly from the breast to improve the accuracy of exclusive breastfeeding estimates.

Limitations

While we set out to explore social desirability bias in women’s responses to questions related to MNH health intervention coverage, there was still potential for this bias to influence our findings as well. We attempted to address this by using social norms research techniques and asked participants about community norms rather than personal beliefs. Our study population was sampled from two informal settlements that have been part of the NUHDSS implemented by APHRC since 2002. Apart from collecting data from each household annually, APHRC serves as a platform for launching external research projects related to health and well-being in Korogocho and Viwandani; as a result, this population is very research saturated so there is reason to be cautious about generalizing findings from them.

Conclusion

Taken together, findings from this study contribute towards understanding research that finds high intervention coverage as measured by the survey questions we examined in this study and poor neonatal health outcomes in densely populated urban spaces like Nairobi, suggesting that some survey questions may not be appropriate for developing estimates in certain populations. While the findings from this study are not generalizable, they demonstrate that a qualitative understanding of the social context from which data are collected can support the interpretation of research that uses them. Further, it demonstrates that further work is needed across more settings to explore the cognitive understandings women have of survey questions that measure intervention coverage. It is important to acknowledge that the data collected in household surveys are limited but can be improved.

Chapter 6: Discussion

This dissertation contributes to efforts to improve neonatal survival in low- and middle-income countries (LMICs) by: (1) comparing coverage of five maternal and neonatal health (MNH) interventions across different settlement types in urban Kenya to identify potential populations that are being left behind; and (2) exploring ways in which the quality of data on intervention coverage collected in nationally representative household surveys might be enhanced and better contextualized. Below is a summary of the findings, a discussion of the findings and limitations, implications for the field and future research, and conclusion.

Heterogeneity in Urban MNH Intervention Coverage

Summary of findings

This study examined intra-urban variation in coverage of five neonatal health interventions using the most recent Kenya Demographic and Health Survey (KDHS) data and data collected in two urban informal settlements in Nairobi. The interventions, health facility delivery (HFD), skilled birth attendance (SBA), early postnatal care (ePNC), skilled postnatal care (sPNC), and early breastfeeding initiation (eBFI) are part of several global strategies to promote neonatal survival and are used as proxy measures for monitoring progress towards achieving related Sustainable Development Goal targets (WHO, 2016b). Household characteristics in the KDHS were used to derive three types of urban residence including informal settlements in cities, informal settlements in towns, and formal settlements in cities and town. Compared to formal areas, neonates in informal towns had lower odds of

having ePNC. No differences were observed in any other intervention across residence type. This study found limited intra-urban variation in coverage, which is inconsistent with observed patterns of variation in neonatal mortality.

Discussion

The five interventions I focus on in this study are important for several reasons. First, interventions provided during labor and birth are more impactful than those provided at any other time in reducing neonatal mortality (Bhutta et al., 2014). Second, they are used by various global health agencies and initiatives to track progress towards improving neonatal survival, including Countdown to 2030 (Countdown 2030, 2021), the Global Strategy for Women's Children's, and Adolescent's Health (2016) (Every Woman Every Child, 2015), the Every Newborn Action Plan (WHO & UNICEF, 2014), and UNICEF in its annual flagship State of the World's Children Report (UNICEF, 2021b) and, consequently, are the subject of a wealth of research on this topic. Third, they are captured in nationally representative household survey programs like the DHS for the purpose of monitoring progress towards achieving high coverage.

However, several studies across LMICs find mixed or weak evidence for the survival benefit of HFD (Central Bureau of Statistics (CBS) [Kenya] et al., 2004; Kenya National Bureau of Statistics (KNBS) & ICF Macro, 2010; National Bureau of Statistics, 2014b), SBA (UNICEF, 2015; Carvajal-Aguirre et al., 2017; Singh et al., 2014; Bellizzi et al., 2017), and sPNC (Haider et al., 2000; Khan et al., 2017; Dennis, 2002). One explanation for this is poor quality of care at facilities (Bhutta et al., 2014; UNICEF, 2015; Wall et al., 2010) where skilled providers are most often based.

Simply being present at a health facility or being in the presence of a skilled provider, as is measured by the HFD, SBA, and sPNC indicators, does not guarantee availability of and access to resources required to provide sufficient routine or emergency care (Carvajal-Aguirre et al., 2017) or access to providers with appropriate knowledge and skills (Martin & Pimhidzai, 2013; Olenja et al., 2009). Low provider-to pregnancy ratio (Koblinsky et al., 2016), poor clinical knowledge, provider absenteeism, low availability of essential drugs (Martin & Pimhidzai, 2013), and high stress levels in providers (Sulemana et al., 2019) have been documented in Kenya and in some cases are experienced disproportionately by poor women (Sharma et al., 2017). The gap between contact and quality is likely especially pronounced in urban informal settings where women are served primarily by unregulated facilities that are ill-equipped to offer emergency care, provide below minimum-standard care, and employ poorly trained providers (Essendi et al., 2011; Ziraba et al., 2009b). Current household survey items offer few options for approximating quality of care, limiting conclusions that can be drawn from the data.

Limitations

As with all cross-sectional data, the findings from Manuscript 1 cannot speak to trends in coverage over time. The 2014 KDHS data were collected within one year of the 2013 Free Maternity Services policy being implemented which removed user fees for antenatal, delivery, and postnatal care at public health facilities. Patterns of coverage were likely changing rapidly at the time these data were collected and may not be indicative of what coverage was like before or after the policy was introduced. The implications that can be drawn from coverage estimates in Korogocho and

Viwandani using data from the Partnership for Maternal, Newborn and Child Health (PAMANECH) project are limited by high missingness in the dataset and other indicators that the data were of poor quality. The research in Manuscript 1 attempts to identify urban informal settlements though the DHS was not designed for this purpose; the poorest urban areas are often not surveyed by the DHS (Moreno, 2003). It is possible that the clusters categorized as city or urban informal were not true informal settlements. The study assumes distance to health facilities is not a barrier to intervention coverage, and this may impact mothers differently depending on their ability to afford or access transportation.

Inability to use dataset due to significant data quality issues

One of the original research questions of this dissertation involved analyzing three waves of data from two projects based out of the African Population Health and Research Center (APHRC): 1) baseline (2013) and endline (2016) data from PAMANECH; and 2) baseline (2018) data from the Promoting of the Sustainability of Healthcare Investments (ProSHI) project (Kyobutungi & Bakibinga, 2018). Specifically, the aim was to determine if sociodemographic disparities (age, education, partnership status) in intervention coverage were decreasing over time (from 2013 to 2018) for mother-child pairs in Korogocho and Viwandani. To assess the usability of the data, I performed checks recommended by the Abdul Latif Jameel Poverty Action Lab (*Data Quality Checks* | *The Abdul Latif Jameel Poverty Action Lab*, n.d.). Several issues were identified and despite efforts to resolve them, significant questions remained unanswered that I felt precluded this analysis from moving forward. The checks and findings are described below.

Data were assessed for: (1) high levels of missingness on some questions more than others or questions that no respondents answered, (2) if respondents were excluded from answering questions that did not apply to them (i.e., a respondent who said she had never had a baby was *not* asked any subsequent questions about her own children), (3) outliers (i.e., responses falling outside the acceptable range), (4) duplicate entries of unique identifiers (i.e., the same respondent having more than 1 set of responses), and (5) number of inconsistent responses (e.g., a mother's age is 30 and her child's is 28 years). These errors would suggest any of the following issues with data collection and data entry: the skip pattern did not work properly, enumerators required further training, data were fabricated, a programming error, that enumerators were not interviewing the correct respondent, or that some data were collected but not entered completely.

After identifying several relevant issues across each of these areas, I met with project team members at APHRC who were involved with data collection and entry to try to resolve them. Through the course of multiple conversations, some concerns were addressed while new ones were raised. A complete list of concerns is provided in Appendix F. Despite multiple attempts to resolve each of the issues, there are several concerns with each of the waves that remain unaddressed, including not being able to produce coverage rates for one of the interventions (breastfeeding initiation). Perhaps the most significant of these is the suspiciously high rates of coverage in the 2016 and 2018 waves of data. For example, ePNC rates were 98% and 97% in 2016 and 2018, respectively, and coverage for each intervention was >97% in 2018. Given the findings in Manuscript 1 with respect to ePNC specifically, we would expect

more variation in coverage rates at each of the waves. For these reasons, I did not proceed with this analysis.

