MEASURING CHILD HEALTH COVERAGE:

Validation of Maternal-Reported Care-seeking and New Methods for Estimating Coverage of Appropriate Management of Childhood Illness

by

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Abstract

Problem Statement: Accurate data on coverage of health interventions is required for continued reduction in child mortality. This study assessed the validity of the standard indicator on care-seeking for child illness and methods for linking household and provider data to improve measures of child health coverage.

Methods: The study was conducted in Southern Province, Zambia. Children <5 years were given cards with barcodes. Healthcare providers tracked sick children brought for care by scanning barcodes and distributing tokens. Provider preparedness to manage child illness was assessed using a tool based on the Service Availability and Readiness Assessment. We conducted a household survey on care-seeking for child illness in the preceding two weeks. We compared maternal-reported and provider-documented care-seeking events. We linked household data on source of care with provider preparedness data to estimate coverage using exact source care and measures of geographic proximity, with data on all providers and only health facilities.

Results: Most children sought care from government facilities or community-based agents (CBAs). We found high sensitivity (0.95, 95% CI: 0.88-0.98) and reasonable specificity (0.74, 95% CI: 0.65-0.81) of maternal report of care-seeking for child illness. Coverage of appropriate management of child illness, calculated using a measure based on provider preparedness, was 55% (95% CI: 51%-58%) overall. Exact-match linking was effective at this small scale. Most ecological linking methods produced similar coverage estimates. Use of facility-only data reduced coverage estimates in the rural area because CBAs were a common skilled source of care.

Conclusions: Maternal report is a valid measure of source of care for child illness in settings where utilization of public sector providers is high. With reliable household data on source of care, exact-match linking may be a feasible method for producing more informative estimates of coverage of appropriate management of child illness. Ecological linking with data on a sample of all skilled providers may be as effective as exact-match linking in areas with low variation in preparedness within a provider category or minimal provider bypassing. More studies are needed at larger scale and a more diverse provider landscape to further evaluate and guide linking methodology.

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Paper 1: Validity of Maternal Recall

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Acronyms

ACT	Artemisinin combination therapy
AUC	Area under the curve
CAMRE	Center for Applied Malaria Research and Evaluation
CBA	Community based agent
CSO	Central Statistics Office
DHS	Demographic and Health Survey
HFCA	Health facility catchment area
IF	Inflation factor
IIP-JHU	Institute for International Programs at Johns Hopkins University
IMCI	Integrated management of child illness
KDE	Kernel density estimation
LAM	Likelihood of appropriate management
LMIC	Low- and middle-income country
MDA	Mass drug administration of dihydroartemisinin - piperaquine
MICS	Multiple Indicator Cluster Survey
NPV	Negative predictive value
ODK	Open data kit
ORS	Oral rehydration solution
PPV	Positive predictive value
RHF	Recommended home fluids
RMNCH	Reproductive, maternal, newborn, and child health
SARA	Service Availability and Readiness Assessment
SPA	Service Provision Assessment
WHO	World Health Organization

Introduction

1. Background

Over the past two decades, global health efforts have targeted improvements in maternal, newborn, and child health (MNCH). Despite recent reductions, child under five mortality in many low- and middle-income countries remains high in absolute numbers. Pneumonia, diarrhea, and malaria remain the primary causes of child death in the post-neonatal period. Deaths from these three illnesses are preventable and can often be easily managed with simple curative interventions.

There are numerous proven interventions for preventing and managing child illness in low- and middle-income countries (LMICs). Despite the efficacy of these interventions, limited intervention coverage has restricted their impact on child survival. Intervention coverage is defined as the proportion of a population in need of an intervention that receives the intervention (1). A strong understanding of coverage of essential child health interventions is required for continued reduction in child mortality. Governments and other organizations implementing health programs are dependent on coverage data for designing and implementing more effective child health programs and policies.

Intervention coverage is commonly measured through nationally representative household surveys, such as the Demographic and Health Survey (DHS) and Multiple Indicator Cluster Survey (MICS). The DHS and MICS both collect information on the management of childhood illnesses. The DHS and MICS define childhood illness as fever (suspected malaria), cough with chest-related rapid breathing (suspected ARI), or

diarrhea in a child < 60 months of age in the two weeks preceding the survey. These surveys provide standardized and repeated population-based coverage estimates. However, these surveys are dependent on respondents' reports for generating estimates. Respondent report may be inaccurate for measuring some interventions. Where household surveys are found to be inaccurate, new methods are needed for generating more reliable MNCH coverage estimates.

1.1. Appropriate Management of Childhood Illness

Appropriate management of a child illness is dependent on a caregiver's decision to seek care (including timing and source of care) and the provision of quality care at the point of care (Figure 1).

The decision to seek care can be influenced by episode, child, caregiver, and household-level characteristics. A systematic review of care seeking behavior for childhood illness found severity of illness, distance to care, household wealth and cost of care were associated with care-seeking behavior (2). Perceived severity, as a component of the Health Belief Model, has been well established as a factor influencing individual health behaviors. A number of factors can influence a caregiver's perception of the severity of an illness episode, including the age and gender of the child, caregiver education and knowledge, and previous healthcare experiences (3). Caregiver perceptions of providers may also influence care-seeking behaviors. Caregiver beliefs about the accessibility and quality of care offered by a provider might influence the timing and location of care sought by altering the perceived benefit of seeking care (3). Previous experiences with providers and the perceptions of close members of a caregiver's social network can inform perceptions of providers (4). Cost of care, and a household's ability

to meet that cost, has also been shown to affect care-seeking (2,5). A caregiver's financial resources are related to household socioeconomic status and social capital. Finally, distance to care influences care-seeking decisions through the time and cost of reaching a provider (2).

Once care has been sought, appropriate case management is dependent on the readiness to treat and quality of care (QOC) offered by the provider. Following the WHO definition, service readiness is dependent on staff qualification, training, and adherence to guidelines, and availability of basic amenities, equipment, diagnostics, medicines and commodities (6). Availability of basic child health commodities, including diagnostic tools and medicines, is essential for a sick child to be correctly managed. However, appropriate training and support is also needed to ensure quality health worker performance (7–10). Together, care-seeking behavior and provider service readiness and QOC influence whether an episode of child illness is correctly managed.

1.2. Validation of Maternal-Reported Care-seeking

There is a growing body of evidence that some MNCH interventions cannot be accurately assessed in their current form through household surveys. With the exception of cesarean section, health interventions that occur around delivery were shown to be particularly vulnerable to incorrect recall and estimation through household surveys (1). Indicators around the management of childhood illness are more variable.

A study in three sites in Pakistan and Bangladesh assessed mothers' ability to accurately identify childhood pneumonia and recall antibiotic use. The discriminative power of caregivers to classify pneumonia was poor across study sites (Pakistan sensitivity 66.9%, specificity 68.8%; Bangladesh sensitivity 45.5%, specificity 69.5%). In

Pakistan and Bangladesh, 66.0% and 66.8% of caregivers correctly reported antibiotic treatment, respectively. This suggests that the current standard household survey questions do not accurately identify pneumonia cases or treatment. Various methods for improving the accuracy of pneumonia classification were also tested, including a pneumonia score and video tool, but failed to significantly improve caregiver classification (11).

A study in Western Province, Zambia assessed the validity of caregiver report of malaria testing, diagnosis, and treatment against a gold standard of clinical observation. Recall of whether a child with fever received an ACT was reliable (sensitivity 81.0%, specificity 91.5%), however recall of a malaria diagnosis was less accurate (sensitivity 76.8%, specificity 75.9%). Poor recall of a malaria diagnosis is becoming increasingly important as malaria prevalence declines globally. The current DHS malaria treatment indicator is based on presumptive treatment of fever, measured as the proportion of children with a fever in the past two weeks who received an antimalarial treatment within 1–2 days of the onset of fever. As malaria contributes fewer cases of fever, laboratory confirmation of malaria and treatment of differential diagnoses will be key in ensuring correct management of childhood fever. Poor report of a diagnosis suggests that caregiver recall should not be used in defining malaria treatment coverage. In order to measure effective treatment of malaria, the author suggests that household survey data should only be used for measuring care-seeking for fever and access to antimalarials. These data should be "supplemented" with health system data on the proportion of suspected malaria cases receiving a laboratory diagnostic test and the subsequent proportion receiving an appropriate antimalarial (12).

Although reliability of respondent report of diarrhea in children under 5 has not been validated, a review by Fischer Walker, Fontaine, and Black highlighted potential issues with household survey measurement of diarrhea prevalence and management. First, large-scale surveys may not include all local terms for diarrhea, systematically failing to capture some diarrhea episodes. Second, a 2-week recall period may underestimate milder diarrhea episodes, which are less likely to be remembered. Third, DHS and MICS do not classify the duration or severity of an episode beyond presence of blood in the stool. Classification of severity is needed to predict whether the child has dehydration requiring treatment. In order to estimate coverage, it is important to know whether those receiving treatment are the children most in need due to dehydration. The paper further advocates for focusing diarrhea management questions on ORS use (rather than recommended home fluids), the amount of food or fluid offered by a caregiver (rather than if a child consumed more or less), and separating breastfeeding from other foods and fluids (13).

In the absence of reliable household data on illness management, care-seeking for child illness is increasingly being reported as a key indicator. In management of both fever and pneumonia, and severe cases of diarrhea, seeking care from an appropriate provider is a necessary step in accessing correct diagnosis and treatment of the episode. Both the DHS and MICS measure maternal reported care-seeking for childhood illness. Care-seeking is defined as mother-reported "seeking advice or treatment for [illness] from any source." Mothers are additionally asked to classify where they sought care by provider type (i.e. private clinic). Despite the importance of care-seeking behavior in the continuum of correct case management of childhood illness, there have been no previous

studies assessing the validity of maternal report of care-seeking for childhood illness collected through household surveys.

1.3. New Methods for Measuring Coverage

Studies of indicator validity have demonstrated that household surveys may inaccurately estimate coverage of key child health interventions, including treatment of malaria, pneumonia, and diarrhea. Other indicators do not reflect receipt of appropriate management due to unclear etiologies of disease, complex treatment, and limited information captured through the survey. Beyond management of common child illnesses, household surveys are inefficient in measuring coverage related to rare events. Additionally, coverage of some interventions are dependent on the quality of service provided, such as the package of ANC services offered, which a caregiver or caregiver may not be able to assess.

Where household surveys are insufficient to estimate coverage, there is need for new methods for generating accurate measures of health intervention coverage. Routine health management information systems (HMIS) can be used to estimate the proportion of those seeking care from a facility that receives a service. However, these data are insufficient for measuring population coverage of essential services. HMIS data in many LMICs are 1) often incomplete, 2) captured at an aggregate level, and 3) not representative at a population level as data are only captured on people accessing care at public health facilities (1). Facility assessments can provide useful information on the availability and quality of services offered by providers. Both the Service Provision Assessment (SPA) developed by ICF International under the MEASURE DHS project and Service Availability and Readiness Assessment (SARA) developed by the WHO

collect nationally representative information on health facility readiness using an inventory scoring system. The SPA additionally collects data on adherence to standards of care through direct observation. These surveys typically collect information on a sample of public health facilities. They do not collect data from community-based, private sector, or informal providers that may constitute the source of care for a significant proportion of MNCH care events. As with HMIS data, facility-based assessments of readiness and QOC are only applicable to those events for which care was sought from a formal health facility.

Linking information on the source of care collected through household surveys with health care provider assessments of the quality and extent of services has been proposed as a means of generating more informative population-level estimates of the coverage of key health interventions (1). A recent systematic review found almost 60 studies published since 1990 have linked information from household surveys and service environment assessments to address coverage of RMNCH interventions in LMICs. The review found the majority of studies (51/59) performed ecological linking by assigning an individual or household to all or the nearest health care providers based on geographic proximity, rather than the reported source of care (14). Most used independent data sources, primarily DHS and SPA surveys. Household and facility data were often collected at different time points and in different geographic locations. SPA surveys are not intended to be representative at a cluster level, rely on a sample of facilities, and do not collect information on community-based public providers or non-facility private providers. In many settings the care environment is pluralistic. Numerous sources may offer some form of MNCH care, including public health facilities, NGO facilities,

community-based health workers, private sector providers, and informal providers. The quality of care offered by these providers varies widely (15). SPA and SARA surveys systematically fail to provide data on the potentially significant contribution of community, private, and informal care providers. Additionally, there is evidence of individuals bypassing more proximal sources of care in favor of better quality services from a more distant source (16). Not only does this suggest that linking households to the closest facility may be inaccurate, but also that the temporality of facility assessment measures is also important. The quality of care offered by a provider varies over time and may influence where an individual chooses to seek care. All of these factors suggest that ecologically linked data, geographically and temporally discordant data, and facility-only provider assessments may not accurately reflect the availability or quality of services accessed by an individual at their specific source of care.

Of the eight studies identified in the review that employed exact-match linking, or assigned the individual to specific providers from which care was received, half drew their sample from facility records introducing potential self-selection bias among care-seekers and could not be used to produce population-level estimates of coverage (14). Only one study in Asembo, Kenya linked household data on care-seeking for child illness to the exact clinic from which care was received (17). However, this study was conducted as part of a demographic surveillance system (DSS) where participating clinics routinely logged the DSS ID of patients. The study did not collect information on sources of care beyond the DSS clinics.

Linking household and provider data may generate more informative estimates of coverage of appropriate management of child illness. This methodology is promising

because it utilizes existing data collection mechanisms to generate a more complete picture of the management of child illness. These publications highlight a number of methodological issues in linking household and health care provider assessments that could limit the accuracy and usefulness of estimates generated through this method. Exact-matching linking with all provider data generates the most precise estimates of coverage of appropriate management, however collection of information on the specific source of care and assessment of all providers may not be feasible in many contexts. There is a need to rigorously test linking methodologies to guide future linking studies.

1.4. Knowledge Gaps Addressed by Study

This study addresses knowledge gaps around the validity of the standard indicator on care-seeking for child illness and methods for linking household and provider data to improve measures of child health coverage. Care-seeking is the first step to accessing appropriate treatment for a sick child. As such, it is crucial to have accurate information on care-seeking behaviors to inform public health interventions to improve care. This is the first study to assess the validity of maternal recall of care-seeking for child illness in sub-Saharan Africa or Asia. The results of this study will support decision making around the continued use of this indicator and interpretation of data on care-seeking collected through household surveys. Additionally, population-level information on care-seeking is an essential component of a linking analysis.

Linking information on the source of care collected through household surveys with health care provider assessments of the quality and extent of services is a potential means of generating more informative population-level estimates of the coverage of key health interventions. Linking analyses can be informative where interventions are

delivered through health providers and respondents are unable to recall specific services or treatment received, the quality of care is essential to its health effect, or need for an intervention cannot be accurately assessed through a household survey. Linking analyses could be used to generate informative measures of intervention coverage across the continuum of care. This study piloted an exact-match linking method for estimating coverage of appropriate management of child illness. The study was designed to assess its feasibility, explore methods for constructing measures of provider preparedness to manage sick children, and compare linked estimates of coverage to estimates generated through household data alone. The data were also used to perform common methods of ecological linking and linking with only facility data. This was done to quantify the degree of bias introduced to estimates generated using less rigorous, but more feasible, linking methods and existing facility assessment mechanisms. The results of this study will assist in developing effective linking study data collection and analysis procedures. The quantification of bias introduced by alternative linking methods will additionally inform decision-making around the trade-offs of different data sources and methods for linking analyses.