In addition to being unable to pursue this research question, I also decided not to use the 2013 wave of PAMANECH in Manuscript 1 to compare intervention coverage with informal settlements identified in the 2014 KDHS as originally proposed. This decision was made after analysis was complete and results suggested that intervention coverage was highest in Korogocho and Viwandani compared to all other areas in the KDHS. This could have been explained by differences in methodologies, however there are limited data available on the sampling and data collection approaches used in the PAMANECH project. The project's co-Principal Investigator, Dr. Pauline Bakibinga, was responsible for overseeing data collection and may have been able to address some of these issues, however she passed away in the summer of 2022. Without her participation, I felt uncomfortable publishing these results from the project. Further, the project team members at APHRC were least confident in the 2013 wave of PAMANECH data compared to subsequent waves for the following reasons: (1) they had been collected 9 years prior, so their memories of why certain decisions were made were weak or no longer intact; (2) the data entry system they used was not reliable and in part because they used an outdated data entry system. For these reasons, I only used the KDHS to develop coverage estimates in Manuscript 1.

Assessing Validity of Household-Based Survey Questions on MNH

Interventions

Summary of findings

Efforts to reduce neonatal mortality in LMICs rely heavily on the accurate measurement of interventions considered essential for neonatal survival. The DHS and UNICEF's Multiple Indicator Cluster Survey (MICS) provide a significant portion of the data used to monitor progress and are vital in tracking inequities in coverage, but these data have several weaknesses that require attention. This study aimed to explore one set of these weaknesses, specifically factors that influence the validity of mothers' responses to questions about place of delivery, SBA, ePNC, sPNC, and eBFI. Recently delivered mothers from Korogocho and Viwandani and healthcare providers employed at four facilities that serve Korogocho and Viwandani residents were interviewed to explore social desirability bias in responding to questions, mothers' understanding of key terms and phrasings used in said questions, and the sources of information they draw upon when answering questions. The following was understood by participants as intended: the question on place of delivery, the term 'assisting with birth' and the related survey question, the term 'postnatal check', and the question on initiating breastfeeding. The framing of the question about first postnatal care check created confusion about what was meant by first, so comprehension of the question was low. Ways of remembering time to initiation of breastfeeding and first postnatal check (that happened prior to discharge) varied, were unclear, and were based on estimates of how long other events that

occurred after delivery took (e.g., a shower takes ~10 minutes). There was potential for social desirability bias for reporting type of place of delivery, birth attendant if the individual was a traditional birth attendant (TBA), and breastfeeding. There were concerns with the validity of responses to the questions about birth attendant and postnatal care provider, as responses are sometimes informed by cues that do not reliably indicate the conclusions that are drawn from them (e.g., anyone who works at a healthcare facility is a skilled provider).

Discussion

Several limitations have been noted in the literature with respect to the validity of survey items measuring SBA, sPNC, ePNC, and eBFI. **First**, measures of provider cadre from self-reports assume mothers across sociodemographic backgrounds are aware of the title of their provider in healthcare settings, and we know this is often not the case for mothers with low levels of education (Blanc et al., 2016b; McCarthy et al., 2016). As was observed in the qualitative component of this dissertation as well as in other studies (Hussein et al., 2005; McCarthy et al., 2016), mothers often use unreliable cues in their environment to determine the cadre of their provider, cues such as uniform color and employment at a facility. Even when mothers accurately report provider cadre, the underlying assumption is that the provider possesses the skills and knowledge commensurate with their title and has access to resources to provide appropriate care which, as noted above, is not always the case. **Second**, while DHS items measuring first PNC check have been updated in the Phase 8 questionnaire (currently in use) (DHS Program, 2018), prior versions did not explicitly distinguish between delivery care and postnatal care for newborns, and

this lack of clarity was expressed by participants in the qualitative study in this dissertation. Estimates of coverage vary by whether this distinction was made or not (Amouzou et al., 2017). Additionally, timing of the first check is based on maternal recall of an event occurring at a stressful time when she may not be fully cognizant of her surroundings. **Third**, validation studies find that events that reflect pain or concern (e.g., cesarean section) are reported with higher accuracy than those that do not (Blanc et al., 2016a; Liu et al., 2013a; Stanton et al., 2013c; Tunçalp et al., 2013), and questions that refer to specific time periods tend to have low response levels and low validity (Blanc et al., 2016). Of the five interventions in this study, none directly measure events associated with pain or concern and two incorporate reports of time between birth and an event (i.e., ePNC and eBFI).

Limitations

The qualitative study explored participants' comprehension of PNC questions as they were worded in the 2014 KDHS (Phase 6). Since then, the DHS has updated its approach to make a clear distinction between intrapartum and postnatal care in the current questionnaire (Phase 8). This study included follow-up questions to make this distinction as well (which is a departure from the sequence in Phase 6), but it did not use the exact pattern from Phase 8, limiting the contribution this study can make to understanding how well the new sequence works in this population.

As with all qualitative research, the findings are not generalizable and are subject to my interpretation. As someone who is not Kenyan and has only visited the country once for three weeks, I have limited on-the-ground familiarity with the country context. However, I engaged a member of the research team to participate in

data analysis to support my interpretation of the findings. Additionally, my prior experience working for over a year in an urban informal settlement in Lahore, Pakistan and with primary data collection in low-income contexts enhanced my competence and the rigor of the research.

Directions for future research and practice

The findings from both Manuscripts 1 and 2 in this dissertation demonstrate the need for continued efforts to improve measures that capture intervention coverage. One would expect neonatal intervention coverage to map to patterns of neonatal mortality in urban Kenya, but this was not observed in the study, and one possible explanation for this is that the coverage estimates are informed by data from survey items with low validity. Another explanation is that quality of care is not directly measured in the interventions in this study, and it is likely that quality-adjusted measures of postnatal care would correspond better to health outcomes.

A next step for the quantitative research presented in this dissertation is to explore proxy measures for quality of PNC available in the 2014 KDHS dataset as well as in the 2022 wave (which has not been released as of the writing of this dissertation). Using a content-qualified coverage indicator for postnatal care, such as the one previously developed for antenatal care (called ANCq) (Arroyave et al., 2021), to estimate intra-urban variation in coverage may map better to observed neonatal mortality trends. The ANCq score incorporates items in the DHS that can approximate quality of antenatal care provided, such as whether blood pressure was measured, if urine and blood samples were taken, and if tetanus vaccination was completed before birth. Using items in the 2014 wave of the KDHS, the PNC-version

of the ANCq would be a score that captures the following: cadre of provider for birth and postnatal care, where the first PNC check took place (facility or other setting), timing of PNC check, if the baby was weighed at birth, early initiation of breastfeeding, if the baby was fed anything other than milk in the first three days, and provision of vaccines. The most recent version of the DHS questionnaire, Phase 8, includes additional items that can be incorporated into a PNCq measure (DHS Program, 2018). These include early skin-to-skin contact, pre-discharge PNC provider cadre, if the baby's umbilical cord was examined and temperature checked, if the mom was counseled on recognizing signs the baby needs immediate medical attention and on breastfeeding, if breastfeeding was observed, and timing of first hepatitis B and polio vaccinations. This suggested PNCq measure would still be based on mothers' self-reports and therefore subject to response biases. Maternal awareness of her newborn's care might be low for elements such as the umbilical cord being examined because it does not require her involvement, whereas it might be higher for skin-to-skin contact because she is directly involved. In addition to a summary PNCq measure, the relationship between coverage across settings should also be examined for each item individually.

Further, this work can be extended by considering the following: the role of ethnicity in predicting intervention coverage, other theoretical frameworks that might be more appropriate for examining this relationship, and alternative compositions of the place type variable. The politics of ethnicity have historically had implications for resource allocation in Kenya, where government funds and international aid has flowed more frequently to areas where the majority ethnicity matched that of sitting

or campaigning political leaders compared to those of different ethnicities (Briggs, 2014). Empirical research finds that this has had implications for development indicators such as access to skilled birth attendance, levels of education, and economic opportunity (Weinreb, 2001). In subsequent analyses, I will control for majority ethnicity at the district or cluster level for analysis. With respect to frameworks, there are several to choose from to guide the analysis and interpretation of the relationships between the variables in this study. I will continue to explore more options to find the best fit as the research question evolves. Finally, I will extend my analysis of household characteristics in the identification of clusters likely situated within informal settlements by furthering my use of the NUHDSS and applying additional sensitivity analyses to develop a more robust measure.

A next step for the qualitative research in this dissertation is continued work to understand socio-cultural influences that may impact women's responses to survey questions across diverse settings. For example, qualitative research methodologies, such as asking about perceptions about the appropriateness and commonness of a behavior in a participant's reference group, are well-suited for investigating social norms and beliefs about sensitive topics (Bicchieri, 2016; Cialdini & Trost, 1998). The findings from Manuscript 2 help contextualize coverage estimates for users of KDHS data, specifically those focused on urban informal settlements, and offer potential explanation for observed inconsistencies and unexpected patterns in relationships between intervention coverage and health benefit. Similar studies in other contexts (countries, settlement types) may also help explain spurious findings in those settings. Low overall rates of breastfeeding and early initiation in the Kenyan

context coupled with the misinformation participants in this study spoke about are concerning and should be prioritized.

At the larger, programmatic level, a multi-pronged approach is necessary for moving forward efforts to track neonatal health outcomes. **First**, linking routinely collected data in facility registers with household survey data would allow for a better understanding of the role of high-risk pregnancies in biasing mortality outcomes against facilities (Fink et al., 2015b) and help triangulate (or verify) self-reports. Facility registers, under ideal circumstances, document detailed health histories, visit reports, and care provided, including data that are ill-suited for capturing in household surveys with mothers.

Second, linking existing service provision assessment efforts (such as those by the DHS) with household survey data would allow for investigation of the role quality of care plays in biasing mortality outcomes against facilities and skilled birth attendants (who are most often facility-based) (Wall et al., 2010) while accounting for neighborhood-level characteristics. Household surveys collect detailed data on household characteristics, household members, dynamics between mothers and other household members (e.g., who has decision-making authority over small purchases), and approximate location. Together, these data offer insight into social determinants of health that are important for measuring health inequities.

Recognizing that linking facility-level data collection efforts with household-level data at scale across LMICs is a resource-intensive, lengthy process, individual-level approaches to improving measurement are also warranted. The global health community will likely continue to rely on survey programs like the DHS and MICS

for the foreseeable future to produce coverage estimates, so efforts should also focus on improving their quality through validation studies across diverse settings. The **third** recommendation is for country-wide or community-level efforts to increase awareness amongst mothers about care their newborns should receive. A mother who knows the importance of her baby receiving a PNC check within a specific timeframe (and the components of that check) may advocate for it, and in the process either learn that it has happened or ensure that it does. In contrast, a mother who is not aware of the importance of care during this critical time may assume that sufficient care is being provided to her newborn at a facility without knowing exactly what that entails. While the primary goal of such an effort would be to increase the number of newborns who receive adequate care at birth, a byproduct could be better data quality resulting from mothers who are engaged and informed about their baby's health.

Conclusion

This project set out to estimate intra-urban variation in coverage of five MNH interventions in Kenya and to explore influences on the validity of mothers' responses to household survey questions that measure those same interventions. This research found limited evidence for variation in coverage across informal settlements in cities, informal settlements in towns, and formal settlements in cities and towns. It found a range of factors that contribute to data validity, including issues with comprehension of key terms and the intended meaning of questions, unreliable means of determining answers to questions, and potential for social desirability bias. This work contributes to the broader goal of improving neonatal survival through increased coverage of

MNH interventions and to the literature that finds mixed evidence for the survival benefit of some of these interventions for newborns.

Appendices

Appendix A. Interview Guides

Provider Interview Guide

INTRODUCTION

Thank you for being here this [morning/afternoon/evening]. I am so pleased you were able to come. My name is _____, and I will be speaking with you today. I am working with a team consisting of researchers from Daystar University and the University of Maryland College Park, USA. This research is part of a doctoral student's research project. As you know, we are having a discussion to understand the healthcare women and babies receive in the intrapartum and immediate postnatal periods. We hope the findings from this research will help improve our understanding of how patients and providers communicate about delivery care. Findings from this research will be shared with you in the form of a report and will be published in academic journals. During the discussion, I will ask you to describe a common interaction between you and a patient who has come in to deliver her baby.

BACKGROUND

1. To begin with, I would like to know more about the different positions you have held in healthcare over time. When and where did you begin your practice of medicine?
 - i. *Probe on journey till present time*
 - ii. *Probe on total number of years of experience with labor and delivery*

2. Can you tell me a little about yourself and the work you do here (at present place of employment)?
 - i. *Hours/day, days/week/ weeks/month OR full-time/part-time*
3. Thank you for helping me to understand all of your experience to date. I would now like to ask you more specifically about the care you provide to women at the time of delivery and to their infants in the immediate post-natal period. Can you explain in detail:
 - a. All of your different responsibilities with providing care to women during labor and delivery
 - b. All of your different responsibilities with providing care to infants in the immediate post-natal period

MOTHERS' AWARENESS

Thank you for sharing those details with me. Next, I will list a series of questions, one by one, and ask you to share your thoughts on what you think your average patient would understand about the meaning of the question. What I mean by your average patient is the most common type of patient you see at your health facility. I will read you the survey questions as they are posed to women of reproductive age along with the response options and ask you what you think mothers interpret from the survey items. This exercise is meant to help us better understand how accurately women report care they and their newborns receive at health facilities in surveys. I will ask for your thoughts on how these questions might be improved so that the surveys capture accurate information. Do you have any questions about this before we start?

I would like you to imagine a ‘typical’ mother who gave birth here 1 year ago.

Imagine she is being asked these questions. We would like to understand your

thoughts on how well you expect her to be able to answer these questions:

1. The first question is: “Where did you give birth to [NAME]?” How do you think she would understand this question?
 - a. If they name a specific facility, how would she know if it is a public, private, or other type of facility?
 - b. How would she know whether a facility is classified as a hospital, clinic, health center, or something else?
 - c. How easy do you think most women would find this question?
 - d. How well do you think they would be able to distinguish between whether facility was a private, public, or other type of facility?
2. The second question is, “Who assisted with the delivery of [NAME]?”
 - a. What kinds of things do you think women in this community understand when they hear this question?
 - i. *Probe on differences in comprehension by education level and parity*
 - b. What is the process by which a woman would come to know the skill level of the person who assisted with the delivery?
 - c. What does ‘assisting with delivery’ mean to you?
3. The next question is, “In the two months after [NAME] was born, did any healthcare provider or traditional birth attendant check on his/her health?”

- a. How do you think a typical mother would understand the meaning of this question?
 - b. What does a ‘check’ mean to you in the context of this question?
 - c. What do you think a ‘check’ means to mothers?
 - d. How would a mother come to know if their baby’s health was checked while they were at the facility in a normal, uncomplicated pregnancy and delivery case?
4. The next question is, “How many hours, days, or weeks after the birth of [NAME] did the first check take place?”
- a. How easy do you think it would be for a typical mother to answer this question?
 - b. For checks that occur before discharge from the hospital, how accurate do you think mothers’ responses to this question are? Why?
 - i. *Probe for different scenarios (e.g., it happened in front of her, it did not happen in front of her)*
5. The next question is, “Who checked on [NAME]’s health at that time?”
- a. Assuming a mother knows their baby had a postnatal check, how would they know who performed it?
 - i. *Probe for different scenarios (e.g., it happened in front of her, it did not happen in front of her)*
 - b. How would they know the skill level of the person who performed it?
6. The next question is, “Did you ever breastfeed [NAME]?”
- a. What do women usually define “breastfeeding” as?

- i. *Probe for expressing and feeding with bottle or spoon, baby latching but not suckling, baby latching and suckling, baby had colostrum, or something else*

7. The next question is, “How long after birth did you first put [NAME] to the breast?”

- a. How might a woman know and remember the answer to this question?

CONCLUSION

Thank you for sharing all of this with me. Is there anything you would like to add or tell me about?

Thank you very much!

Mother Interview Guide

INTRODUCTION

Thank you for being here this [morning/afternoon/evening]. I am so pleased you decided to come. My name is _____, and I will be speaking with you today. I am working with a team of researchers from Daystar University and the University of Maryland College Park, USA. This research is part of a graduate student's research project. As you know, we are having a discussion to help us understand the healthcare you and your child received during childbirth and in the first few days after that. During the discussion, we will talk about your experiences with the delivery, with healthcare providers such as doctors and nurses, at healthcare facilities like hospitals and clinics, and caring for your baby. Your input will help us to understand how we can make maternal and child health services better for people in the community.

Asante kwa kukuja hapa leo. Nashukuru sana umepata nafasi ya kukuja. Jina langu ni _____ nitakua nazungumza na wewe leo. Nafanya kazi pamoja na kikundi, cha watafiti, kutoka Daystar University na University of Maryland College Park, USA. Tunafanya mazungumzo tukitaka kuelewa huduma za afya ambazo wewe na mtoto wako mlipata wakati wa kujifungua na siku chache baada ya kujifungua. Wakati wa mazunguzo tutaongea kuhusu yale ulioyapitia wakati wa kujifungua na wahudumu wa afya kama vile madaktari, manesi katika vituo vya afya kama hospitali na kliniki na utunzi wa mtoto wako. Maoni yako yatatusaidia kuelewa jinsi ambavyo tunaweza kuboresha huduma za akina mama na Watoto katika mtaa huu.