Together, the proposed research aims to improve our ability to accurately estimate the proportion of children who are receiving appropriate treatment for common killers of children under 5, a key contribution to tracking progress for global goals around child health. Ultimately, the objective of this research is to generate more robust data to improve equitable access to quality health services in LMICs.

2. Methods

2.1. Study Aims and Research Questions

The study addressed three primary aims presented in this thesis:

1) Assess the validity of maternal-reported care-seeking for child illness as captured through household surveys
    - Calculate the sensitivity and specificity of maternal-report for both urban and rural populations
    - Estimate the individual level accuracy (area under the curve - AUC) and population-level validity (inflation factor - IF) of maternal report
    - Assess characteristics of the household, mother, child, and illness episode associated with accuracy of report
2) Conduct exact-match linking to estimate coverage of appropriate management of child illness by linking household data on source of care with provider readiness data for a specific source of care
    - Assess the feasibility of conducting exact-match linking data collection and analysis
    - Evaluate measures of provider preparedness, or likelihood to appropriately manage common child illnesses
    - Estimate coverage of appropriate management of child illness using linked data for both urban and rural population
    - Compare linked estimates against coverage measures generated using maternal-reported management data

3) Assess the degree of bias introduced to coverage estimate by linking data using ecological linking and using facility-only provider data

- Link sick children to source(s) of care based on 6 measures of geographic proximity:
    - Absolute nearest provider
    - Nearest provider by travel distance
    - All providers within 5 km radius of household
    - All providers within health facility catchment area (HFCA)
    - All providers in total study area
    - Kernel density estimation (KDE)
- Estimate coverage of appropriate management of child illness using ecological linking with provider preparedness score and procedures selected through Aim 2
- Estimate coverage of appropriate management of child illness using ecological linking and exact-match linking using only facility data to model product of SPA or SARA provider assessment
- Compare exact-match linking estimates against ecological linking estimates and facility-only estimates of coverage

2.2. Survey Organization

The Bill and Melinda Gates Foundation provided funding for the survey. The Institute for International Programs at Johns Hopkins University (IIP-JHU) and the Center for Applied Malaria Research and Evaluation (CAMRE) at the Tulane School of Tropical Medicine and Public Health were responsible for the conception, design, and

implementation of the study. IIP-JHU identified and contracted faculty at Chainama College of Health Sciences, a clinical officer training college in Lusaka, to conduct the fieldwork, including recruitment and training of data collectors and data collection. IIP-JHU provided oversight for all aspects of the survey.

2.3. Study Site

The study was conducted in Choma District in Southern Province, Zambia. Choma district is located 285 kilometers for the national capitol, Lusaka, along the primary highway and railway line between Lusaka and Livingstone. Choma town became the provincial capital of Southern Province in 2011. Choma district has a population of approximately 250,000, including an urban population of 50,000 (18). The economy of Choma district is primarily agrarian, although Choma town is a growing commercial hub for the province (19). Zambia experiences three seasons, a cool dry season from May to August, a hot dry season from September to October, and a warm rainy season from November to April (20). Southern Province experienced delayed rains and drought conditions during the 2015 – 2016 rainy season due in part to effects of El Niño. Southern Province received less than two-thirds of its normal precipitation (rainfall in inches) and reduced hydropower outputs resulted in national power rationing (21).The Tonga are the majority ethnic group in Southern Province and Chitonga is the most common lingua franca in Southern Province.

Child under five mortality rates in Southern Province have declined dramatically over the past 2 decades from 134 deaths per 1,000 live births in 1992 to 68 deaths per 1,000 live births in 2013-2014. Pneumonia, diarrhea, and malaria remain the leading causes of child under five mortality in the post-neonatal period. The 2013 Zambia DHS

(ZDHS), which was conducted between August 2013 and April 2014, found high variability in the two-week prevalence of illness among children less than 5 years, with 21 percent experiencing fever, 18 percent experiencing diarrhea, and 4 percent of children experiencing symptoms of ARI. Seasonality in child illness exists in the region, with ARI cases peaking in the dry season, diarrhea most prevalent during the hot rainy season, and malaria rates peaking late in the rainy season (20). Southern Province is classified as an area with sustained malaria control resulting in malaria parasite prevalence under 10% in children under 5 years at peak transmission (22). Reported care-seeking for child illness is high in Southern Province, with approximately 70 percent of mothers reporting they sought care for their child with fever (68.5%), diarrhea (70%), or ARI symptoms (68%) (20). National guidelines on the management of suspected pneumonia, fever, and diarrhea align with WHO IMCI guidelines, including use of low-osmolarity ORS and zinc in the management of diarrhea, antibiotics for management of ARI, and ACT for treatment of malaria (23). Guidelines on the management of fever were revised in 2013 to include RDT confirmation of malaria at government health facilities (20,24).

The public sector dominates health service delivery in Zambia. The government manages 90% of health facilities either directly or through service agreements with the Churches Health Association of Zambia. There is growing private sector involvement in urban centers. Of the 254 health facilities in Southern Province in 2011, only 13 were private (25). IMCI has been implemented in all districts since the 1990s; however only about 65% of health facilities are staffed by an IMCI-trained clinician (26). Health user fees were removed for all rural districts, including Choma District, in 2006 although

enforcement of the policy has been variable (27,28). Health services are free for children under five at all government facilities, including referral services to hospitals with presentation of a referral letter (27). Community based health agents (CBAs) may participate in task shifting at government health centers and health posts and deploy a variable package of community-based interventions, including diagnosis and treatment of malaria and treatment of diarrhea with ORS (29). In addition to implementation of the IMCI strategy, national programs to improve child health have focused on improving vaccination coverage, prevention and treatment of diarrhea and ARI, and prevention of mother to child transmission of HIV (20). Recent malaria elimination efforts have included routine reactive case detection in Southern Province (30) and research-driven focused mass testing and treatment (MTAT) in the catchment of Macha Hospital (31) and MTAT plus prophylaxis for malaria in health facility catchment areas in Gwembe, Siavonga, Sinazongwe, and southern Kalomo district (32).

2.4. Study Population and Inclusion Criteria

2.4.1. Households with children < 5 years

Households were eligible to participate in the study if a woman of reproductive age (15-49 years) with at least one biological child under the age of 58 months resided in the household. These criteria were selected to correlate with the DHS requirements for the Women's Questionnaire and ensure participating children were less than 5 years of age at the time of the follow-up household survey (4-6 weeks post enrollment).

2.4.2. Health Care Providers

Health care providers were defined as public, private, informal or traditional source of care, including government health workers, private clinics, pharmacies, shops, and traditional or faith healers. In each catchment area, community leaders and health workers generated a listing of care providers offering medicine or alternative treatment for sick children. Providers that treated a relatively small number of children per month or only treated specific conditions, such as misshapen fontanel, were excluded from the study.

2.5. Sampling Frame and Sample Selection

The study area consisted of three rural (Mochipapa, Sikalongo, and Simikutu) and two urban (Shampande and Railways) HFCAs in Choma District. The study area was selected to utilize an existing household sampling frame developed for the mass drug administration (MDA) with dihydroartemisinin+ piperaquine trial being conducted in Southern Province (33). The trial began in 2014 and was conducted by the Malaria Control and Elimination Partnership in Africa (MACEPA) and Tulane University. The sampling frame included all households in the study area, which encompassed districts along Lake Kariba. The three rural HFCAs were selected because they were all control areas, located adjacent to each other and an urban center, and represented a range of access to infrastructure and health care.

An equal sample of households was drawn separately from the rural and urban study areas. Rural households were randomly sampled from the catchment area of three rural health facilities using an existing household listing created in 2014. Urban households were sampled from a census of households conducted immediately prior to

the household enrollment phase. Employees of the Central Statistics Office (CSO) conducted the census of urban Choma town. CSO conducts the national census and developed the sampling frame for the MDA trial. Households were defined and the census was conducted using the same protocol as the MDA study.

2.6. Sample Size

We estimated a sample of 107 documented care-seeking events for child illness in the preceding 2 weeks was needed in both strata to estimate the sensitivity and specificity of maternal report with a precision of ±8.0%. The sample size estimate was based on a type-1 error probability of 5% (two-tailed test), an underlying sensitivity and specificity of 80%, and a design effect of 1.1 for limited clustering within the health facility catchment area due to correlation in source of care. Approximately 560 children under 5 per strata were needed to capture 107 care-seeking events assuming 27.8% of children experienced a DHS illness in the 2 weeks preceding the survey (34), mothers reported seeking care for 81% of those illnesses (34), 10% of care-seeking events would occur at a provider not participating in the care-seeking event tracking, and the mothers of 5% of children would be unavailable at the time of the follow-up survey. To enroll 560 children per stratum, 700 households were sampled in each stratum assuming 90% of sampled households would be available and willing to participate and a household on average has 0.88 children <5 years (33).

2.7. Study Components

The study included four data collection components: 1) household enrollment survey, 2) provider readiness and knowledge assessment, 3) health care provider tracking

of sick child care-seeking events, and 4) survey of participating households on care-seeking for child illness in the preceding 2 weeks.

2.7.1. Household Enrollment Survey

In consenting households with a child under 5 years, we conducted a brief survey on household assets, demographics, and maternal preferences in seeking care for sick children. All children under 58 months were assigned a laminated card with a unique barcode number. In the event curative services were sought for a sick child, household members were instructed to present the card at the source of care. Household members were also instructed to save any ribbon given to them by a health care provider.

2.7.2. Health Care Provider Assessment

Concurrent to the enrollment of households, consenting health care providers were asked a series of questions about their individual or facility's readiness to provide curative services for children <5 years. At facilities and pharmacies with multiple staff, the questionnaire was administered to the most senior staff member. The questionnaire was modeled off the SARA general and child health questionnaire and adapted for use with facility-based, community-based, public, private, and informal providers. The questionnaire included additional questions about staff supervision, operating hours, and user fees. Health care provider knowledge was assessed using clinical case scenarios developed for use in the evaluation of the IMCI program (35). Providers were read four clinical case scenarios and asked how they would manage each hypothetical sick child. At outlets with multiple clinical staff, up to three staff members within a cadre of clinical health workers were randomly selected among those available at the time of the assessment to respond to case scenarios.

2.7.3. Care-seeking Event Tracking

Health care providers that agreed to participate in the study were given a smart phone with an application for reading barcodes and recording information on the time, location, and treatment given to a sick child. Providers were instructed to scan the barcode for any child participating in the study brought to them for care. Providers were also given serialized Tyvek ribbons of a color corresponding to the category of health care provider (e.g. blue for pharmacy, gold for traditional practitioner). Each ribbon could be traced to a specific care provider based on the serial number. Providers were also instructed to give a ribbon to the caregiver of any child under the age of five brought to them for care. Providers were encouraged to maintain a paper record of children brought for care. Barcode scan information was transmitted via cellular data in real-time. Where data could not be transmitted due to inconsistent cellular signal, data were manually extracted from the study phones at the end of the data collection period.

2.7.4. Household Care-seeking Survey

Approximately four to six weeks after enrollment, participating households were revisited and the follow-up care-seeking survey was administered. Mothers were asked a series of questions on child illness and care seeking identical to those asked in the Zambia DHS. Participating mothers were asked about the presence of diarrhea, fever, or suspected ARI in each of their children under the age of 5 in the preceding two weeks. ARI was defined using the current DHS definition of a child with a "cough accompanied by short, rapid breathing and difficulty breathing as a result of a chest-related problem" as these symptoms are consistent with conditions leading to pneumonia (20). If a child experienced one or more of these illnesses, the mother was asked if any care was sought,

the source of care, and treatment received. Following the completion of the series of DHS care-seeking questions, an additional questionnaire was administered to ascertain the name of the specific source of care, dates of the illness and care-seeking events, whether the barcode card was presented to the provider, and whether a ribbon was given by the caregiver at the source of care. If a caregiver received a ribbon, additional questions captured information about the color and serial number of the ribbon(s).

2.8. Data and Indicators

The data collected included all standard household indicators on child illness management. Information was collected on children under 5 with fever, diarrhea, and/or symptoms of ARI within the past 2 weeks. Data were collected on illness management, with a focus on source of care. Additional information on household demographic characteristics was also collected.

Data collected from health care providers included information on health care equipment, commodities, amenities, training, guidelines, and staffing related to curative child health services. Information on provider knowledge was assessed through standardized case scenarios. Health workers tracked care-seeking events for children participating in the study, which served as an operational gold standard of care-seeking events. Health workers also reported information on their management of sick children participating in the study.

2.9. Study Instruments

The household questionnaires were adapted from the ZDHS to most effectively assess the accuracy of standard questions on care-seeking and ensure that data collected

reflected data available through this existing tool. The provider survey was adapted from the SARA as the existing gold standard on provider readiness assessment and to evaluate its functionality in future linking studies. All survey instruments were administered as electronic questionnaires; paper versions of the instruments are presented in the appendix. Electronic questionnaires were developed using Open Data Kit (ODK) and implemented using ODK Collect, an open-source platform for mobile data collection.

2.9.1. Household Enrollment Survey

The enrollment survey collected information on household demographics and general care-seeking for child illness (Appendix 1). Demographic questions were derived from the 2014 ZDHS household questionnaire (36). Additional questions on general care-seeking for child illness addressed the most commonly used, accessible, affordable, and knowledgeable sources of care. The care-seeking preference questions were adapted from the ACTwatch household survey questionnaire (37).

2.9.2. Household Care-seeking Survey

The care-seeking survey (Appendix 2) was used to collect information on child illness in the past 2 weeks and management of the illness, including care-seeking. The questionnaire was taken directly from the ZDHS women's questionnaire on child health (36). Additional questions were asked after the DHS about the timing and severity of symptoms, sequential care-seeking events, cost of care, distance to care, and maternal impressions of quality of service. Mothers were also asked if the barcode card was presented during the care-seeking event and if a token was received.

2.9.3. Provider Readiness Assessment

The provider readiness assessment (Appendix 3) was adapted from the SARA survey for use with facility-based, community-based, public, private, and informal care providers (38). It included all tracer indicators for general service readiness and child health curative care. The survey included additional questions on hours of service, cost of services, and infectious disease medicines.

2.9.4. Case Management Scenarios

Case scenarios (Appendix 4) were used to evaluate provider knowledge in managing sick children. The case scenarios were adapted from a questionnaire used in the IMCI evaluation (35). The questionnaire included 5 cases scenarios with an emphasis on management of severe illness. Interviewers were instructed to read the case scenario and then listen to the open-ended response of providers on how the child should be assessed and treated. Provider responses were selected from a pre-defined list of options including correct management based on Zambian IMCI guidelines (23).

2.9.5. Care-seeking Event Tracking

Health providers documented care-seeking events using a questionnaire (Appendix 5). When a child participating in the study was brought for care, the provider used the electronic phone application to scan the child's barcode card. This generated a record of the date and time the child was brought for care. Then providers were prompted to answer a series of questions on the care given to the child. The questionnaire asked providers to report the child's symptoms, diagnostic tests performed, diagnosis, and treatment given. The questions were modeled off the IMCI treatment algorithm (23) to allow for classification of correct management upon review. Four questionnaire

variations were developed and loaded on provider's phones depending on their type of outlet and literacy. Three questionnaires were developed with slight variations for health facilities, CBAs, and pharmacies. A fourth questionnaire was developed for illiterate providers, primarily traditional practitioners, which only included the barcode scan and no additional questions.