ICE BREAKER AND BACKGROUND INFORMATION

1. To begin with, can you tell me a little about yourself.

Tukianzia unaweza kuniambia kidogo kujihusu

- a. What is your favorite way to spend your free time?

Ni njia gani wewe unapenda kutumia muda wako wa ziada?

- b. Who all do you live with?

Unaishi na akina nani?

- c. How many children do you have?

Uko na Watoto wangapi?

- d. What is the highest level of education completed?

Umehitimu kiwango kipi cha juu Zaidi cha elimu?

- e. What do you do for work?

Je, wewe unajihusisha na shuguli gani ya kikazi?

- f. What is the income range of your household?

Mapato ya familia yako ni ya kiwango kipi?

- g. What is your marital status?

Hali yako ya ndoa ni ipi?

Thank you. Now I'll ask you to tell me the story of [NAME's] birth.

Asante, sasa nitakuuliza uniambie kuhusu kujifungua kwa [JINA].

COMMUNITY

1. Thank you so much for sharing this information with me. Now I would like to ask you about what people in your community think about maternal and

newborn health. Where do most people in this community think it is best to deliver their baby? Why?

Asante sana, kwa kunipatia hiyo habari. Sasa ningependa unielezee watu katika jamii hii fikiria aje kuhusu afya ya akina mama na watoto katika mtaa huu. Ni wapi watu katika mtaa huu hufikiria ni bora zaidi kujifungulia watoto wao? Kwa nini?

- i. *If “facility”, probe on type of facility (public/private/other), location*
- b. Would you say everyone feels this way, or do some people feel differently?

Unaweza sema kila mtu anahisi fikiria ama kuna watu wanahisi tofauti?

- i. *Probe on different perspectives between friends, neighbors, family, religious leaders, doctors, nurses, clinical officers, CHVs, TBAs*
- c. How do people in this community view mothers who deliver at public facilities?

Watu katika jamii hii huwa chukulia aje kina mama wanao jifungulia kwenye vituo vya afya za umma?

- d. How about those that deliver at private facilities?

Na je wale ambao hujifungulia kwenye vituo vya afya vya kibinafsi?

2. When mothers in this community are asked about where they delivered, do most usually give an honest answer? Why do you say that?

**Wakati kina mama katika jamii hii wanapoulizwa mahali walipo
jifungua je hao huwa wanapeana jibu la hakika? Kwa nini unasema
hivyo?**

What are the things people care about when they choose where to deliver their baby?

Ni vitu gani watu hujali wanapochagua mahali pa kujifungua mtoto?

- i. *Probes: what others will say, societal expectations*
- b. Are there any places that are considered bad places to give birth? If so, what makes them bad?

Kuna mahali ambapo watu huchukulia ni pabaya pakujifungulia?

Kama ni hivyo ni nini hupafanya kuwa pabaya?

- c. Are there any places that are considered good or superior to give birth? If so, what makes them good or superior?

Kuna mahali ambapo watu huchukulia ni pazuri pakujifungulia?

Kama ni hivyo ni nini hupafanya kuwa pazuri ama bora zaidi?

- d. In this community, what are people's opinions on giving birth in public vs private facilities?

**Jamii hii ina maoni gani kumusu watukujifungulia kwenye vituo
vya afya vya umma ama vya kibinafsi?**

3. Who do most people in this community think it's best to attend/supervise births? Why?

**Ni nani watu katika hii jamii hufikiria ni bora zaidi kuwa hudumia
wanapo jifungua/kuwa simamia? Kwa nini?**

*i. Probe on different perspectives between friends, family,
religious leaders, healthcare providers, CHVs, TBAs, others*

*b. Are there any types of people that are considered bad birth attendants?
If so, what makes them bad?*

**Kuna aina ya watu ambao huchukuliwa ni wabaya kuhudumia
mtu anapojifungua? Kama ni hivyo ni nini inawafanya kudhaniwa
wabaya?**

**4. How do most people in this community view postnatal health checks for the
baby?**

**Watu wengi katika hii jamii huchukulia vipi kukaguliwa afya kwa watoto
baada ya kuzaliwa?**

*i. Probe on timing, by whom, number of checks, what things are
checked for*

b. What are the reasons people might choose to have one done?

**Ni sababu zipi ambazo watu wangependelea mtoto wao
akaguliwe?**

*c. Are there reasons why people in this community would choose not to
have one done?*

**Je, kuna sababu zipi ambazo watu hawangependelea mtoto wao
akaguliwe?**

5. What do people in this community know about breastfeeding?

Watu katika jamii hii wanajua nini kuhusu kunyonyesha watoto?

- i. *Probes: importance, health benefits to mom/child, health risks to mom/child, colostrum, recommended initiation time, duration, exclusive breastfeeding*
- b. Where do most people get this information from?

Watu wengi hupata habari hii kutoka wapi?

6. What do people in this community think about breastfeeding?

Watu katika jamii hii wana fikira zipi kuhusu kunyonyesha?

- i. *Probes: importance, duration, how common it is, colostrum, exclusive breastfeeding, peer pressure/social expectation to breastfeed or not to breastfeed*
- b. How do people feel about initiating early, that is, within the first 60 minutes after giving birth?

Watu huhisi vipi kuhusu kuanzisha kunyonyesha katika dakika 60 za kwanza mtoto anapozaliwa?

- i. *Probes: positive and negative perceptions, importance, norms, traditions, practicality, how common it is, if not common, why not?*
- c. What are all the reasons people would initiate in the first 60 minutes?
(Facilitators)

Ni sababu zipi hufanya watu wanyonyeshe Watoto dakika 60 za kwanza?

- i. What are all the reasons people might not initiate in the first 60 minutes? (Barriers)

Ni sababu zipi hufanya watu wasinyonyeshe Watoto dakika 60 za kwanza? (Vizuizi)

- d. Imagine someone in this community recently had a baby and she chose to breastfeed. How do you think other people in the community would view that?

Fikiria kuwa mtu katika jamii hii alipata mtoto hivi karibuni na akaamua kumyonyesha. Unafikiria watu katika jamii hii wataichukulia vipi?

- e. How would they view it if she decided not to breastfeed?

Wataichukulia aje akikataa kunyonyesha?

BREAK FOR 5-10 MINUTES

COGNITIVE INTERVIEW

Thank you. Next, I'll ask you some specific questions about things that may have happened at the time [NAME] was born and afterwards. I need your help because I am trying to understand how well some of these questions are being asked in big surveys. We are looking for your help in making them better. I'll ask you questions, and then I'll ask you if you think the question was clear and how you understand some of the words. We are trying to understand what these things mean for you so we can make the questions better for everyone. If you do not know or remember the answer to a question, please say so. Do you have any questions before we begin?

Asante sana. Sasa nitakuuliza maswali maalum kuhusu wakati ambapo [JINA] alipozaliwa na baadaye. Nahitaji usaidizi wako kwa sababu najaribu kuelewa maswali yanayoulizwa vyema katika utafiti kubwa. Tunataka usaidizi wako kuyaboresha. Nitakuuliza maswali halafu nitakuuliza kama swali hilo lilikuwa linaeleweka na jinsi ambavyo ulielewa maneno mengine. Tunajaribu vitu hivi vinamaana gani kwako ilituboreshe maswali kwa kila mtu. Iwapo hujui ama hukumbuki jibu kwa swali yoyote tafadhali sema. Unaswali yeyote kabla tuanze?

7. Where did you give birth to [NAME]?

Ulijifungulia wapi [JINA]?

i. Probe to identify the type of place (i.e., home, public or private facility, other)

b. (If any type of facility), how did you learn that this facility was [TYPE OF PLACE MENTIONED ABOVE]?

Ulijua aje kuwa kituo hicho cha afya hii ni cha aina gani?

c. Now I will read a list of options. Can you please tell me which one best describes your answer to this question?

Sasa nitakusomea orodha ya majina yafuatayo. Tafadhali nieleze ni ipi kati ya orodha hii inashiria jibu la swali hili?

HOME: YOUR HOME, OTHER HOME

PUBLIC: GOVERNMENT HOSPITAL, GOVERNMENT HEALTH CENTER, GOVERNMENT DISPENSARY, OTHER PUBLIC SECTOR

PRIVATE: MISSION HOSPITAL/CLINIC, PRIVATE
HOSPITAL/CLINIC, NURSING/ MATERNITY HOME, OTHER
PRIVATE MEDICAL SECTOR,
OTHER: OTHER, DON'T KNOW, NOT SURE

8. ho assisted with the delivery of [NAME]? Anyone else?

Ni nani aliyekusaidia kujifungua [JINA]? Nani mwingine?

- i. Probe for the type(s) of person(s) and record all mentioned.*
- b. Can you say a little more about how you came to know this person was a [SKILL LEVEL OF PERSON MENTIONED]? *Repeat for each person mentioned in 8A.*

Unaeza nieleza kidogo kuhusu jinsi ambavyo ulijua mtu huyu ni [SKILL LEVEL OF PERSON MENTIONED]

- c. How long were they with you? *Repeat for each person mentioned in 8A.*

Walikuwa na wewe kwa muda gani?

- d. What was happening during that time?

Ni nini kilifanyika wakati huo?

- e. What does it mean for someone to ‘assist with delivery’?

Inamaanisha nini mtu kusema ‘Kusaidiwa kujifungua’?

- f. Now I will read a list of options. Can you please tell me which one best describes your answer to the question about who assisted with [NAME]’s delivery?

Sasa nitakusomea orodha ya majina yafuatayo. Tafadhali nieleze

**ni ipi inashiria jibu la swali kuhusu nani alisaidia kujifungua
[JINA]?**

DOCTOR, NURSE/MIDWIFE, COMMUNITY HEALTH WORKER,
TRADITIONAL BIRTH ATTENDANT, RELATIVE/FRIEND,
OTHER, NO ONE ASSISTED

- g. Can you say this question in your own words, “Who assisted with the delivery of [NAME]?”?

**Unaweza kurudia swali hili ukitumia maneno yako, “Nani
alisaidia kujifungua [JINA]?”**

9. In the two months after [NAME] was born, did any healthcare provider or a traditional birth attendant check on his/her health?

**Katika miezi miwili baada ya [Jina] kuzaliwa, kuna mhudumu yeyote wa
afya au mkunga wa kitamaduni alikagua afya ya [JINA]**

- a. What does ‘healthcare provider’ mean to you?

Mhudumu wa afya inamanisha nini kwako?

- b. Who are all the people you consider to be a healthcare provider?

Ni akina nani ambao unazingatia kuwa ni wahudumu wa afya?

- c. What does it mean for a baby’s health to be checked?

Inamaana gani kwako afya mtoto kukaguliwa?

- d. What are all the things that should be examined during a check?

**Ni vitu gani vyote ambavyo vinafaa kukaguliwa wakati wa
ukaguzi?**

- e. Imagine a TBA visited your neighbor's baby a few days after birth.

Would you consider this to be a health check? Why?

Fikiria mkunga wa kitamaduni amemtembelea Jirani yako siku chache baada ya kujifungua. Utazingatia hii kuwa ukaguzi wa afya? Kwa nini?

- f. Now I will repeat the question I asked earlier, and I would like you to tell me what it means to you. The question is: "In the two months after [NAME] was born, did any healthcare provider or a traditional birth attendant check on his/her health?". What does this question mean to you?

Sasa ni tarudia swali ambalo nilikuhuliza hapo awali na ningependa unieleze lina maana gani kwako. Swali: "Katika miezi miwili baada ya [Jina] kuzaliwa, kuna mhudumu yeyote wa afya au mkunga wa kitamaduni alikagua afya ya [JINA]?" Swali hili lina maana gani kwako?

- 10.** How many hours, days, or weeks after the birth of [NAME] did the first check take place?

Ukaguzi wa kwanza wa [JINA] ulifanyika baada ya masaa, siku au wiki ngapi baada ya kuzaliwa?

- a. What helped you remember the answer to this question?

Ni nini imekusaidia kukumbuka jibu la swali hili?

- 11.** Who checked on [NAME]'s health at that time?

Ni nani aliyekagua afya ya [JINA] wakati huo?

- i. *Probe for most qualified person*
- b. How did you learn that this person was [SKILL LEVEL OF PERSON MENTIONED]? *Ask for each person mentioned.*

Uliweza kujua vipi [SKILL LEVEL OF PERSON MENTIONED]? *Ask for each person mentioned.*

- c. Now I will read a list of options. Can you please tell me which one best describes your answer to the question about who checked on [NAME]'s health?

**Sasa nitakusomea orodha ya majina yafuatayo. Tafadhali nieleze ni ipi inashiria jibu la swali kuhusu nani alikagua afya ya [JINA]?
DOCTOR, NURSE/MIDWIFE, COMMUNITY HEALTH
WORKER/VOLUNTEER, TRADITIONAL BIRTH ATTENDANT,
RELATIVE/FRIEND, OTHER, NO ONE CHECKED**

12. Did you ever breastfeed [NAME]?

Uliwahi kunyonyesha [JINA]

- a. Can you tell me a little more about the first time you breastfed [NAME]?

Nielezee kidogo kuhusu mara ya kwanza ulimnyonyesha [JINA]

- i. *Probe for whether she expressed milk and fed with bottle or spoon, baby latched but did not suckle, baby latched and suckled, baby had colostrum, or something else*
 - b. What all counts as breastfeeding?
- Nini inahesabika kama kunyonyesha?**

- i. *Probe for whether this includes milk expressed from the breast and then given to the baby (via bottle, spoon, etc.), baby successfully suckles directly from breast, an attempt for baby to suckle was made but was unsuccessful*

13. (If ever breastfed) How long after birth did you first put [NAME] to the breast?

(iwapo uliwahi kunyonyesha) Ilikuchukua muda gani baada ya kujifungua kumuweka [JINA] kwenye titi?

- a. What helped you remember the answer to this question?

Ni nini imekusaidia kukumbuka jibu la swali hili?

CONCLUSION

Thank you for sharing all of this with me. Is there anything you would like to add or tell me about?

Asante kwa kuzugumza na mimi.kuna kitu ungependa kuongeza au kuniambia?

Thank you very much!

Asante sana!

Appendix B. Eligibility Surveys

Provider Eligibility Survey

Q#	Question	Answer	End interview IF
1	How old are you?		<18
2	How long have you worked at this facility for?		<1 year; probe to find out if they worked in any other Vwandi/Kgcho facility for a combined period of >1 year
3	In your role at this facility, do you routinely manage labor and deliveries?		No
4	In your role at this facility, do you routinely manage neonates?		_____
5	Have you received formal training to manage labor and deliveries?		No

Mother Eligibility Survey

INITIAL ELIGIBILITY QUESTIONS

Q#	Question	Answer	End interview IF
1	How old are you? Una miaka ngapi?		<18
2	Are you fluent in English or Kiswahili? Unaweza kuzungumza kingereza ama Kiswahili?	Yes/No English; Yes/No Kiswahili	Fluent in neither language
3	Where do you live? <i>Probe for Korogocho or Viwandani</i> Unaishi wapi?		Not Korogocho or Viwandani
4	How long have you lived in Korogocho/Viwandani for? Umeishi hapa kwa muda gani?		<1 year in Korogocho or Viwandani

ADDITIONAL ELIGIBILITY QUESTIONS

Q#	Question	Answer	End interview IF
1	How old is your youngest child? Mtoto wako mchanga ana umri gani?	___ years ___ months ___ weeks	Age is <2 weeks OR >2 years
2	What is the gender of this child? Ni wa jinsia gani?	Male or female	
3	What is his/her [NAME]? Anaitwa nani?		
4	Where did you give birth to [NAME]? Ulijifungulia wapi?		Not Tumaini, Korogocho Health Centre, Cana, or Makadara
5	Was [NAME] delivered by caesarean? Ulijifungua kwa njia ya upasuaji?		Yes, baby delivered by c-section
6	After you delivered [NAME], did you experience postpartum hemorrhaging?		Yes, hemorrhaged

	Baada ya kujifungua ulitoka damu nyingi isiyo kuwa ya kawaida?		
7	After you delivered [NAME], did you experience loss of consciousness? Baada ya kujifungua ulipoteza fahamu?		Yes, lost consciousness
8	After [NAME] was born, did s/he require neonatal resuscitation or experience loss of consciousness? Baada ya mtoto kuzaliwa alihitaji usaidizi wa kupumuwa ama alipoteza fahamu?		Yes, required resuscitation AND/OR lost consciousness
9	Was [NAME] taken to the nursery after birth? If yes, why? [NAME] alipelekwa nursery baada ya kuzaliwa? Kama ndio, kwa nini?		<i>Decide</i>
10	Was [NAME] born with any complications?		Yes, was born with complication(s)

	Mtoto alizaliwa na shida yoyote?		
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Appendix C. Consent Forms

Provider Consent Form



Institutional Review Board

1204 Marie Mount Hall • 7814 Regents Drive • College Park, MD 20742 • 301-405-4212 • irb@umd.edu

CONSENT TO PARTICIPATE Providers

Project Title	Improving data quality from household surveys about neonatal health interventions
Purpose of the Study	This research is being conducted by Sr Professor Agnes L. Lando at Daystar University and Sacha St-Onge Ahmad at the University of Maryland, College Park. We are inviting you to participate in this research project because you have been providing healthcare to newborns and mothers in labor in facilities that serve Korogocho and/or Viwandani for at least one year. The purpose of this research project is to identify ways to improve the accuracy of and better understand findings from household surveys about newborn health.
Procedures	A trained researcher will conduct an interview with you in a private space at this health facility. An additional researcher may be present to take notes during the interview. You will be asked to share what you know and think about communication that occurs between patients and providers during labor and delivery. You will also be asked to share what you think about how women understand and respond to survey questions about the care they and their newborns receive during labor and delivery. For example, we may ask a question like, ‘What are your thoughts on how well a mother who visits this facility understands the question, ‘Who assisted with the delivery of your most recent baby?’’. We are not looking for any particular responses, so there are no correct or wrong answers. Finally, you will be asked to engage a role play exercise where we will pretend I am a woman about to deliver her baby and you are the provider. You will be asked to describe how that interaction usually goes from start to finish.