2.10. Study Procedures

The study protocol and data collection tools were developed by IIP-JHU, in consultation with researchers from CAMRE and Chainama College. The study followed the general validation study design developed by the Improving Coverage Measurement (ICM) group. The study protocol and tools evolved through field visits, formative research, and method piloting in the study area. Chainama College was responsible for translation of study tools to Tonga, the local language of Southern Province, in collaboration with social scientists at the University of Zambia.

The study was conducted in two phases. Phase 1 included formative research in the study area, a census of households in the urban area, data collector training, and study instrument pilot. Phase 2 included enrollment of households and health care providers, the provider assessment, tracking of care-seeking events, and the follow-up household care-seeking survey.

2.10.1. Phase 1

Formative Research

Phase 1 began with a field visit and a 2-week formative research period. Formative research, conducted from December 13 – December 23, 2015, included

interviews with government health workers, traditional practitioners, community leaders, and mothers of children <5 years. Key informants were recruited using a standard script (Appendix 6A) and oral consent was sought (Appendix 7A). Key informants were asked about care-seeking practices, opinions on the acceptability of the study methods, and to identify commonly utilized sources of care in the study area.

Revisions to the study methods were made based on the results of the formative research including:

- A barcode necklace was rejected in favor of a barcode card based on feedback from key informants that children would not be allowed to wear jewelry from an unknown source.
- Provider inclusion criteria were revised because too many informal shops and traditional practitioners existed in the study area. Inclusion criteria was revised to enroll only health providers meeting a case threshold of number of children treated per month and exclude those that only treated specific conditions, such as misshapen fontanel.

Community Sensitization

During the formative research period, the local principal investigator (PI) visited all public health facilities to introduce the study, give proof of ministry clearance, and ensure their willingness to participate. A period of community sensitization followed the formative research. All study villages were visited, the study was presented to local leaders, and local leaders held meetings with the community to introduce components of the study and build support.

Urban Census

The urban household census began December 21, 2015 and continued until completion on January 29, 2016. The census was conducted by a team from CSO using the same protocol used in the census of rural households for the MDA trial and aligning with household criteria for the national census. The census also collected information on whether a household included a child <5 years. A map of households and primary landmarks was generated for use as the sampling frame in the urban area by importing coordinates into ArcGIS 10.1.

Data Collector Training

Data collection training was conducted from January 11 – 14, 2016 and led by the senior research team, including the local PI and staff from Chainama College and IIP-JHU. Twenty-five data collectors participated in the 4-day training. Each data collector was a recent graduate of Chainama College, literate, familiar with clinical medicine, and fluent in English and either Nyanja or Tonga. The training included instruction in interview skills, study protocols, use of the electronic data collection forms, and administration of the household enrollment and care-seeking survey. Training included discussion of interview questions, paired administration of the questionnaires, and role-play questionnaire administration. All data collectors were given a data collection manual (Appendix 8). Data collectors were evaluated on quiz responses and the accuracy of questionnaire responses recorded during role-play sessions. The top 20 participants were selected to serve as data collectors.

Four individuals were selected to serve as team supervisors. Two were nurses with district-level positions and all four had experience in conducting surveys and

working within the public health system. Team supervisors were responsible for managing their team's movements and logistics, extracting data from their team's phones, and ensuring data quality each day through interview observation and call-backs. Team supervisors also conducted the provider assessment and trained providers in care-seeking event tracking. Supervisors attended the full training, with an additional day and a half training on team management, data extraction, training providers in event tracking, and administration of the provider assessment survey.

Field Pilot

Following the data collector training, a day long pilot of data collection tools was conducted in the community surrounding Chainama College. Data collectors practiced identifying eligible households and administering both the enrollment and follow-up survey. Team supervisors visited Chainama Hospital and a local clinic in pairs with a member of the research team to practice administering the provider assessment. Following the pilot, collected data were reviewed for errors. A small number of revisions were made to improve the clarity and ease of administration of the surveys. The full research team attended an additional two-hour session on common issues and areas to improve in conducting the survey.

2.10.2. Phase 2

Household Enrollment

Household and provider enrollment was conducted from January 18 – February 13, 2016. The enrollment began in the rural HFCAs, and continued to the urban areas following completion of the rural enrollment. Households were visited up to three times

for the enrollment survey. If a household was not available at one visit, neighbors were asked if the household would be present within one week and the best time to return. If the household could not be interviewed after three visits, the household was not included in the study.

In the rural area, 700 households were screened to assess their eligibility using a recruitment script (Appendix 6B). In the urban area, 550 households were originally sampled to participate in the study based on census information that those households had a child <5 years. However, this information proved to be inaccurate and an additional 150 households were sampled to achieve an equal household enrollment in both the urban and rural areas. Consent to participate in the study was solicited from the head of the household and each mother of a child <5 years separately (Appendix 7B-C).

Sampled households were identified using their geolocation and consultation with community members. Using ArcGIS, the location of all sampled households were mapped and then exported to Google Earth. The Google Earth map of households with satellite imagery of roads, trails, and landmarks was installed on the laptops of team supervisors. Supervisors identified clusters of households and divided the clusters among data collectors to ensure efficient team movement. EpiSample was used to track individual households using their geolocation. EpiSample is an open-source application for Android phones, developed by MACEPA, which shows the distance and cardinal direction of a geographic location from the user's current location without need for a data connection. EpiSample was installed on all data collector phones with the coordinates of sampled households. When directions to a specific household could not be ascertained from local CBAs, data collectors used EpiSample to find a route to the household.

Provider Enrollment

Provider enrollment occurred concurrent to the household enrollment. Team supervisors approached identified providers to participate in the provider assessment and care-seeking event tracking. In outlets with multiple staff, the facility in-charge or manager was approached to participate. The provider recruitment script (Appendix 6C) and consent forms (Appendix 7D-E) are available in the appendix. One private facility and one pharmacy refused to participate in the event tracking, but agreed to participate in the provider assessment. Two additional government clinics were identified during the household enrollment survey. Additional approval was sought from the District Health Office (DHO) to approach the facilities to participate. Approval was delayed by the absence of the relevant staff member, and enrollment of the two facilities was delayed by three weeks.

At facilities and pharmacies with multiple staff, the provider assessment was administered to the most senior staff member. At outlets with multiple clinical staff, up to three staff members within a cadre of clinical health workers were randomly selected among those available at the time of the assessment to respond to case scenarios.

Household Care-seeking Survey

The study team revisited all participating households 4 – 6 weeks after enrollment. Households were revisited in approximately the same order as they were originally enrolled to ensure an equal amount of time between enrollment and follow-up in all HFCAs. The care-seeking survey was administered to all mothers that originally consented to participate. Households could refuse to participate in the follow-up survey.

In a few cases, households had moved during the follow-up period or a respondent was unavailable. If the household had moved within the study area, all attempts were made to identify their new residence and conduct the care-seeking interview.

Care-Seeking Event-Tracking

Staff members routinely treating sick children were identified and trained to track care-seeking events. In each HFCA, all providers attended a group training session on use of the phone application and then received one-on-one training with a team supervisor. For the first 3 weeks, a senior study team member visited each provider once a week. The team member extracted data from the phones, checked for any issues with the application or with data entry, and addressed any of the provider's concerns. For the remaining study period, the study team checked in with the provider once a week by phone to minimize the impact of the study on the provider's routine.

At the end of the study period, smart phones were collected from participating providers and data were extracted. Team supervisors administered a short survey to providers, assessing self-reported compliance with event tracking procedures and any issues encountered in tracking events.

A register review was conducted with providers that kept a separate record of children brought to them for care. If a provider kept an informal record exclusively for study purposes, the record was collected at the same time as the phone. Providers that kept a formal register as part of their routine system were visited after electronic records and the care-seeking survey had been reviewed. Team supervisors conducted the initial record review. Supervisors searched the registers for children whose mother reported they

had been taken to the provider for care, but who did not have either a token or electronic record to substantiate the report. Information on the name (first and last), sex, age, and date of visit were used in identifying matches in the register. Some flexibility was allowed for each criterion, including name due to the use of English and traditional names in the study area. Additionally, supervisors searched for a sample of children with electronic records substantiating treatment by the provider to verify the completeness of the register. A senior study team member rechecked all registers following the search by team supervisors. Shampande Health Center used an electronic record system to track patients, with an additional paper system when the computers were down due to lack of electricity. A team supervisor initially searched both register systems. The staff member that regularly maintained the system conducted a second search using special search criteria to account for misspelling and incorrect first names.

2.11. Data Quality and Management

Team supervisors monitored data quality through observation of interviews and callbacks. Supervisors performed callbacks for 5% of interviews, which included re-administering a brief questionnaire to households. The senior research team reviewed household survey data daily and gave feedback to supervisors or directly to data collectors.

Data were collected on Motorola Moto G (gen 2) smartphones running the Android 5.0.2 system. Data collection forms were developed and tested using XLSForm Offline for use in the Open Data Kit (ODK) suite. Data were collected using ODK Collect. Household survey data were extracted from data collector phones every two days. Data were manually extracted to minimize the risk of data loss and form breakage

reported by some researchers when transferring data wirelessly. Data on each phone were compressed into a zip file using OI File Manager, and then transferred from the phone to supervisor laptops via USB. All data were transferred to the senior research team as zip files. ODK Briefcase was used to extract and compile CSV data files by form. Data could then be read in Stata 14.2. Each two-day data extraction was saved to minimize data loss due to broken or lost phones. The senior research team conducted the final complete data extraction at the end of the enrollment survey and follow-up survey. Raw data were stored securely in JH Box.

Provider phones were programmed to automatically transfer completed event tracking forms to an online server. An application lock was used to prevent providers from altering the phone settings or using other applications. However, in some cases automatic operating system updates drained phone data. In the rural area, many providers lived in areas with poor or non-existent data connections. Both issues prevented automatic data uploads. Data were stored on the phones, in addition to being transmitted to the server. Data were extracted from all phones at the end of the survey using the same procedures for data collector survey data extraction. One urban CBA's phone software had become corrupted and data could not be extracted. However, the CBA reported they did not treat any child with a barcode card during the study period.

2.12. Analysis

The study analysis was conducted in Stata 14.2. Enrollment and follow-up survey datasets were merged and reshaped to generate a child-specific dataset with information on the child, mother, and household. Provider electronic event tracking records were

matched with the child data file based on child barcode ID, to generate a full data set with child information and documentation of child-specific care-seeking events.

Data values were checked for consistency. Three children with incorrect ID codes were corrected. Variables were generated for child illness, reported care-seeking event, category of source of care, specific name of source of care, and documentation of true care-seeking event. These variables were used in the validation of maternal report analysis. A separate data set with provider assessment variables was generated. This data set included a provider ID code that corresponded with the ID code for a specific source of care in the child data set. Likelihood of appropriate management scores were generated from variables in the provider file. These scores were combined with the child data set, matched on provider ID, for use in the linking analysis. The provider data set, which included location coordinates, was exported to ArcGIS to generate measures of geographic proximity for use in the ecological linking analysis.

2.12.1. Validity of Maternal Report

The sensitivity, specificity, and accuracy of maternal report for the three care-seeking event measures, and associated 95% confidence intervals (CIs), were calculated using a multi-level mixed effects logistic regression model with a random intercept to account for potential clustering at the level of the health facility catchment area. Sensitivity and specificity were estimated using provider-documented events as the measure of truth and maternal report as the diagnostic test under evaluation. Prior to estimating the primary outcomes, the reported sources of care were reclassified based on the name of the specific source of care from which care was sought. Care-seeking events reported for providers not participating in the study were excluded from the analysis.

Primary outcomes were calculated using reclassified sources of care and exclusion of non-participating providers.

Individual accuracy of maternal report was estimated as the area under the curve (AUC) of the receiver operating characteristic (ROC) curve of maternal report. Using the sensitivity and specificity for each of the three maternal report indictors, we predicted the coverage of each care-seeking outcome we would expect from a household survey on maternal report of care-seeking for childhood illness modeled for a range of true care-seeking prevalence (0 – 100%). Predicted coverage was compared against true coverage to estimate the population-level validity, or inflation factor, of maternal report.

Differences in accuracy of maternal report of care-seeking events by characteristics of the child, mother, household, episode, and source of care were tested through multivariable mixed effects logistic regression models allowing for a random intercept by health facility catchment area.

Sensitivity analyses were conducted to assess the effect of reclassification and exclusion of non-participating providers on the estimation of the primary outcomes.

2.12.2. Exact-match Linking

Coverage of appropriate management of child illness was calculated using an exact-match linking method where each sick child was assigned the likelihood of appropriate management (LAM) score for the specific source(s) of care from which care was sought. If no care was sought for the illness, the child was assigned a likelihood of appropriate management score of zero. Coverage was calculated using a generalized linear model to estimate the average LAM score across all sick children.

The LAM score, or estimate of a provider's preparedness to appropriately managing a child illness, was defined using information from the provider readiness assessments. The score assessed availability of commodities and human resources needed to appropriately manage common child illnesses. A provider received one point for each indicator if requirements were met and zero if not, and each domain received equal weight. The knowledge domain was calculated as an average score of provider performance on the four case scenarios.

Multiple score constructions were evaluated against a measure of correct management of child illness. The fit of each score was evaluated on the basis of the magnitude of the coefficient of determination and predictive accuracy of each score. Additionally, the association between each domain and the correct management score was assessed.

Coverage of maternal-reported treatment of sick children was calculated using relevant questions from the household survey. Coverage was calculated as the proportion of children with fever, diarrhea, or ARI that received the appropriate treatment based on maternal-reported care.

The feasibility of exact-match linking data collection was evaluated on the proportion of sources of care reported during the household care-seeking survey that could not by identified and assessed.

2.12.3. Ecological and Facility-only Linking

Coverage of appropriate management of child illness was calculated using ecological linking to assign each sick child the LAM score of the closest source(s) of care based on various measures of geographic proximity. Measures of geographic proximity

employed in the ecological linking were adapted from the work of Skiles and colleagues (39). All non-Kernel Density Estimation ecological linking methods maintained the reported category of source of care. Geographic proximity was calculated using ArcGIS 10.1 and included:

1. Nearest Absolute Distance: Closest provider by straight-line distance.
2. Nearest Travel Distance: Closest provider by road distance.
3. Radius (5 Kilometer): All providers within a 5 km radius of the child's house.
4. Administrative Unit (HFCA): All providers within the HFCA.
5. Administrative Unit (Study Area): All providers within the study area.
6. Kernel Density Estimation (KDE): Weighted pull of all providers. This method attempts to account for various forces exerting pressure on care-seeking decision making, specifically distance to a provider and provider preparedness to correctly manage a child illness.

Coverage of appropriate management of child illness was calculated using each ecologically linked data set. Each child was assigned the LAM score for the linked source of care. No care-seeking and care-seeking from multiple sources were handled the same way as the exact-match linking analysis.

Coverage of appropriate management of child illness was estimated using facility-only data. Coverage was estimated using the exact-match linking method and each of the ecological linking methods with only facility LAM scores. Children that did not recieve treatment from a health facility were assigned a LAM score of zero, equivalent to seeking no care. All other components of the linking methodology remained the same. Using the KDE methods, data on non-facility providers were excluded while modeling care-seeking

behavior. Coverage was calculated using a generalized linear model to estimate the average LAM score across all sick children.

A one-sample t-test was used to calculate the significance of the difference between the exact-match linking coverage estimates and each ecological linking and facility-only coverage estimate by strata.

2.13. Ethical Considerations

2.13.1. Risks and Benefits to Subjects

There were no direct risks to participants, beyond the risk that private information might accidentally be shared. However, none of the surveys collected sensitive information and steps were taken to protect the data and ensure confidentiality.

There was no direct benefit to participants. The study was designed to collect information to improve the quality of household surveys and help the Ministry of Health and other organizations to improve maternal and child health programs.

2.13.2. Informed Consent

Informed consent was obtained from all participants prior to data collection. Oral consent was sought from key informants prior to their interview. In households deemed eligible for the study, oral consent was sought from the head of household and written consent was sought from each mother of a child < 5yrs at enrollment. Written consent was sought from each provider separately for participation in the provider assessment, event tracking, and record review. At outlets with multiple staff, consent was sought from the facility in-charge or pharmacy manager. Where multiple staff were included in the

knowledge assessment, oral consent was sought from each staff member separately. All consent forms are available in Appendix 8.

2.13.3. Cost and Compensation

There was no cost to participate in the study. Mothers received 40 ZMW (approximately $4) for enrolling in the study and another 40 ZMW for participating in the follow-up survey. This payment aligned with compensation given to participants in other studies in Southern Province. Health care providers were given 150 ZMW for tracking care-seeking events for the duration of the study period. No compensation was given to key informants or providers that participated in the provider assessment alone.

2.13.4. Confidentiality Assurances

No sensitive data were collected as part of the survey. Study data were collected on password protected study phones and stored on a secure study server. All names of children, caregivers, heads of household and providers were replaced with numerical identifiers in the final analytical datasets. Household and provider geo-coordinates were retained.

2.13.5. Ethical Clearance

Ethical approval for the study was obtained from the Institutional Review Boards of Johns Hopkins School of Public Health and Excellence in Research Ethics and Science (ERES) Converge in Zambia.

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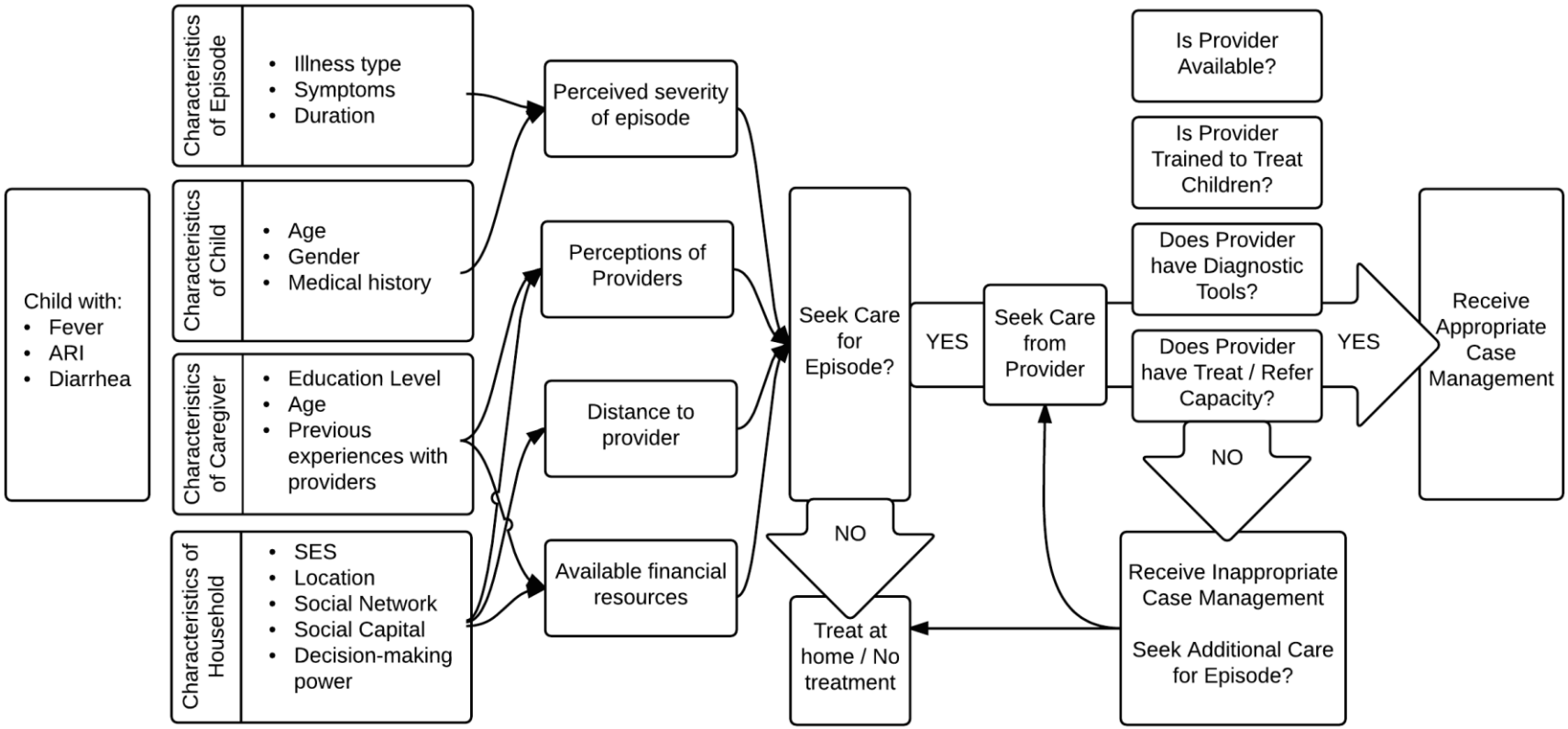
Figure 1. Conceptual Framework of Receiving Appropriate Management of Childhood Illness



Paper 1: Validity of Maternal Report of Care-Seeking for Childhood Illness

1. Background

Despite recent reductions, child under five mortality in many low- and middle-income countries (LMICs) remains high in absolute numbers. Pneumonia, diarrhea, and malaria remain the primary causes of child death in the post-neonatal period. Deaths from these three illnesses are preventable and can often be easily managed with simple curative interventions.

In management of both fever and pneumonia, and cases of diarrhea with dehydration, seeking care from an appropriate health care provider is a necessary step in accessing correct diagnosis and treatment of the episode. A number of factors can influence decision-making around the timing and source of care for child illness (1–4). Accurate information on the rates and patterns of care-seeking for child illness is essential for the development and direction of health programs to ensure correct management of key child illnesses.

Accurate information on the source of care is an essential component for understanding the type of care a sick child received. In most low- and middle-income countries, information on treatment of suspected acute respiratory infection (ARI), malaria, and diarrhea is collected through population-based household surveys. Recent studies have shown significant limitations in the accuracy of caregiver report of management of recent child illness including receipt of a malaria test in children with fever (5) and antibiotic treatment among children with symptoms of ARI (6).

Presumption of appropriateness of reported management on the basis of illness symptoms alone is insufficient in many contexts (7). Given these limitations, information on the timing and source of care may be the best predictor of correct management of child illness in many situations, particularly when coupled with timely data on the quality of care at various sources.

Information on care-seeking for child illness is commonly collected through population-based surveys, such as the Demographic and Health Survey (DHS) and Multiple Indicator Cluster Survey (MICS) that rely on maternal-report of care-seeking behaviors. Maternal report of care-seeking behavior for child illness may be subject to systematic and random error associated with autobiographical questions, including memory degradation, social desirability bias, and telescoping or temporal displacement of events (8). Inaccuracies in maternal report of care-seeking behavior could result in misdirection of public health programming to improve the management of childhood illnesses.

Despite the importance of care-seeking behavior in the continuum of correct case management of childhood illness, there have been no previous studies assessing the validity of maternal report of care-seeking behavior for childhood illness as collected by household surveys in sub-Saharan Africa or Asia. The objective of this study was to assess the validity of maternal report of care-seeking for illness in a child <5 years old, as captured through a household survey in Southern Province, Zambia. The study aimed to estimate the sensitivity, specificity, and accuracy of maternal report of care-seeking for child illness as collected through household surveys against a gold standard of health care

provider records of care-seeking events. We also assessed the association between accuracy of maternal report and socio-demographic characteristics.

2. Methods

Ethical approval for the study was obtained from the Institutional Review Boards of the Johns Hopkins Bloomberg School of Public Health and Excellence in Research Ethics and Science (ERES) Converge in Zambia.

2.1. Study Site

The study was conducted in Choma District in Southern Province, Zambia, between January 18 and March 20, 2016. The economy of Choma District is primarily agrarian, although Choma town is a growing commercial hub and provincial capital (9). Zambia experiences three seasons, a cool dry season from May to August, a hot dry season from September to October, and a warm rainy season from November to April (10).

Child under five mortality rates in Southern Province have declined dramatically over the past 2 decades from 134 deaths per 1,000 live births in 1992 to 68 deaths per 1,000 live births in 2013-2014 (10). Pneumonia, diarrhea, and malaria remain the leading causes of child under five mortality in the post-neonatal period (10). The 2013 Zambia Demographic and Health Survey (ZDHS) conducted between August 2013 and April 2014 found high variability in the two-week prevalence of illness among children less than 5 years, with 21 percent experiencing fever, 18 percent experiencing diarrhea, and 4 percent of children experiencing symptoms of ARI. Seasonality in child illness exists in the region, with ARI cases peaking in the dry season, diarrhea most prevalent during the

rainy season, and malaria rates peaking late in the rainy season (10). Southern Province is classified as an area with sustained malaria control resulting in malaria parasite prevalence under 10% in children under 5 years at peak transmission (11). Reported care-seeking for child illness is high in Southern Province, with approximately 70 percent of mothers reporting they sought care for their child with fever (68.5%), diarrhea (70%), or ARI symptoms (68%).

The public sector dominates health service delivery in Zambia. The government manages 90% of health facilities either directly or through service agreements with the Churches Health Association of Zambia. There is growing private sector involvement in urban centers (12). Health services are free for children <5 years at all government facilities, including referral services to hospitals with presentation of a referral letter (13). Community based health agents (CBAs) may participate in task shifting at government health centers and health posts and deploy a variable package of community-based interventions, including diagnosis and treatment of malaria and treatment of diarrhea with oral rehydration solution (ORS) (14).

2.2. Study Design, Participants, and Data Collection

The study included three data collection components: 1) enrollment of households with children under the age of 58 months, 2) tracking of sick child care-seeking events by health care providers, and 3) survey of participating households on care-seeking for child illness in the preceding 2 weeks. The study area was defined as the catchment population of five government health facilities in and around Choma town, and stratified into urban and rural populations.

Households with children <5 years were enrolled in the study (January 18 – February 13, 2016). Households were randomly sampled from the catchment area of three rural health facilities using an existing household listing created in 2014 (15). Urban households were sampled from a census of households conducted immediately prior to the household enrollment phase. Households were eligible to participate in the study if a woman of reproductive age (15-49 years) with at least one biological child < 58 m resided in the household. These criteria were selected to correlate with the DHS requirements for the Women's Questionnaire and ensure participating children were less than 5 years of age at the time of the follow-up household survey. In consenting households, we conducted a brief survey on household assets, demographics, and maternal preferences in seeking care for sick children. All enrolled children < 58 months were assigned a laminated card with a unique barcode number. In the event curative services were sought for a sick child, household members were instructed to present the card at the source of care. Household members were also instructed to save any ribbon given to them by a health care provider.

Health care providers were identified and recruited to track children brought to them for curative services. Care providers were defined as public, private, informal or traditional source of care, including government health workers, private clinics, pharmacies, shops, and traditional or faith healers. In each catchment area, community leaders and health workers generated a listing of care providers offering medicine or alternative treatment for sick children. Providers that treated a relatively small number of children per month or only treated specific conditions, such as misshapen fontanel, were excluded from the study. Ten to fifteen health providers were identified in each

catchment area. Providers that agreed to participate in the study were given a smart phone with an application for reading barcodes and recording information on the time, location, and treatment given to a sick child. Providers were also given serialized Tyvek ribbons of a color corresponding to the category of health care provider (e.g. blue for pharmacy, gold for traditional practitioner). Each ribbon could be traced to a specific care provider via the unique serial number. Providers were instructed to scan the barcode for any child participating in the study brought to them for care. Providers were also instructed to give a ribbon to the caregiver of any child <5 years brought to them for care, regardless of whether the child had a card. Providers were also encouraged to maintain a paper record of children brought for care. Barcode scan information was transmitted via cellular data in real-time. Where data could not be transmitted due to inconsistent cellular signal, data were manually extracted from the study phones at the end of the data collection period.

Approximately four to six weeks after enrollment, participating households were revisited and the follow-up care-seeking survey was administered (March 3 – 20, 2016). Mothers were asked a series of questions on child illness and care seeking identical to those asked in the Zambia DHS (see Box 1). Participating mothers were asked about the presence of diarrhea, fever, or suspected ARI in each of their children <5 years in the preceding two weeks. If a child experienced one or more of these illnesses, the mother was asked if any care was sought, the source of care, and treatment received. Following the completion of the series of DHS care-seeking questions, an additional questionnaire was administered to ascertain the name of the specific source of care, dates of the illness and care-seeking events, whether the barcode card was presented to the provider, and whether a ribbon was given at the caregiver at the source of care. If a caregiver received a

ribbon, additional questions captured information about the color and serial number of the ribbon(s).

2.3. Primary Outcome and Explanatory Variables

The primary study outcomes were the sensitivity, specificity, and accuracy of maternal report for three definitions of care-seeking events; 1) maternal report of the correct source of care by ZDHS provider category (see Box 1); 2) maternal report of any care-seeking event regardless of source of care; and 3) maternal report of care-seeking at a skilled provider. A skilled provider was defined as a source of care with clinical training in the management of one or multiple illnesses affecting children under 5. In this context, skilled providers included government, mission, and private hospitals, health centers, and health posts, private doctors, and government community based agents.

The sensitivity, specificity, and accuracy of maternal report were estimated by comparing maternal-reported care-seeking events for child illness against provider-confirmed care-seeking events. Provider-confirmed care-seeking events served as the gold standard against which maternal report was assessed. A care-seeking event was considered to be provider-confirmed if there was 1) record of scan of the child's barcode by the provider, 2) report of provider-specific ribbon in household, or 3) paper record of the child in the provider's register. Maternal report of care-seeking for child illness was ascertained from the follow-up questionnaire as described above.

Sensitivity represents the percent of mothers that correctly reported a care-seeking event among those care-seeking events that actually occurred. Specificity represents the percent of mothers who reported that a care-seeking event did not occur among those for whom care was truly not sought for their sick child based on provider documentation.

Accuracy represents the percent of mothers whose report of their child's care-seeking events agreed with provider documentation of true care-seeking events. The positive predictive value (PPV) and negative predictive value (NPV) of maternal report are also presented. PPV represents the proportion of reported care-seeking that truly occurred. NPV represents the proportion of unreported care-seeking events that truly did not occur. The interpretations of sensitivity, specificity, and accuracy are presented in Box 2.