	If you agree to take part in this study, you will be first required to sign a form that shows that you have given your permission and you would like to take part in this study. The interview will take 60-90 minutes to complete. We would like to use a voice recorder (no video) to record our conversation so that we can listen to the recording in case we miss anything you say in the notes. If at any time during the interview, you do not want to answer any of the questions we are asking for any reasons, you are free not to answer them, and you have the right to stop the interview at any time.
Potential Risks and Discomforts	There may be some risks from participating in this research study. Some of the questions we ask may make you feel uncomfortable. You do not have to answer any question you do not want to. If you have any questions about the questions I ask, please let us know. It is also possible that someone who walks by us will hear parts of our conversation. If someone comes close, we will stop talking until they can no longer hear us. Please let me know if you would like to sit somewhere else.
Potential Benefits	There are no direct benefits from participating in this research. However, we hope the information you provide will contribute towards a better understanding of how the quality of data from household surveys on labor and delivery care may be improved, and we hope that this will ultimately benefit people in this community.
Confidentiality	We will not ask you for your telephone number or any other contact information. We will not share your personal information with other people in this study. We will keep all the personal information you share secret. We will not use any names in our notes or in any reports or presentations about this study to make sure that no one else can tell who provided these responses. We will use the signed consent forms only for this research. We will keep all the information in a locked cabinet. We will take the recorder to an office, which will be locked and only a small number of people from the research team will be able to listen to the recording. We will save all the recordings and other electronic data on computers that will be locked with a password, and only members of the research team will have access to them. After the interview, we will remove the first few minutes of introductions to ensure that there are no names on the recording. We will destroy all the recordings and other information after we have completed our analysis. If we write a report or article about this research project, your identity will be protected to the maximum extent possible. Your

	information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law.
Compensation	You will receive KES 1,000.
Right to Withdraw and Questions	Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify. If you decide to stop taking part in the study, if you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator: Sr Professor Agnes L. Lando Principal Investigator Director of Research & Graduate Studies Chair, Daystar University Ethics & Review Board Email: allando2014@gmail.com Sacha St-Onge Ahmad Co-Principal Investigator 4200 Valley Drive, University of Maryland School of Public Health, College Park, Maryland, 20740, USA Email: ssoa@umd.edu Milka Omuya Project Coordinator Email: omuya.milka@gmail.com Telephone: 0721453966
Participant Rights	If you have questions about your rights as a research participant or wish to report a research-related injury, please contact: University of Maryland College Park

	Institutional Review Board Office 1204 Marie Mount Hall College Park, Maryland, 20742 E-mail: irb@umd.edu Telephone: +1-301-405-0678 For more information regarding participant rights, please visit: https://research.umd.edu/irb-research-participants This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.	
Statement of Consent	Your signature indicates that you are at least 18 years of age; you have read this consent form or have had it read to you; your questions have been answered to your satisfaction; you voluntarily agree to participate in this research study; and you consent to the interview being audio-recorded. You will receive a copy of this signed consent form. If you agree to participate, please sign your name below.	
Signature and Date	NAME OF PARTICIPANT [Please Print]	
	SIGNATURE OF PARTICIPANT	
	DATE	

Mother Consent Form



Institutional Review Board

1204 Marie Mount Hall • 7814 Regents Drive • College Park, MD 20742 • 301-405-4212 • irb@umd.edu

CONSENT TO PARTICIPATE

Mothers

Project Title	Improving data quality from household surveys about neonatal health interventions
Purpose of the Study	This research is being conducted by Sr Professor Agnes L. Lando at Daystar University and Sacha St-Onge Ahmad at the University of Maryland, College Park, United States. We are inviting you to participate in this research project because you recently gave birth at a public or private healthcare facility in or near Korogocho or Viwandani, and because you have lived in this area for at least one year prior to giving birth. The purpose of this research project is to identify ways to improve the accuracy of and better understand findings from household surveys about newborn health. Utafiti huu unafanywa na Sr Professor Agnes L. Lando kutoka Daystar University na Sacha St-Onge Ahmad kutoka Maryland, College Park, United States. Tunakualika kushiriki katika utafiti huu kwa sababu ulijifungua hivi majuzi katika kituo cha afya cha umma au kibinafsi hapa ama karibu na Korogocho/Viwandani, na kwa sababu umeishi hapa kwa muda wa mwaka mmoja kabla ujifungue. Lengo la utafiti huu ni kutambua njia za kuboresha usahihi na kuweza kuelewa vyema matokeo kutoka kwa utafiti utakaopatikana kutoka kwa kina mama kuhusu afya ya watoto wachanga.
Procedures	I am a trained researcher who will conduct an interview with you in a in this space. An additional researcher may be present to take notes during the interview. You will be asked to share your experiences of giving birth to your most recent child and details around conversations you had with providers during your stay at the health facility. The interviewer will also ask you questions about care you and

	your newborn received during labor and delivery, and then ask you to speak about how you interpreted those questions. For example, you will be asked, ‘Who assisted with the delivery of your youngest baby?’, and then you will be asked, ‘What does it mean for someone to ‘assist with delivery?’ Finally, you will be asked to share your thoughts on how people in this area feel about receiving care during labor and delivery. We are not looking for any particular responses, so there are no correct or wrong answers. If you agree to take part in this study, you will be first required to sign a form that shows that you have given your permission and you would like to take part in this study. The interview will take 60-90 minutes to complete. We would like to use a voice recorder (no video) to record our conversation so that we can listen to the recording in case we miss anything you say in the notes. We will begin recording after we finish introducing ourselves so that no identifiers will be in the recording. If at any time during the interview you do not want to answer a question for any reason, you are free not to answer them. You have the right to stop the interview at any time. Mtafiti aliyepata mafunzo atazungumza na wewe katika sehemu iliyotengwa hapa kwenye mtaa wako. Mtafiti mwingine anaweza kuwa hapo ili aweze kuandika yale ambayo mtakuwa mkizungumza. Utatakiwa kuelezea kuhusu kujifungua kwako kwa hivi karibuni na mazungumzo ambayo ulikuwa nayo na wahudumu wa afya ulipokuwa hospitali. Mtafiti atakuuliza kuhusu utunzi ulioupokea wewe na mtoto wako ulipokuwa ukiumwa na ulipokuwa unajifungua, halafu atakuuliza uzungumzie kuhusu jinsi ambavyo ulitafsiri maswali hayo. Kwa mfano, utaulizwa, ‘Ni nani alikusaidia kujifungua mtoto wako mchanga?’, halafu utaulizwa ‘ni nini maana ya ‘mtu kukusaidia kujifungua?’. Mwisho utaulizwa upeane hisia zako kuhusu jinsi ambavyo watu katika mtaa huu wanahisi kuhusu kupokea utunzi rasmi wanapokuwa wanaumwa na wanapokuwa wanajingua. Hakuna majibu rasmi tunayotarajia, hivyo basi hakuna jibu sahihi ama jibu lisilo sahihi.
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	Ukikubali kushiriki katika utafiti huu, Utatakiwa kutia sahihi katika fomu ili kuonyesha kuwa umekubali kushiriki katika utafiti huu. Mazungumzo yatachukua kati ya dakika 60-90 kukamilika. Tungependa kurekodi (hakuna video) mazungumzo yetu ili tuweze kuskiza baadaye iwapo kuna kitu tutakosea chochote. Tuta anza kurekodi baada ya kujitambulisha ili kusikuwe na habari yoyote ya kukutambulisha. Iwapo utataka kukosa kujibu swali yoyote wakati wa mazungumzo, una uhuru wa kukataa kujibu maswali hayo. Pia una uhuru wa kusitisha mazungumzo wakati wowote unaoutaka.
Potential Risks and Discomforts	There may be some risks from participating in this research study. Some of the questions we ask may make you feel uncomfortable. You do not have to answer any question you do not want to. If you have any questions about the questions I ask, please let me know. It is also possible that someone who walks by us will hear parts of our conversation. If someone comes close, we will stop talking until they can no longer hear us. Please let me know if you would like to sit somewhere else. Kuna weza kuwa na madhara kidogo kutoka kwako kushiriki katika utafiti huu. Maswali mengine yanaweza kukufanya ujihisi una wasiwasi. Sio lazima ujibu swali yoyote ambayo hutaki kujibu. Iwapo una swali yoyote kuhusu maswali unayoulizwa, tafadhali tujulishe. Inawezekana kuwa mtu anayepita karibu na sisi, atasikia baadhi ya mazungumzo yetu. Iwapo mtu atatukaribia, tutawacha kuzungumza mpaka aache kusikia mazungumzo yetu. Tafadhali nieleze iwapo ungependa kukaa mahali pengine.
Potential Benefits	There are no direct benefits from participating in this research. However, we hope the information you provide will contribute towards a better understanding of how the quality of data from household surveys on labor and delivery care may be improved, and we hope that this will ultimately benefit people in this community. Hakuna faida ya moja kwa moja utakayopata kutokana na kushiriki katika utafiti huu. Ila tunatumai kuwa habari utakazotupatia zitachangia kwa kuelewa vyema ubora wa data kutoka kwa nyumba kuhusu kuumwa na kujifungua utakavoimarishwa, na tunatumai kuwa hili litanufaisha jamii hii.