Characteristics of study participants were collected through the household enrollment survey. Questions on household assets, household composition, and maternal education were based on questions in the ZDHS. Household wealth was derived from a principal component analysis of household assets within each stratum (urban/rural) using an established method for estimating household wealth and divided into quintiles (16). The number of children <5 years in the household was calculated based on the household roster. Maternal education was categorized as no or incomplete primary education, complete primary education, incomplete secondary education, and secondary complete or higher education.

2.4. Sample Size and Stratification

A sample size of 560 children under 5 per strata was sought to capture 107 documented care-seeking events for child illness in the preceding 2 weeks within both the rural and urban strata. The sample size for estimating the sensitivity and specificity of maternal report of care-seeking from any source was based on a type 1 error probability of 5% (two-tailed test), an underlying sensitivity and specificity of 80%, a precision of ±8.0%, and a design effect of 1.1 for limited clustering within the health facility catchment area due to correlation in source of care, resulting in a sample size of 107

documented care-seeking events in each strata. Approximately 560 children under 5 per strata were needed to capture 107 care-seeking events assuming care would be sought for illness among 22.5% of children, 10% of care-seeking events would occur at a provider not participating in the care-seeking event tracking, and the mothers of 5% of children would be unavailable at the time of the follow-up survey. The 22.5% care-seeking rate was calculated from 2007 ZDHS data in Southern Province, which showed 27.8% of children experienced fever, diarrhea, or symptoms of ARI in the 2 weeks preceding the survey and mothers reported seeking care for 81% of those illnesses. To enroll 560 children per stratum, 700 households were sampled in each stratum assuming 90% of sampled households would be available and willing to participate and a household on average has 0.88 children <5 years.

2.5. Analysis

The study analysis was conducted in Stata 14.2. The primary outcomes of sensitivity, specificity, and accuracy of maternal report for the three care-seeking event measures, and associated 95% confidence intervals (CIs), were calculated using a multi-level mixed effects logistic regression model with a random intercept to account for potential clustering at the level of the health facility catchment area. Prior to estimating the primary outcomes, we reclassified the reported sources of care based on the name of the specific source of care from which care was sought. Care seeking events reported for providers not participating in the study (20 events equal to 6.8% of maternal-reported events) were excluded from the analysis. Primary outcomes were calculated using reclassified sources of care and exclusion of non-participating providers. For children

with care-seeking events from multiple provider types, each event was assessed individually when evaluating of maternal report of source of care by provider category.

Differences in accuracy of maternal report of care-seeking events by characteristics of the child, mother, household, episode, and source of care were tested through multivariable mixed effects logistic regression models allowing for a random intercept by health facility catchment area.

Using the sensitivity and specificity for each of the three maternal report indictors, we predicted the coverage of each care-seeking outcome we would expect from a household survey on maternal report of care-seeking for childhood illness modeled for a range of true care-seeking prevalence (0 – 100%). Predicted coverage of care-seeking based on maternal report was estimated as:

Predicted Coverage = (true coverage of CS x sensitivity) +[(1 – true coverage of CS) x (1 – specificity)]

At zero care-seeking for child illness, the predicted coverage of care-seeking based on maternal report is equal to the observed 1 – specificity. At 100% care-seeking for child illness, the predicted coverage of care-seeking based on maternal report is equal to the observed sensitivity.

Sensitivity analyses were conducted to assess the effect of reclassification and exclusion of non-participating providers on the estimation of the primary outcomes. The primary outcomes were estimated using the original reported source of care classification and without excluding non-participating providers and compared against the adjusted outcomes. Where the original reported provider category did not include any participating

provider, the reported event was treated as if it occurred at a non-participating provider and excluded from the analysis. If a mother reported seeking care at a non-participating provider, the event was treated as an undocumented care-seeking event and treated as a false positive event.

3. Findings

A total of 335 rural household (566 children) and 469 urban households (590 children) were enrolled in the study. At follow-up, 10 households (3%) in the rural area and 33 households (7%) in the urban area were unavailable to complete the survey because the participating mother(s) had moved outside of the study area or to an unknown residence for the remainder of the study period. At follow-up, 4 rural and 10 urban households withdrew consent for the follow-up survey. This resulted in a loss-to-follow-up of 7.1% of households. One child was excluded from the analysis because their barcode number was unknown due to a scanning error.

Characteristics of participating children, mothers, and households are shown in Table 1. There was an approximately equal distribution of children by age and gender. There were slightly fewer children under one year of age due to the lag period between enrollment and the follow-up survey, which excluded neonates born within the follow-up period. The mean age of mothers was 29.6 years in the rural area and 27.1 years in the urban area. Mothers in the urban area on average had slightly higher education (66.5% with some secondary or higher) compared to mothers in the rural area (44.5% with some secondary or higher).

All government health centers, health posts, and CBAs trained in child curative services within the study area agreed to participate in care-seeking event tracking. During the household enrollment phase, two additional government facilities outside of the study area were identified which provided services to a segment of households participating in the study. These two government facilities were enrolled in the care-seeking event tracking during the follow-up period. The number of participating CBAs ranged from 4 to 7 per government health center. There were no private facilities or pharmacies within the rural study area. In the urban area, one private clinic and one pharmacy refused to participate. In the rural area, 29 traditional or faith-based practitioners participated in the event-tracking. Two churches and one traditional birth attendant in the urban area participated in the event-tracking.

No mobile clinics, mission facilities, or private community health workers were present in the study area. Choma General Hospital was located in the urban study area but excluded from the study due to low anticipated numbers of study participants seeking care at a referral facility and potential disruption caused by event-tracking in a high-volume referral facility. A large number of informal shops that stocked one or two unregulated drugs, such as paracetamol, in addition to grocery items were identified. None were included in the study because they did not meet the threshold volume of care-seeking events and no more than two participating households reported purchasing drugs at a specific informal shop during the enrollment survey.

Among the 1,083 children included in the care-seeking survey, 34.5% of urban children and 36.4% of rural children experienced at least one illness according to DHS questions ("DHS illness") in the 2 weeks preceding the survey (Table 2). Fever was the

most commonly experienced symptom in both the rural and urban areas. Among those children that experienced a DHS illness, mother's reported care was sought for 78.9% of rural children and 66.5% of urban children. Reported care-seeking from more than one source was uncommon (5% of children taken for care). Among those children taken for care, mothers most often reported their child was taken to a skilled provider (95.8% rural care-seeking events, 91.4% urban care-seeking events). In the rural area, 5 care-seeking events were reported with non-participating providers. In the urban area, 15 care-seeking event were reported with non-participating providers, including informal shops (9), non-consenting private sector providers (1), and the general hospital (5).

3.1. Sensitivity and Specificity of Maternal Report

Maternal report of care-seeking for child illness was compared against provider-documented care-seeking events. Table 3 presents the distribution of reported and documented (true positive), reported but undocumented (false positive), and unreported but documented (false negative) care-seeking events by provider type and strata among providers participating in event-tracking. In both the rural and urban strata, the majority of care-seeking events occurred at government health centers or health posts. Community health workers accounted for a significant proportion of care-seeking events in the rural stratum. Very few mothers reported seeking care in the private sector (private clinic or pharmacy) and no reported events were confirmed by private providers (Table 3). A relatively high proportion of documented care-seeking events among traditional practitioners were unreported by mothers (Table 3).

Maternal report of correct source of care by provider category is presented in Table 4A. Maternal report of correct source of care had a sensitivity, or proportion of true

care-seeking events that were correctly reported, of 91.2% (95% CI 83.6% – 95.5%) in the rural strata and 97.9% (95% CI 92.0% – 99.5%) in the urban strata. The specificity of maternal report of source of care was lower at 71.4% (95% CI 57.4% – 82.3%) in the rural and 75.5% (95% CI 62.1% - 85.3%) in the urban strata. The PPV, or proportion of reported care-seeking events that truly occurred, was 91.3% (95% CI 85.8% - 94.8%) and 82.3% (95% CI 74.1% - 88.3%) in the rural and urban strata respectively. The NPV of maternal report of source of care was 74.0% (95% CI 45.4% – 90.7%) in the rural and 96.8% (95% CI 88.2% - 99.2%) in the urban strata. The individual accuracy of maternal report of source of care, calculated as area-under-the-curve, was 81.1 % (95% CI 74.3% - 87.9%) in the rural strata and 86.6% (95% CI 81.6% – 91.5%) in the urban strata.

Maternal report of any care-seeking event had a slightly higher sensitivity and specificity than maternal report of source of care by provider category (Table 4B). Maternal report of care-seeking had a sensitivity of 95.4% (95% CI 89.3% - 98.1%) and 99.0% (95% CI 92.9% - 99.8%) in the rural and urban strata, respectively. Maternal report had a specificity of 72.9% (95% CI 58.7% - 83.6%) and 76.8% (95% CI 61.1% - 87.4%) in the rural and urban strata, respectively. The accuracy of maternal report of any care-seeking was also lower at 84.1% (95% CI 77.5% - 90.6%) in the rural strata and 87.6% (95% CI 82.8% - 92.4%) in the urban strata.

Maternal report of care-seeking from a skilled provider had the highest sensitivity, specificity, PPV, NPV, and accuracy of the three report measures (Table 4C). The sensitivity of maternal report of seeking care from a skilled provider was 96.6% (95% CI 90.1% - 98.9%) in the rural stratum and 98.9% (95% CI 92.8% - 99.8%) in the urban stratum. The specificity of maternal report of seeking care from a skilled provider was

76.4% (95% CI 63.4% - 85.8%) in the rural strata and 80.2% (95% CI 63.5% - 90.5%) in the urban strata. Accuracy of maternal report of care-seeking from a skilled provider was high at 86.4% (95% CI 80.6% - 92.3%) and 89.1% (95% CI 84.7% - 93.5%) in the rural and urban strata, respectively.

3.2. Characteristics Associated with Report Accuracy

The relationship between accuracy of maternal report and characteristics of the child, mother, household, illness episode, and source of care are presented in Table 5. There were no significant associations between accuracy of maternal report and characteristics of the child, mother, or household. Adjusting for other characteristics, mothers of children taken to a government health center (AOR: 25.8; 95% CI 8.81 – 75.52) or CBA (AOR: 6.15; 95% CI 1.48 – 25.56) had significantly greater odds of accurately reporting the care-seeking event compared to mothers of children for whom no care was sought. Mothers of children for whom care was exclusively sought from a public sector provider had greater odds of accurately reporting seeking care from a skilled provider and seeking care from any source. Mothers that sought care from a traditional practitioner had significantly lower odds (AOR: 0.2; 95% CI 0.04 – 0.94) of accurately reporting the care-seeking event when adjusting for other characteristics. Mothers of children with fever and symptoms of ARI had significantly lower odds (AOR: 0.2; 95% CI 0.05 – 0.88) of accurately reporting care-seeking events compared to mothers of children with fever alone. However, this association was not significant when assessing characteristics associated with accuracy of reporting any care-seeking or seeking care from a skilled provider.

3.3. Population-level Accuracy of Maternal Report

The modeled coverage of care-seeking by source of care ascertained from maternal report over a range of coverage scenarios, demonstrates that at low coverage levels the low specificity of maternal report would result in substantial overestimation of the proportion of sick children taken for care at the reported source of care (Fig 1). At high coverage levels, the high sensitivity of maternal report would result in only a slight underestimation of proportion of sick children taken for care at the reported source of care. This trend was true for estimation of any care-seeking event and seeking care from a skilled provider. At low coverage of care-seeking, low specificity of maternal report leads to overestimation of the proportion of children for whom any care was sought and the proportion of children for whom care was sought at a skilled provider. High sensitivity of maternal report resulted in only slight underestimation of coverage of any care-seeking event and seeking care from a skilled provider at high coverage levels. In both the rural and urban strata, all three measures of maternal report slightly overestimated or produced estimates of care-seeking behavior very close to the true prevalence in the study population (Table 6).

3.4. Robustness Tests

Report characteristics were estimated considering each symptom independently. There was no significant difference in estimated report characteristics by illness symptom (Sup Table 1). However, there was low precision around report characteristic estimates among children with symptoms of ARI, and to lesser extent diarrhea, minimizing detectable differences.

Results of the sensitivity analyses on effect of reclassification and exclusion on non-participating provider on the estimation of the primary outcomes are presented in supplementary tables. The originally reported source of care, reclassified source of care, and events among participating providers are presented in Sup Table 2. Most misclassifications of sources of care occurred between skilled-provider categories, specifically mothers reporting seeking care from a hospital or mission facility when care was actually sought from a government health center based on the reported name of the facility. There was no difference in estimated characteristics of maternal report of any care-seeking event or seeking care from a skilled provider without correcting misclassified providers (Sup Table 3) compared to the estimates with corrected provider categories presented in Table 4. However, in the rural strata, the estimated sensitivity and NPV of maternal report of source of care was marginally lower without provider reclassification. There was no significant difference in estimated report characteristics maintaining non-participating providers (Sup Table 4) compared to the estimates excluding non-participating providers presented in Table 4.

There was no evidence that the care-seeking event tracking methods affected maternal report of care-seeking. Adjusting for source of care, there was no significant association between event-tracking confirmation method and maternal report of a source of care. Mothers of children that received a ribbon and/or barcode scan did not have significantly different odds of reporting a true care-seeking event compared to mothers whose child's care-seeking event was only documented in a paper register (Sup Table 5).

4. Conclusions

The validity of maternal report of care-seeking for child illness was calculated by comparing maternal report against provider-documented care-seeking events. This study found high sensitivity and reasonable specificity of maternal report of care-seeking for child illness. Maternal report of any care-seeking event and report of seeking care from a skilled provider performed slightly better than maternal report of the exact source of care. There have been no other studies of the validity of maternal report of care-seeking for child illness in sub-Saharan Africa. Results from a similar study in Pune, India are forthcoming. A study in Mozambique found high accuracy (sensitivity 81% CI 75-87%; specificity 94% CI 90-98%) of maternal report of delivery in a hospital (versus a health facility) with an 8 – 10 day recall period (17). A number of studies in high-income countries have assessed accuracy of self-reported adult health service use and found moderate to high agreement with medical records (18–22). A study in the US demonstrated accuracy of recall of outpatient care declined with increasing reference period (20). A study in the Netherlands found slight over-reporting of health service utilization (19).

The observed sensitivity of maternal report of source of care was high overall but somewhat lower in the rural areas, compared to the urban areas, due in large part to under-reporting of care sought from traditional practitioners. Traditional practitioners were the most common type of health provider in the rural study area, although they saw a relatively low volume of sick children. Availability and use of traditional practitioners was much lower in the urban area. Cadres of traditional practitioners are common in many societies, but health workers, government bodies, and non-governmental

organizations often discourage utilization of traditional practitioners. Within the study area, caregivers reported seeking care from traditional practitioners, including herbalists and faith healers, for specific illnesses of a spiritual or traditional origin or when public sector treatment failed. Some local leaders and health workers openly discouraged the use of traditional practitioners, although a handful of traditional practitioners had been incorporated into the public sector as CBAs or members of local health committees or safe motherhood action groups. Concern over negative perceptions of treatment by a traditional practitioner has been cited as a potential cause of under-reporting of the use of traditional practitioners in many settings and may explain the underreporting in this setting (23,24). Alternatively, mothers may not consider treatment by traditional practitioners to be seeking care, a point that could be clarified in the survey question administration.

The lower specificity of maternal report was driven by over-reporting of seeking care from public sector providers, including government health centers, posts, and CBAs. This over-reporting of care-seeking events in the public sector may be attributable to mothers' expectation that researchers want to hear that care was sought for a sick child, and greater approval of treatment from a government provider, resulting in a social desirability bias (8).

The study findings were limited by the low diversity in care-seeking practices for child illness and the exclusion of informal shops. The majority of care-seeking events occurred in the public sector, with most in government health centers and a smaller number with government CBAs in the rural study area. Despite the availability of a number of private clinics and pharmacies in the urban area, very few care-seeking events

were reported, and even fewer were documented in the private sector. Provision of free treatment for children under 5 in the public sector may account for low care-seeking in the private sector. The public sector is the primary source of care for child illness in many sub-Saharan African countries (25). However, this provider landscape may not be representative in urban areas or in other regions, limiting the generalizability of these findings.

As pharmacists did not provide consultations and adult formulations of medicines can be used to treat children, it was difficult for pharmacists to know when care was being sought for a child, potentially resulting in under-documentation of care-seeking events. The study cannot draw conclusions about the accuracy of maternal report of care-seeking in the private sector. Additionally, care seeking from informal providers, such as shops, was not tracked because the shops did not meet study inclusion criteria. Although reported care-seeking from informal providers was low, absence of tracking data among informal providers prohibits us from assessing accuracy of maternal report as it relates to informal providers.

ARI was defined using the current DHS definition of a child with a "cough accompanied by short, rapid breathing and difficulty breathing as a result of a chest-related problem" as these symptoms are consistent with conditions leading to pneumonia (10). There are known limitations in the accuracy of maternal report of ARI (6) and diarrhea (7), although maternal report of fever was found to be reliable in a study in Western Province, Zambia (5).

Provider documentation of care-seeking events through barcode scans and distribution of tokens was imperfect due to issues with keeping the phone charged and

accessible, caregivers failing to present the barcode card to providers, providers forgetting to distribute ribbons, and caregiver refusal or loss of ribbons. To account for these limitations, we reviewed health provider records. In the public sector and private clinics, these records were already being kept as part of routine health service tracking and were maintained separately from the study event tracking methods. This independent source of data on treatment of children strengthened the completeness of event-tracking data.

While the overall accuracy of maternal report of source of care was high, we found some misclassification of source of care. Based on the originally reported source of care using the ZDHS provider categories, many mothers reported seeking care at a hospital, mission facility, or government mobile clinic when the true source of care was a government health center. Misclassification was most likely due to a number of factors, including use of "hospital" as a colloquial term for health facility, changing authority from mission to government management at one health center in the study area, and data collector error in reading and selecting provider categories. Misclassification was simple to identify when mothers were asked to report the name of the provider or facility from which care was sought. Inclusion of an additional question on the name of the provider, or additional unrecorded prompting to verify the category of health provider, could reduce misclassification error in household surveys but may not be feasible at scale. Additionally, some provider categories currently used in the ZDHS are non-exclusive and uninformative. CBAs in the study area ran or staffed some government health posts. However, government health posts were grouped with health centers, although the range

of service and quality care offered by a CBA compared to a nurse or clinical officer could vary greatly.

This study suggests that maternal report as captured through household surveys is a valid measure of source of care for child illness in settings where utilization of public sector providers is high. This finding is broadly applicable to other setting where the public sector is the primary source of care. However, there is need for additional research to assess the accuracy of maternal report of care-seeking for childhood illness in other contexts, particularly to understand report related to care-seeking in the private formal and informal sectors.

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Box 1. ZDHS Questions on Care-seeking for Child Illness

Care-seeking for diarrhea

Single Choice	Has [NAME] had diarrhoea in the last 2 weeks?
Single Choice	Did you seek advice or treatment for the diarrhoea from any source?
Multiple Choice	Where did you seek advice or treatment? Anywhere else? [PROBE TO IDENTIFY EACH TYPE OF SOURCE; IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, WRITE THE NAME OF THE PLACE.]

Care-seeking for fever and / or ARI

Single Choice	Has [NAME] been ill with fever at any time in the last 2 weeks?
Single Choice	Has [NAME] had an illness with cough at any time in the last 2 weeks?
Single Choice	When [NAME] had an illness with a cough, did he/she breathe faster than usual with short, rapid breaths or have difficult breathing?
Single Choice	Was the fast or difficult breathing due to a problem in the chest or to a blocked or runny nose?
Single Choice	Did you seek advice or treatment for the illness from any source?
Multiple Choice	Where did you seek advice or treatment? Anywhere else? [PROBE TO IDENTIFY EACH TYPE OF SOURCE; IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, WRITE THE NAME OF THE PLACE.]

Multiple choice source(s) of care categories

Public Sector
- Govt hospital
- Govt health center / post[1]
- Mobile hospital / clinic
- Community based agent / fieldworker
- Other public sector

Private Medical Sector
- Pvt Hospital / clinic
- Mission hospital / clinic[2]
- Pharmacy
- Pvt doctor
- Mobile hospital / clinic
- Community based agent / fieldworker
- Other private sector

Other Source[3]
- Shop
- Traditional Practitioner
- Market

Other (Specify)

[1] MICS questionnaire records government health centers and health posts as separate categories
[2] Mission hospitals / clinics are not a category in MICS questionnaire
[3] MICS "Other Source" category includes 1) Relative / Friend, 2) Shop / Market/ Street, 3) Traditional Practitioner

Table 1. Characteristics of participating children, mothers, households and health care providers, by strata

	Rural			Urban			Overall		
	n	%	[95% CI]	n	%	[95% CI]	n	%	[95% CI]
Child Age (in years)	547			536			1,083		
0	102	18.6	[15.6-22.1]	102	19	[15.9-22.6]	204	18.8	[16.6-21.3]
1	115	21	[17.8-24.6]	121	22.6	[19.2-26.3]	236	21.8	[19.4-24.4]
2	115	21	[17.8-24.6]	107	20	[16.8-23.6]	222	20.5	[18.2-23.0]
3	109	19.9	[16.8-23.5]	100	18.7	[15.6-22.2]	209	19.3	[17.1-21.8]
4	106	19.4	[16.3-22.9]	106	19.8	[16.6-23.4]	212	19.6	[17.3-22.1]
Child Sex									
Female	274	50.1	[45.9-54.3]	276	51.5	[47.3-55.7]	550	50.8	[47.8-53.8]
Male	273	49.9	[45.7-54.1]	260	48.5	[44.3-52.7]	533	49.2	[46.2-52.2]
Maternal Age (in years)	387			451			838		
15-19	47	12.1	[9.2-15.8]	51	11.3	[8.7-14.6]	98	11.7	[9.7-14.1]
20-29	155	40.1	[35.3-45.0]	253	56.1	[51.5-60.6]	408	48.7	[45.3-52.1]
30-39	126	32.6	[28.1-37.4]	127	28.2	[24.2-32.5]	253	30.2	[27.2-33.4]
40-49	59	15.2	[12.0-19.2]	20	4.4	[2.9-6.8]	79	9.4	[7.6-11.6]
Maternal Education									
None or primary incomplete	97	25.1	[21.0-29.6]	81	18	[14.7-21.8]	178	21.2	[18.6-24.1]
Primary complete	118	30.5	[26.1-35.3]	70	15.5	[12.5-19.2]	188	22.4	[19.7-25.4]
Secondary incomplete	138	35.7	[31.0-40.6]	171	37.9	[33.5-42.5]	309	36.9	[33.7-40.2]
Secondary complete or higher	34	8.8	[6.3-12.1]	129	28.6	[24.6-33.0]	163	19.5	[16.9-22.3]
Providers									
Govt health center/ post	5			2			7		
Govt CBA/ fieldworker	19			8			27		
Pvt hospital/ clinic	0			4			4		
Pharmacy	0			5			5		
Traditional practitioner	29			3			32		

Table 2. Characteristics of reported child illness and care-seeking events, by strata

	Rural			Urban			Overall		
	n	%	[95% CI]	n	%	[95% CI]	n	%	[95% CI]
	547		536				1083		
Proportion of children with at least one reported DHS illness	199	36.4	[32.4-40.5]	185	34.5	[30.6-38.6]	384	35.5	[32.7-38.4]
Reported child illness	199			185			384		
Fever	117	58.8	[51.8-65.4]	84	45.4	[38.4-52.6]	201	52.3	[47.3-57.3]
Diarrhea	23	11.6	[7.8-16.8]	50	27	[21.1-33.9]	73	19	[15.4-23.3]
ARI[1]	6	3	[1.4-6.6]	3	1.6	[0.5-4.9]	9	2.3	[1.2-4.4]
Diarrhea & Fever	28	14.1	[9.9-19.6]	35	18.9	[13.9-25.2]	63	16.4	[13.0-20.5]
Diarrhea & ARI	3	1.5	[0.5-4.6]	0	0	-	3	0.8	[0.3-2.4]
Fever & ARI	17	8.5	[5.4-13.3]	10	5.4	[2.9-9.8]	27	7	[4.9-10.1]
Diarrhea, Fever, & ARI	5	2.5	[1.0-5.9]	3	1.6	[0.5-4.9]	8	2.1	[1.0-4.1]
Proportion of illnesses for which mother reported seeking care	157	78.9	[72.7-84.0]	123	66.5	[59.4-72.9]	280	72.9	[68.2-77.1]
Maternal reported number of sources of care among children taken for care[2]	157			123			280		
1	148	94.3	[89.3-97.0]	118	95.9	[90.6-98.3]	266	95	[91.7-97.0]
2	9	5.7	[3.0-10.7]	5	4.1	[1.7-9.4]	14	5	[3.0-8.3]
Maternal Reported Care-Seeking Events									
Any provider	166			128			294		
Participating provider	161	97	[93.0-98.7]	113	88.3	[81.5-92.8]	274	93.2	[89.7-95.6]
Skilled provider[3]	159	95.8	[91.4-98.0]	117	91.4	[85.1-95.2]	276	93.9	[90.5-96.1]

[1] ARI defined as cough with chest-related difficulty breathing

[2] There was a maximum of two reported care-seeking events for a single illness

[3] Skilled provider defined as government, mission, and private hospitals, health centers, and health posts, private doctors, and government community based agents

Table 3: Reported versus documented source of care among participating providers, by strata

Provider Type	Rural			Urban			Overall		
	Reported & Documented (TP)	Reported, undocumented (FP)	Unreported, documented (FN)	Reported & Documented (TP)	Reported, undocumented (FP)	Unreported, documented (FN)	Reported & Documented (TP)	Reported, undocumented (FP)	Unreported, documented (FN)
Govt / Public Sector									
Govt Hospital	-	-	-	-	-	-	-	-	-
Govt health center/post	112	10	5	93	17	1	205	27	6
Govt mobile hospital/clinic	-	-	-	-	-	-	-	-	-
Govt CBA/fieldworker	31	4	3	0	1	0	31	5	3
Private Sector									
Pvt hospital/clinic	0	0	0	0	0	0	0	0	0
Mission hospital/clinic	-	-	-	-	-	-	-	-	-
Pharmacy	0	0	0	0	2	1	0	2	1
Pvt doctor	-	-	-	-	-	-	-	-	-
Pvt CBA/fieldworker	-	-	-	-	-	-	-	-	-
Informal									
Shop	-	-	-	-	-	-	-	-	-
Traditional practitioner	4	0	7	0	0	0	4	0	7
Market	-	-	-	-	-	-	-	-	-
TOTAL	147	14	15	93	20	2	240	34	17
ANY SOURCE	139	13	7	94	13	7	233	32	8
SKILLED PROVIDER	137	13	5	93	13	5	230	31	6

Box 2. Interpretation of report characteristic by care-seeking event outcome

Sensitivity	Source of care	Percent of care-seeking events reported for a source of care (category) among care-seeking events that actually occurred at a source of care within the provider category
	Any care-seeking	Percent of mothers who correctly reported seeking care for their sick child (from any source) among mothers of children for whom care was actually sought
	Care-seeking at skilled provider	Percent of mothers who correctly reported seeking care for their sick child from a skilled provider among mothers of children for whom care was actually sought from a skilled provider
Specificity	Source of care	Percent of mothers who correctly reported not seeking care for their sick child among mothers of children for whom care was not sought
	Any care-seeking	Percent of mothers who correctly reported not seeking care for their sick child (from any source) among mothers of children for whom care was not sought
	Care-seeking at skilled provider	Percent of mothers who correctly reported not seeking care for their sick child from a skilled provider among mothers of children for whom care was not sought from a skilled provider
PPV	Source of care	Percent of care-seeking events that actually occurred at a source of care within a category of provider among those care-seeking events reported to have occurred at a source of care
	Any care-seeking	Percent of mothers who actually sought care for a sick child among mothers who reported seeking care for a sick child
	Care-seeking at skilled provider	Percent of mothers who actually sought care for a sick child from a skilled provider among mothers who reported seeking care for a sick child from a skilled provider
NPV	Source of care	Percent of mothers who actually did not seek care for a sick child among mothers who reported not seeking care for a sick child
	Any care-seeking	Percent of mothers who actually did not seek care for a sick child among mothers who reported not seeking care for a sick child.
	Care-seeking at skilled provider	Percent of mothers who actually did not seek care for a sick child from a skilled provider among mothers who reported not seeking care for a sick child from a skilled provider
Accuracy	Source of care	Percent of mothers whose report of source of care (category) for a sick child agreed with provider-documented care-seeking events
	Any care-seeking	Percent of mothers whose report of any care-seeking for a sick child agreed with provider-documented care-seeking events
	Care-seeking at skilled provider	Percent of mothers whose report of seeking care for a sick child from a skilled provider agreed with documented care-seeking events among skilled providers

Table 4. Accuracy of maternal report (provider category match, any provider match, skilled provider match) by strata and overall

A. Source of Care (Provider Category)						
	Rural		**Urban**		**Overall**	
TP	147		93		240	
TP+FN	162		95		257	
Sensitivity, percent (95% CI)	91.21	[83.59 - 95.48]	97.89	[91.97 - 99.47]	94.6	[88.15 - 97.64]
TN	35		61		96	
TN+FP	49		81		130	
Specificity, percent (95% CI)	71.43	[57.36 - 82.29]	75.53	[62.11 - 85.32]	73.85	[65.20 - 80.97]
TP	147		93		240	
TP+FP	161		113		274	
PPV, percent (95% CI)	91.3	[85.85 - 94.78]	82.3	[74.15 - 88.29]	87.63	[82.82 - 91.24]
TN	35		61		96	
TN+FN	50		63		113	
NPV, percent (95% CI)	74.05	[45.45 - 90.72]	96.83	[88.18 - 99.20]	88.68	[66.33 - 96.89]
TP+TN	182		154		336	
TP+TN+FP+FN	211		176		387	
Accuracy, percent (95% CI)	86.25	[80.92 - 90.28]	87.5	[81.75 - 91.63]	86.82	[83.07 - 89.84]
AUC, percent (95% CI)	81.08	[74.31 - 87.86]	86.6	[81.66 - 91.54]	83.62	[79.53 - 87.70]