Confidentiality	During the interview, we will not ask you for your telephone number or any other contact information. We will not share your personal information with other participants in this study. We will not use any names in our notes or in any reports or presentations about this study to make sure that no one else can tell who provided these responses. We will use the signed consent forms only for this research. We will keep all the information in a locked cabinet. We will take the recorder to an office, which will be locked and only a small number of people from the research team will be able to listen to the recording. We will save all the recordings and other electronic data on computers that will be locked with a password, and only members of the research team will have access to them. We will destroy all the recordings and other information after we have completed our analysis. If we write a report or article about this research project, your identity will be protected to the maximum extent possible. Your information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law. Hatutakuuliza nambari yako ya simu au ya mtu mwingine. Hatutapeana taarifa yako kwa washiriki wengine. Tutaweka taarifa yako yote ya kibinafsi kwa usiri, hata kutoka kwako. Hatutatumia majina katika maandishi yetu au ripoti au nakala kuhusu utafiti huu ili kuhakikisha kuwa hakuna atakayejua ni nani alipeana majibu haya. Tutatumia fomu za kibali zilizotiwa sahihi kwa minajili ya utafiti huu. Tutaweka habari zote kwenye kabati iliyofungwa. Tutapeleka kinasu sauti kwa ofisi itakayofungwa na ni watu wachache tu miongoni mwa timu ya watafiti watakaoweza kusikiza ujumbe huo. Tutahifadhi rekodi zote na habari kwenye kompyuta itakayofungwa na nywira, na timu ya watafiti tu ndio watakaoweza kifikia. Tutaharibu rekodi zote na habari zote tukimaliza uchambuzi. Tukiandika ripoti ama Makala kuhusu utafiti, habari zako za kibinafsi zitalindwa kwa njia ya juu. Habari zako zinaweza kupeanwa kwa wasimamizi kutoka university ya Maryland, College Park ama serikali iwapo wewe ama mtu mwingine yuko katika hatari ama iwapo tutahitajika kufanya hivyo kisheria.
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Compensation	You will receive KES 570 as compensation for your time. Utapokea shilling 570 kama fidia ya muda wako.
Right to Withdraw and Questions	Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify. Kushiriki kwako katika utafiti huu ni kwa kujitolea. Unaweza kuchagua kutoshiriki kabisa. Ukikubali kushiriki katika utafiti huu, unaweza kusitisha mazungumzo kwa wakati wowote. Hutaadhibiwa au kupoteza manufaa yoyote iwapo utakataa kushiriki ama ukisitisha mazungumzo. If you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator: Iwapo una maswali, wasiwasi ama malalamishi, ama iwapo unahitaji kuripoti jeraha kutokana na utafiti huu, tafadhali wasiliana na: Sr Professor Agnes L. Lando Principal Investigator Director of Research & Graduate Studies Chair, Daystar University Ethics & Review Board Email: allando2014@gmail.com Sacha St-Onge Ahmad Co-Principal Investigator 4200 Valley Drive, University of Maryland School of Public Health, College Park, Maryland, 20740, USA Email: ssoa@umd.edu Milka Omuya Project Coordinator Email: omuya.milka@gmail.com Rose Omol Community Health Volunteer, Korogocho Telephone: 0720913375

Participant Rights	If you have questions about your rights as a research participant or wish to report a research-related injury, please contact: Iwapo una maswali kuhusu haki zako kama mshirika ama ungependa kuripoti jeraha kutoka na utafiti huu, tafadhali wasiliana na: University of Maryland College Park Institutional Review Board Office 1204 Marie Mount Hall College Park, Maryland, 20742 United States of America E-mail: irb@umd.edu Telephone: +1-301-405-0678 For more information regarding participant rights, please visit: https://research.umd.edu/irb-research-participants This research has been reviewed according to the University of Maryland, College Park Institutional Review Board and Daystar University Ethical Review Board procedures for research involving human subjects. Utafiti huu umeidhinishwa na taratibu kulingana na Chuo kikuu cha Maryland, College Park Institutional Review Board na Daystar University Ethical Review Board zinazohusisha binadamu. Do you have any questions for me about what you have read/I have read to you so far? Je una maswali kuhusiana na yale ambayo umesoma/nimekusomea hadi sasa?
Statement of Consent	Your signature indicates that you are at least 18 years of age; you have read this consent form or have had it read to you; your questions have been answered to your satisfaction; you voluntarily agree to participate in this research study; and you consent to the interview being audio-recorded. You will receive a copy of this signed consent form. Sahihi yako ni dhibitisho kuwa umehitimu/una umri wa miaka 18 na zaidi; umesoma fomu hii ya idhini au umesomewa; maswali yako yamejibiwa kwa kuridhika kwako na unakubali kwa hiari kushiriki katika utafiti huu. Utapokea nakala ya fomu hii ya idhini iliyosainiwa.

	If you agree to participate, please sign your name below. Iwapo unakubali kushiriki, tafadhali tia sahihi hapa chini:	
Signature and Date	NAME OF PARTICIPANT [Please Print]	
	SIGNATURE OF PARTICIPANT	
	DATE	

Appendix D. Research Approvals, Licenses, and Authorizations

Daystar University Ethics Review Board Approval Letter

VERDICT – APPROVAL WITH COMMENTS

Daystar University Ethics Review Board

Our Ref: DU-ERB/10/05/2022/000647

Date: 10th May 2022

To: Agnes Lucy Lando,

Dear A.L. Lando,

RE: IMPROVING DATA QUALITY FROM HOUSEHOLD SURVEYS ABOUT NEONATAL HEALTH INTERVENTIONS

Reference is made to your ERB application reference no. 040522-01 dated 4th May 2022 in which you requested for ethical approval of your proposal by Daystar University Ethics Review Board.

We are pleased to inform you that ethical review has been done and the **verdict is to revise as per the attached comments and then proceed to the next stage**. As guidance, ensure that the attached comments are addressed. Please be advised that it is an offence to proceed to collect data without addressing the concerns of Ethics Review board. Your application approval number is **DU-ERB-000647**. The approval period for the research is between **10th May 2022 to 9th May 2023** after which the ethical approval lapses. Should you wish to continue with the research after the lapse, you will be required to apply for an extension from DU-ERB at half the review charges.

This approval is subject to compliance with the following requirements.

- i. Only approved documents including (informed consents, study instruments, MTA) will be used.
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by Daystar University Ethics Review Board.
- iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to Daystar University Ethics Review Board within 72 hours of notification.
- iv. Any changes anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to Daystar University Ethics Review Board within 72 hours.
- v. Clearance for export of biological specimens must be obtained from relevant institutions.
- vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- vii. Submission of a signed one page executive summary report and a closure report within 90 days upon completion of the study to Daystar University Ethics Review Board via email [duerb@daystar.ac.ke].

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI)
<https://research-portal.nacosti.go.ke> and other clearances needed.

Yours sincerely,



Dr. Susan Muriungi PhD
Vice Chair, Daystar University Ethics Review Board



Encl. Review Report

...until the day dawn and the
DAYSTAR arise in your hearts!
2 Peter 1:19 KJV

University of Maryland Institutional Review Board Approval Letter



1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
FAX 301.314.1475
irb@umd.edu
www.umresearch.umd.edu/IRB

DATE: April 28, 2022

TO: Sacha St-Onge Ahmad, MPH
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [1877019-1] Improving data quality from household surveys about neonatal health interventions

REFERENCE #:
SUBMISSION TYPE: New Project

ACTION: APPROVED
APPROVAL DATE: April 28, 2022

REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # 7

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Prior to final approval of this project scientific review was completed by the IRB Member reviewer.

This submission has received Expedited Review based on the applicable federal regulations.

This project has been determined to be a MINIMAL RISK project.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Unless a consent waiver or alteration has been approved, Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate Amendment forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed. All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Please note that all research records must be retained for a minimum of seven years after the completion of the project.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

Nairobi Metropolitan Services Research Authorization Letter



REPUBLIC OF KENYA
EXECUTIVE OFFICE OF THE PRESIDENT
NAIROBI METROPOLITAN SERVICES

Att faculty exchange Nairobi City
SCCSFP
Kindly assist the researcher the
necessary assistance.
Vik Dr Nelly Didi

Telegraphic Address
Telephone +3313002/4
When replying please quote

Kenyatta International Convention Centre
P. O. Box 49130-00100
NAIROBI

REF: EOP/NMS/HS/183

DATE: 12th July, 2022

SR. PROF. AGNES LUCY N. LANDO
DAYSTAR UNIVERSITY
NAIROBI.

Dear Sr. Prof. Agnes,

RE: RESEARCH AUTHORIZATION

This is to inform you that the Nairobi Metropolitan Services - Health Directorate's Research Ethics Committee (REC) reviewed the documents on the study titled "Improving data quality from household surveys about neonatal health interventions."

I am pleased to inform you that you have been authorized to carry out the study Korogocho and Viwandani in Nairobi County. The researcher will be required to adhere to the ethical code of conduct for health research in accordance to the Science Technology and Innovation Act, 2013 and the approval procedure and protocol for research for Nairobi.

On completion of the study, you will submit one hard copy and one copy in PDF of the research findings to the REC. In addition, you will disseminate recommendations of the research at a virtual meeting organized by the REC. By copy of this letter, the Sub County Medical Officers of Health – Kasarani and Makadara are to accord you the necessary assistance to carry out this research study.

Yours sincerely,

DR. ANDREW TORO
CHAIR – RESEARCH ETHICS COMMITTEE

Cc: Director Health Services
Sub County Medical Officers of Health – Kasarani and Makadara

National Commission for Science, Technology & Innovation Research License

 REPUBLIC OF KENYA	 NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
Ref No: 323550	Date of Issue: 22/June/2022
RESEARCH LICENSE	
	
This is to Certify that Prof.. Agnes Lucy .N. Lando of Daystar University, has been licensed to conduct research in Nairobi on the topic: Improving data quality from household surveys about neonatal health interventions for the period ending : 22/June/2023.	
License No: NACOSTI/P/22/18246	
323550	
Applicant Identification Number	Director General
	NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
	Verification QR Code
	
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Appendix E. Findings from Quality Checks Performed on Data from 2013 and 2016 PAMANECH and 2018 ProSHI Surveys

2013 PAMANECH data

1. Extremely high response rate
 - According to APHRC's study description [\[38\]](#), PAMANECH's randomly drawn sample included 849 women of reproductive age (ages 12-49) with a 100% response rate.
2. Unexplained missing data
 - 97 of 606 (16%) women who said they have ever been pregnant have a missing response to the question, "Where is [NAME]?" in reference to the child from the last pregnancy. Response options were child at home, child not at home, child dead. Of the 97 missing responses, 5 were from women who were currently pregnant for the first time (so they would have had no child to refer to). No explanation for the remaining 92 missing responses, which is 15.3% of the 606 women who reported ever being pregnant. Pregnancy loss is a possible explanation for high missingness, but miscarriage, stillbirth, and death after a live birth were recorded separately (i.e., this outcome was addressed in the survey in specific questions).
 - 14% missing responses on skilled birth attendance (outcome variable)
 - 19% missing responses on timing of postnatal care (outcome variable)
 - 19% missing responses on skilled postnatal care (outcome variable)

- Logistic regression results suggest several maternal sociodemographic characteristics were predictive of missingness in variables used to calculate outcome or eligibility for analysis. See table below for breakdown.

Logistic regression results for sociodemographic variables that are significantly predictive of missingness in variables used to calculate outcome or eligibility for analysis				
<i>Outcome variable</i>	Income	Education	Age	Korogocho or Viwandani
<i>PNC timing</i>			yes	yes
<i>Skilled postnatal care provider</i>			yes	
<i>Skilled birth attendance</i>	yes	yes	yes	yes
<i>Where is child now</i>			yes	Yes
Note: “Yes” denotes that the sociodemographic variable significantly predicted missingness.				

3. Inconsistencies and faulty skip patterns as noted from the data

- 6 women had a recorded age difference with their baby of less than 15 years. In 2 cases the difference was less than 2 years.
- 6 instances of questions being asked when they should not have been, per the skip pattern.
- 11 instances of the question “Have you ever been pregnant?” not being asked when it should have been. All these women had an interview start date and time but only 4 had an interview end time.
- 4 instances of women who said they had never been pregnant were asked “Are you pregnant now?”; this is inconsistent with the skip pattern.

- Per the skip pattern in the survey, women who said yes to “Are you pregnant now?” were supposed to skip the question, “Including this current pregnancy, how many times have you been pregnant?”, but they were asked it. This is a faulty skip pattern.
- 9 instances of women who said nobody checked on their or their baby’s health after delivery were then asked questions about those checks; this was inconsistent with the skip pattern as well.
- At least 11 additional instances of incorrect skip pattern application across the survey.

2013 and 2016 PAMANECH data

1. High response rate in 2016 but low in 2013 on same variable
 - The question about skilled birth attendance has a 100% response rate in the 2016 dataset whereas the same question in 2013 has 12.5% missing responses.

2016 PAMANECH data

1. Inconsistencies
 - Of the 587 eligible women for this study, 18 (3%) had inconsistent responses to the question on place of delivery (e.g., two places were mentioned for the same delivery) and 51 (8.5%) had unexplained missing data on this variable. There is no overlap between these two groups.

2. Missing data critical to calculating early breastfeeding initiation variable
 - The question “How soon after birth did you start breastfeeding?” includes the option to enter number of hours in the questionnaire, but this variable was not included in the dataset. Several unsuccessful attempts were made to obtain these additional data.
3. Unexplained missingness
 - 13% missing on health facility delivery (outcome variable)
 - 20% observations missing at least 1 outcome variable

2018 ProSHI data

1. High coverage rates
 - 97.97% of women had a health facility delivery
 - 97.97% of women had a skilled birth attendant at the delivery
 - 97.18% of women’s babies had a postnatal check on time
 - 100% of these babies had a postnatal check by a skilled provider
 - See table below for coverage rates across waves computed with available data

Percent coverage by wave and intervention from PAMANECH and ProSHI surveys			
	Year		
Intervention	2013	2016	2018
Health facility delivery	84.84	88.27	97.97
Skilled birth attendance	97.43	87.86	97.97
Early postnatal care	50.51	97.73	97.18
Skilled postnatal care	82.00	98.77	100
Early breastfeeding initiation	34.15	N/A	88.45

Glossary

Antenatal care (ANC)	The care provided by skilled health-care professionals to pregnant women and adolescent girls in order to ensure the best health conditions for both mother and baby during pregnancy
Antenatal	Before birth
Continuum of care for maternal, neonatal, and child health	Care for mothers and children from pregnancy to delivery, the immediate postnatal period, and childhood
Coverage	The proportion of individuals receiving an intervention or practice (numerator) among the population that requires it (denominator)
Early neonatal mortality	Death within the first 6 days of life
Health facility delivery (HFD)	Delivery of an infant at either a hospital or a clinic
Intrapartum	Occurring or provided during the act of birth
Low birthweight	A baby born weighing <2,500 g
Maternal and neonatal health intervention	A recommended practice or guideline for the promotion of health and prevention of disease along the maternal and child health continuum
Neonatal mortality	Death within the first 28 days of life
Neonatal mortality rate (NMR)	Number of deaths during the first 28 completed days of life per 1,000 live births in a given year or other period
Perinatal mortality	Fetal death beyond 28 weeks of gestation or infant death within 7 days of birth
Perinatal mortality rate	The number of infant deaths beyond 28 weeks of gestation and within 7 days of birth per 1,000 live births
Postpartum/postnatal	The time after childbirth
Respectful maternity care (RMC)	A form of care provision that prioritizes dignity, privacy, and continuous support during labor and childbirth
Singleton birth	Birth of only one child
Skilled birth attendant (SBA)	A midwife, doctor or nurse – who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns
Under-5 mortality rate (U5MR)	Probability of dying by age 5 per 1,000 live births

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