B. Any Care-seeking						
	Rural		Urban		Overall	
TP	139		94		233	
TP+FN	146		95		241	
Sensitivity, percent (95% CI)	95.36	[89.31 - 98.06]	98.95	[92.91 - 99.85]	97.11	[92.42 - 98.93]
TN	35		61		96	
TN+FP	48		80		128	
Specificity, percent (95% CI)	72.92	[58.75 - 83.58]	76.78	[61.13 - 87.42]	75.09	[65.83 - 82.50]
TP	139		94		233	
TP+FP	152		113		265	
PPV, percent (95% CI)	91.45	[85.83 - 94.97]	83.19	[75.15 - 89.02]	87.96	[83.20 - 91.51]
TN	35		61		96	
TN+FN	42		62		104	
NPV, percent (95% CI)	85.45	[60.44 - 95.76]	98.39	[89.43 - 99.77]	94.3	[77.68 - 98.75]
TP+TN	174		155		329	
TP+TN+FP+FN	194		175		369	
Accuracy, percent (95% CI)	89.69	[84.56 - 93.25]	88.57	[82.95 - 92.51]	89.16	[85.56 - 91.95]
AUC, percent (95% CI)	84.06	[77.48 - 90.65]	87.6	[82.79 - 92.40]	85.84	[81.91 - 89.77]

C. Care-seeking at Skilled Provider						
	Rural		Urban		Overall	
TP	137		93		230	
TP+FN	142		94		236	
Sensitivity, percent (95% CI)	96.64	[90.06 - 98.92]	98.94	[92.84 - 99.85]	97.76	[93.05 - 99.30]
TN	42		69		111	
TN+FP	55		87		142	
Specificity, percent (95% CI)	76.36	[63.43 - 85.75]	80.24	[63.48 - 90.47]	78.44	[69.31 - 85.43]
TP	137		93		230	
TP+FP	150		111		261	
PPV, percent (95% CI)	91.33	[85.65 - 94.90]	83.78	[75.72 - 89.54]	88.13	[83.61 - 91.52]
TN	42		69		111	
TN+FN	47		70		117	
NPV, percent (95% CI)	91.46	[68.75 - 98.12]	98.57	[90.55 - 99.80]	96.66	[83.72 - 99.39]
TP+TN	179		162		341	
TP+TN+FP+FN	197		181		378	
Accuracy, percent (95% CI)	90.86	[85.96 - 94.17]	89.5	[84.13 - 93.20]	90.21	[86.78 - 92.83]
AUC, percent (95% CI)	86.42	[80.55 - 92.29]	89.12	[84.72 - 93.53]	87.81	[84.26 - 91.37]

Table 5. Characteristics associated with accuracy of maternal report

A. Source of Care (Provider Category)	n	OR	[95% CI]	p-value
Demographic Characteristics				
Child Sex				
Female (Ref)	200	1		
Male	187	1.58	[0.75 - 3.30]	0.228
Child Age	387	1.26	[0.95 - 1.67]	0.11
Number of children <5 years in HH	387	1.22	[0.74 - 2.01]	0.437
Maternal Age	387	0.99	[0.94 - 1.05]	0.732
Maternal education				
None or primary incomplete (Ref)	79	1		
Primary complete	82	0.84	[0.26 - 2.65]	0.761
Secondary incomplete	168	0.6	[0.22 - 1.65]	0.318
Secondary complete or higher	58	1.76	[0.37 - 8.43]	0.482
Household wealth (quintile)				
Poorest (Ref)	94	1		
Second	71	2.71	[0.77 - 9.55]	0.122
Middle	80	0.58	[0.22 - 1.49]	0.253
Fourth	78	0.96	[0.31 - 2.97]	0.95
Highest (Wealthiest)	64	0.5	[0.14 - 1.80]	0.286
Household location				
Rural (Ref)	211	1		
Urban	176	1.34	[0.55 - 3.29]	0.524
Illness Characteristics				
Fever (Ref)	200	1		
Diarrhea	74	2.57	[0.98 - 6.77]	0.056
ARI	9	0.68	[0.12 - 3.95]	0.664
Fever & Diarrhea	64	0.84	[0.31 - 2.32]	0.741
Diarrhea & ARI	3	1	[1.00 - 1.00]	-
Fever & ARI	28	0.2	[0.05 - 0.88]	0.033
Fever & ARI & Diarrhea	9	0.28	[0.02 - 3.27]	0.309
Source of Care				
No source (Ref)	130	1		
Govt health center / post	211	25.8	[8.81 - 75.52]	<0.001
Govt CBA	34	6.15	[1.48 - 25.56]	0.012
Pharmacy	1	1	[1.00 - 1.00]	-
Traditional Practitioner	11	0.2	[0.04 - 0.94]	0.042

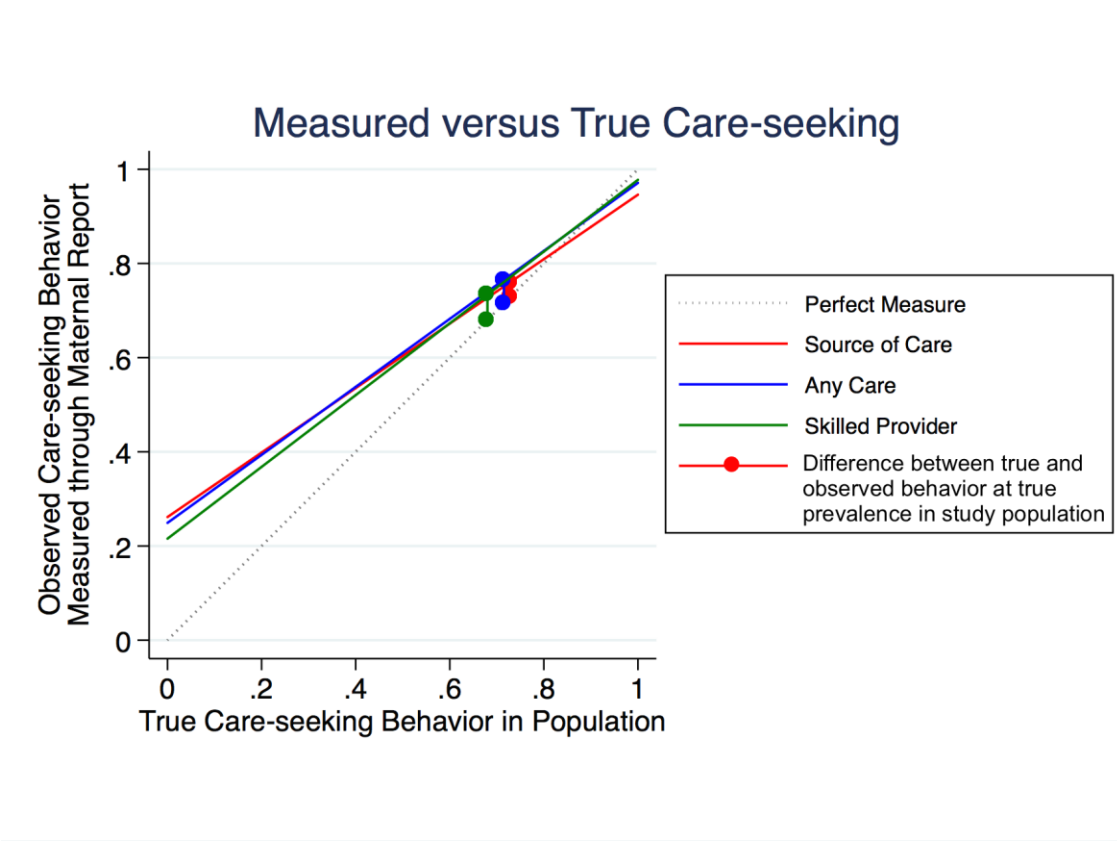
B. Any Match	n	OR	[95% CI]	p-value
Demographic Characteristics				
Child Sex				
Female (Ref)	191	1		
Male	178	1.56	[0.69 - 3.56]	0.287
Child Age	369	1.24	[0.90 - 1.71]	0.179
Number of children <5 years in HH	369	1.41	[0.77 - 2.56]	0.263
Maternal Age	369	0.99	[0.93 - 1.05]	0.689
Maternal education				
None or primary incomplete (Ref)	77	1		
Primary complete	74	1.36	[0.35 - 5.32]	0.658
Secondary incomplete	161	0.46	[0.15 - 1.39]	0.168
Secondary complete or higher	57	1.23	[0.24 - 6.34]	0.805
Household wealth (quintile)				
Poorest (Ref)	90	1		
Second	67	3.96	[1.02 - 15.37]	0.047
Middle	78	0.95	[0.34 - 2.67]	0.927
Fourth	75	1.23	[0.35 - 4.32]	0.743
Highest (Wealthiest)	59	0.96	[0.22 - 4.09]	0.953
Household location				
Rural	194	1		
Urban	175	1.63	[0.63 - 4.19]	0.312
Illness Characteristics				
Fever (Ref)	191	1		
Diarrhea	73	3.53	[1.15 - 10.82]	0.027
ARI	9	0.55	[0.09 - 3.24]	0.506
Fever & Diarrhea	60	0.57	[0.19 - 1.71]	0.316
Diarrhea & ARI	3	1	[1.00 - 1.00]	-
Fever & ARI	25	0.23	[0.04 - 1.38]	0.107
Fever & ARI & Diarrhea	8	0.24	[0.02 - 3.02]	0.266
Source of Care				
No source (Ref)	128	1		
Public Sector	229	26.03	[8.65 - 78.31]	<0.001
Traditional	5	0.31	[0.03 - 2.73]	0.288
Public & Private	1	1	[1.00 - 1.00]	-
Public & Traditional	6	1	[1.00 - 1.00]	-

C. Skilled Provider	n	OR	[95% CI]	p-value
Demographic Characteristics				
Child Sex				
Female (Ref)	195	1		
Male	183	1.31	[0.58 - 2.98]	0.511
Child Age	378	1.25	[0.91 - 1.72]	0.167
Number of children <5 years in HH	378	1.5	[0.83 - 2.72]	0.184
Maternal Age	378	0.97	[0.92 - 1.04]	0.405
Maternal education				
None or primary incomplete (Ref)	81	1		
Primary complete	74	1.28	[0.32 - 5.22]	0.728
Secondary incomplete	163	0.38	[0.13 - 1.13]	0.082
Secondary complete or higher	60	0.91	[0.18 - 4.64]	0.91
Household wealth (quintile)				
Poorest (Ref)	92	1		
Second	68	4.75	[1.21 - 18.60]	0.025
Middle	79	1.16	[0.41 - 3.29]	0.784
Fourth	77	2.24	[0.59 - 8.46]	0.235
Highest (Wealthiest)	62	1.51	[0.36 - 6.37]	0.572
Household location				
Rural	197	1		
Urban	181	2.05	[0.80 - 5.27]	0.135
Illness Characteristics				
Fever (Ref)	197	1		
Diarrhea	73	2.97	[0.94 - 9.44]	0.064
ARI	9	0.74	[0.10 - 5.17]	0.758
Fever & Diarrhea	62	0.52	[0.18 - 1.48]	0.219
Diarrhea & ARI	3	1	[1.00 - 1.00]	-
Fever & ARI	26	0.25	[0.04 - 1.43]	0.118
Fever & ARI & Diarrhea	8	0.19	[0.02 - 2.44]	0.204
Source of Care				
No source (Ref)	137	1		
Public Sector	229	22.82	[7.62 - 68.35]	<0.001
Traditional	5	1	[1.00 - 1.00]	-
Public & Private	1	1	[1.00 - 1.00]	-
Public & Traditional	6	1	[1.00 - 1.00]	-

Table 6. Inflation factor for maternal report of care-seeking at true prevalence in study population, by strata

		True Prevalence	Sensitivity	Specificity	Estimated Prevalence	IF
A. Source of care	Rural	82.23%	91.21%	71.43%	80.08%	0.97
	Urban	60.90%	97.89%	75.53%	69.18%	1.14
	Overall	72.80%	94.60%	73.85%	75.98%	1.04
B. Any Care-seeking	Rural	80.66%	95.36%	72.92%	82.16%	1.02
	Urban	60.90%	98.95%	76.78%	69.34%	1.14
	Overall	71.51%	97.11%	75.09%	76.54%	1.07
C. Care-seeking at Skilled Provider	Rural	77.17%	96.64%	76.36%	79.98%	1.04
	Urban	57.67%	98.94%	80.24%	65.42%	1.13
	Overall	68.01%	97.76%	78.44%	73.38%	1.08

Figure 1. Measured versus true care-seeking behavior estimated through maternal report of care-seeking for child illness



Sup Table 1. Accuracy of maternal report provider category match by reported illness type, by strata and overall

A. Diarrhea						
	Rural		**Urban**		**Overall**	
TP	44		32		76	
TP+FN	48		33		81	
Sensitivity, percent (95% CI)	95.08	[54.42 - 99.68]	96.97	[81.39 - 99.57]	95.78	[78.90 - 99.28]
TN	14		41		55	
TN+FP	17		52		69	
Specificity, percent (95% CI)	82.35	[57.29 - 94.20]	84.94	[43.13 - 97.67]	84.59	[60.76 - 95.11]
TP	44		32		76	
TP+FP	47		43		90	
PPV, percent (95% CI)	93.62	[82.00 - 97.93]	74.42	[59.45 - 85.23]	87.77	[72.33 - 95.17]
TN	14		41		55	
TN+FN	18		42		60	
NPV, percent (95% CI)	95.96	[6.65 - 99.99]	97.62	[84.94 - 99.67]	97.5	[56.03 - 99.92]
TP+TN	58		73		131	
TP+TN+FP+FN	65		85		150	
Accuracy, percent (95% CI)	91.86	[70.93 - 98.12]	89.78	[65.88 - 97.56]	91.01	[77.37 - 96.77]
AUC, percent (95% CI)	87.01	[76.87 - 97.15]	87.91	[81.57 - 94.25]	86.77	[81.31 - 92.23]

B. Fever						
	Rural		Urban		Overall	
TP	132		80		212	
TP+FN	143		81		224	
Sensitivity, percent (95% CI)	92.31	[86.64 - 95.69]	98.77	[89.07 - 99.87]	96.22	[87.92 - 98.89]
TN	24		26		50	
TN+FP	34		43		77	
Specificity, percent (95% CI)	70.59	[53.44 - 83.39]	60.47	[45.35 - 73.81]	64.94	[53.70 - 74.73]
TP	132		80		212	
TP+FP	142		97		239	
PPV, percent (95% CI)	92.96	[87.41 - 96.17]	82.47	[73.60 - 88.82]	88.97	[82.43 - 93.27]
TN	24		26		50	
TN+FN	35		27		62	
NPV, percent (95% CI)	68.57	[51.66 - 81.66]	96.3	[77.92 - 99.48]	80.65	[68.93 - 88.67]
TP+TN	156		106		262	
TP+TN+FP+FN	177		124		301	
Accuracy, percent (95% CI)	88.14	[82.49 - 92.14]	85.48	[78.13 - 90.66]	87.04	[82.76 - 90.39]
AUC, percent (95% CI)	81.45	[73.37 - 89.52]	79.62	[72.12 - 87.11]	79.79	[74.23 - 85.35]

C. ARI						
	Rural		Urban		Overall	
TP	23		11		34	
TP+FN	27		11		38	
Sensitivity, percent (95% CI)	85.19	[66.54 - 94.33]	100	[100 - 100]	89.47	[75.10 - 95.99]
TN	3		4		7	
TN+FP	5		6		11	
Specificity, percent (95% CI)	59.97	[20.02 - 89.96]	66.67	[26.81 - 91.61]	63.64	[33.88 - 85.67]
TP	23		11		34	
TP+FP	25		13		38	
PPV, percent (95% CI)	92	[73.06 - 97.99]	84.61	[54.94 - 96.13]	89.47	[75.10 - 95.99]
TN	3		4		7	
TN+FN	7		4		11	
NPV, percent (95% CI)	42.86	[14.37 - 77.02]	100	[100 - 100]	65.09	[27.83 - 90.01]
TP+TN	26		15		41	
TP+TN+FP+FN	32		17		49	
Accuracy, percent (95% CI)	81.25	[64.08 - 91.33]	88.23	[63.17 - 97.04]	83.67	[70.61 - 91.62]
AUC, percent (95% CI)	72.59	[47.64 - 97.55]	83.33	[62.67 - 100]	76.56	[60.85 - 92.26]

Sup Table 2: Maternal report of source of care: original report, reclassified by specific provider name, and events reported at participating providers

	Rural			Urban			Overall		
Provider Type	**Reported**	**Reclassified**	**Participating**	**Reported**	**Reclassified**	**Participating**	**Reported**	**Reclassified**	**Participating**
Govt / Public Sector									
Govt Hospital	12	0		6	5		18	5	0
Govt health center/post	105	123	122	109	110	110	214	233	232
Govt mobile hospital/clinic	0	--	--	0	--	--	0	--	--
Govt CBA/fieldworker	35	35	35	1	1	1	36	36	36
Private Sector									
Pvt hospital/clinic	0	0	0	1	1	0	1	1	0
Mission hospital/clinic	6	--	--	0	--	--	6	--	--
Pharmacy	1	1	0	2	2	2	3	3	2
Pvt doctor	0	--	--	0	--	--	0	--	--
Pvt CBA/fieldworker	1	--	--	0	--	--	1	--	--
Informal									
Shop	2	2	0	8	8	0	10	10	0
Traditional practitioner	4	4	4	0	0	0	4	4	4
Market	0	0	0	1	1	0	1	1	0
TOTAL	0	1	0	0	0	0	0	1	0

Sup Table 3. Accuracy of maternal report provider category match by strata and overall, without correcting incorrect provider classifications

A. Source of Care (Provider Category)						
	Rural		Urban		Overall	
TP	131		92		223	
TP+FN	161		95		256	
Sensitivity, percent (95% CI)	82.98	[71.40 - 90.49]	96.84	[90.66 - 98.98]	91.35	[79.91 - 96.56]
TN	35		61		96	
TN+FP	49		81		130	
Specificity, percent (95% CI)	71.43	[57.36 - 82.29]	75.53	[62.11 - 85.32]	73.85	[65.20 - 80.97]
TP	131		92		223	
TP+FP	145		112		257	
PPV, percent (95% CI)	90.34	[84.36 - 94.20]	82.14	[73.93 - 88.18]	86.78	[82.06 - 90.40]
TN	35		61		96	
TN+FN	65		64		129	
NPV, percent (95% CI)	59.73	[33.38 - 81.45]	95.31	[86.45 - 98.48]	82.9	[52.97 - 95.43]
TP+TN	166		153		319	
TP+TN+FP+FN	210		176		386	
Accuracy, percent (95% CI)	79.96	[71.05 - 86.64]	86.93	[81.10 - 91.16]	83.51	[77.31 - 88.27]
AUC, percent (95% CI)	76.4	[69.33 - 83.46]	86.08	[81.03 - 91.12]	80.48	[76.16 - 84.79]

B. Any Care-seeking						
	Rural		Urban		Overall	
TP	139		94		233	
TP+FN	146		95		241	
Sensitivity, percent (95% CI)	95.36	[89.31 - 98.06]	98.95	[92.91 - 99.85]	97.11	[92.42 - 98.93]
TN	35		61		96	
TN+FP	48		80		128	
Specificity, percent (95% CI)	72.92	[58.75 - 83.58]	76.78	[61.13 - 87.42]	75.09	[65.83 - 82.50]
TP	139		94		233	
TP+FP	152		113		265	
PPV, percent (95% CI)	91.45	[85.83 - 94.97]	83.19	[75.14 - 89.01]	87.96	[83.20 - 91.51]
TN	35		61		96	
TN+FN	42		62		104	
NPV, percent (95% CI)	85.45	[60.44 - 95.76]	98.38	[89.42 - 99.77]	94.3	[77.68 - 98.75]
TP+TN	174		155		329	
TP+TN+FP+FN	194		175		369	
Accuracy, percent (95% CI)	89.69	[84.56 - 93.25]	88.57	[82.95 - 92.51]	89.16	[85.56 - 91.95]
AUC, percent (95% CI)	84.06	[77.48 - 90.65]	87.6	[82.79 - 92.40]	85.84	[81.91 - 89.77]

C. Care-seeking at Skilled Provider						
	Rural		Urban		Overall	
TP	136		93		229	
TP+FN	142		94		236	
Sensitivity, percent (95% CI)	95.77	[90.91 - 98.09]	98.94	[92.84 - 99.85]	97.04	[92.77 - 98.82]
TN	42		69		111	
TN+FP	55		87		142	
Specificity, percent (95% CI)	76.36	[63.43 - 85.75]	80.24	[63.48 - 90.47]	78.44	[69.31 - 85.43]
TP	136		93		229	
TP+FP	149		111		260	
PPV, percent (95% CI)	91.28	[85.55 - 94.87]	83.78	[75.72 - 89.54]	88.08	[83.54 - 91.49]
TN	42		69		111	
TN+FN	48		70		118	
NPV, percent (95% CI)	87.83	[71.09 - 95.49]	98.57	[90.55 - 99.80]	95.82	[82.18 - 99.13]
TP+TN	178		162		340	
TP+TN+FP+FN	197		181		378	
Accuracy, percent (95% CI)	90.36	[85.37 - 93.76]	89.5	[84.13 - 93.20]	89.95	[86.48 - 92.60]
AUC, percent (95% CI)	86.07	[80.17 - 91.97]	89.12	[84.72 - 93.53]	87.6	[84.02 - 91.18]

Sup Table 4. Accuracy of maternal report provider category match by strata and overall, without excluding non-participating providers

A. Source of Care (Provider Category)						
	Rural		Urban		Overall	
TP	147		93		240	
TP+FN	162		95		257	
Sensitivity, percent (95% CI)	90.74	[85.21 - 94.34]	97.89	[91.97 - 99.47]	93.39	[89.62 - 95.85]
TN	35		61		96	
TN+FP	54		96		150	
Specificity, percent (95% CI)	64.81	[51.31 - 76.30]	63.54	[53.49 - 72.53]	64	[56.02 - 71.27]
TP	147		93		240	
TP+FP	166		128		294	
PPV, percent (95% CI)	88.55	[82.75 - 92.58]	72.66	[64.30 - 79.67]	81.63	[76.79 - 85.65]
TN	35		61		96	
TN+FN	50		63		113	
NPV, percent (95% CI)	70	[56.03 - 81.03]	96.83	[88.18 - 99.20]	84.96	[77.13 - 90.44]
TP+TN	182		154		336	
TP+TN+FP+FN	216		191		407	
Accuracy, percent (95% CI)	84.26	[78.78 - 88.53]	80.63	[74.41 - 85.63]	82.56	[78.56 - 85.94]
AUC, percent (95% CI)	77.78	[70.97 - 84.58]	80.72	[75.67 - 85.77]	78.69	[74.55 - 82.84]

B. Any Care-seeking						
	Rural		Urban		Overall	
TP	139		94		233	
TP+FN	146		95		241	
Sensitivity, percent (95% CI)	95.21	[90.29 - 97.70]	98.95	[92.91 - 99.85]	96.68	[93.50 - 98.33]
TN	35		61		96	
TN+FP	48		80		128	
Specificity, percent (95% CI)	72.92	[58.75 - 83.58]	76.25	[65.73 - 84.31]	75	[66.79 - 81.74]
TP	139		94		233	
TP+FP	152		113		265	
PPV, percent (95% CI)	91.45	[85.83 - 94.97]	83.19	[75.14 - 89.01]	87.92	[83.42 - 91.33]
TN	35		61		96	
TN+FN	42		62		104	
NPV, percent (95% CI)	83.33	[68.95 - 91.84]	98.39	[89.42 - 99.77]	92.31	[85.37 - 96.11]
TP+TN	174		155		329	
TP+TN+FP+FN	194		175		369	
Accuracy, percent (95% CI)	89.69	[84.56 - 93.25]	88.57	[82.95 - 92.51]	89.16	[85.56 - 91.95]
AUC, percent (95% CI)	84.06	[77.48 - 90.65]	87.6	[82.79 - 92.40]	85.84	[81.91 - 89.77]

C. Care-seeking at Skilled Provider						
	Rural		Urban		Overall	
TP	136		93		229	
TP+FN	142		94		236	
Sensitivity, percent (95% CI)	95.77	[90.91 - 98.09]	98.94	[92.84 - 99.85]	97.03	[93.91 - 98.58]
TN	42		69		111	
TN+FP	55		87		142	
Specificity, percent (95% CI)	76.36	[63.43 - 85.75]	79.31	[69.53 - 86.56]	78.17	[70.63 - 84.21]
TP	136		93		229	
TP+FP	149		111		260	
PPV, percent (95% CI)	91.28	[85.55 - 94.87]	83.78	[75.72 - 89.54]	88.08	[83.54 - 91.49]
TN	42		69		111	
TN+FN	48		70		118	
NPV, percent (95% CI)	87.5	[74.85 - 94.27]	98.57	[90.55 - 99.80]	94.07	[88.08 - 97.15]
TP+TN	178		162		340	
TP+TN+FP+FN	197		181		378	
Accuracy, percent (95% CI)	90.36	[85.37 - 93.76]	89.5	[84.13 - 93.20]	89.95	[86.48 - 92.60]
AUC, percent (95% CI)	86.07	[80.17 - 91.97]	89.12	[84.72 - 93.53]	87.6	[84.02 - 91.18]

Sup Table 5. Sensitivity of maternal report provider category match by method of confirmation

	n	OR	95% CI	p-value
Source of care				
Govt health center / post (Ref)	211	1	-	-
Govt CBA	34	0.31	[0.06 - 1.47]	0.139
Pharmacy	1	1	[1.00 - 1.00]	-
Traditional practitioner	11	0.02	[0.00 - 0.10]	<0.001
Confirmation Method				
Register Only (Ref)	59	1	-	-
Ribbon	58	0.3	[0.03 - 2.87]	0.296
Scan	42	0.3	[0.03 - 3.18]	0.319
Ribbon & Scan	98	1.23	[0.11 - 14.15]	0.868

Paper 2: Exact-match Linking to Estimate Coverage of Appropriate Management of Child Illness

1. Background

There are numerous proven interventions for preventing and managing child illness in low- and middle-income countries (LMICs). Despite the efficacy of these interventions, limited intervention coverage has restricted their impact on child survival. Intervention coverage is defined as the proportion of a population in need of an intervention that receives the intervention. Governments and other organizations implementing health programs need coverage data to development more effective child health programs and policies. Accurate, timely, and informative data on coverage of essential child health interventions is required for continued reduction in child mortality.

Intervention coverage is commonly measured through nationally representative household surveys, such as the Demographic and Health Survey (DHS) and Multiple Indicator Cluster Survey (MICS). These surveys typically collect information through respondent self-report. Studies of indicator validity have demonstrated that household surveys may inaccurately estimate coverage of key child health interventions, including treatment of malaria, pneumonia, and diarrhea (1–3). Other indicators do not reflect receipt of appropriate management due to unclear etiologies of disease, complex treatment, and limited information captured through the survey. Where household surveys are found to be inaccurate, new methods are needed for generating more reliable child health coverage estimates.

Linking information on the source of care collected through household survey with health care provider assessments of the quality and extent of services has been proposed as a means of generating more informative population-level estimates of the coverage of key health interventions (4). A recent systematic review found almost 60 studies published since 1990 have linked information from household surveys and service environment assessments to address coverage of reproductive, maternal, newborn, and child health (RMNCH) interventions in LMICs (5). The review found the majority of studies (51 / 59) performed ecological linking by assigning an individual or household to all or the nearest health care providers based on geographic proximity, rather than the reported source of care. Most used independent data sources, primarily DHS and Service Provision Assessment (SPA) surveys, presenting issues for how accurately facility data reflected the service environment for surveyed households. Household and facility data were often collected at different time points and in different geographic locations. SPA surveys are not intended to be representative at a cluster level, rely on a sample of facilities, and do not collect information on community-based public providers or non-facility private providers. All of these factors suggest that data do not accurately reflect the availability or quality of services accessed by an individual at their specific source of care.

The review identified eight studies that employed exact-match linking, or assigned the individual to specific providers from which care was received (5). Half drew their sample from facility records introducing potential self-selection bias among care-seekers and could not be used to produce population-level estimates of coverage. Only one study in Asembo, Kenya linked household data on care-seeking for child illness to

the exact clinic from which care was received (6). However, this study was conducted as part of a demographic surveillance system (DSS) where participating clinics routinely logged the DSS ID of patients. The study did not collect information of sources of care beyond the DSS clinics.

These publications highlight a number of methodological issues in linking household and health care provider assessments that could limit the accuracy and usefulness of estimates generated through this method. There is a need to rigorously test linking methodologies to guide future linking studies. This study was purposively designed to assess the feasibility of collecting geographically and temporally concurrent household and complete provider data at a small scale in both an urban and rural setting. It also addresses methodological issues in generating estimates of provider preparedness to manage child illness and statistical concerns in linking data.

2. Methods

Ethical approval for the study was obtained from the Institutional Review Boards of Johns Hopkins Bloomberg School of Public Health and Excellence in Research Ethics and Science (ERES) Converge in Zambia.

2.1. Study Site

The study was conducted in Choma District in Southern Province, Zambia, between January 18 and March 20, 2016. The economy of Choma District is primarily agrarian, although Choma town is a growing commercial hub and provincial capital (7). Zambia experiences three seasons, a cool dry season from May to August, a hot dry season from September to October, and a warm rainy season from November to April (8).

Child under five mortality rates in Southern Province have declined dramatically over the past 2 decades from 134 deaths per 1,000 live births in 1992 to 68 deaths per 1,000 live births in 2013-2014 (8). Pneumonia, diarrhea, and malaria remain the leading causes of child under five mortality in the post-neonatal period (8). The 2013 Zambia Demographic and Health Survey (ZDHS) found high variability in the two-week prevalence of illness among children less than 5 years, with 21 percent experiencing fever, 18 percent experiencing diarrhea, and 4 percent of children experiencing symptoms of ARI. Seasonality in child illness exists in the region, with ARI cases peaking in the dry season, diarrhea most prevalent during the rainy season, and malaria rates peaking late in the rainy season (8). Southern Province is classified as an area with sustained malaria control resulting in malaria parasite prevalence under 10% in children under 5 years at peak transmission (9). Reported care-seeking for child illness is high in Southern Province, with approximately 70 percent of mothers reporting they sought care for their child with fever (68.5%), diarrhea (70%), or ARI symptoms (68%). National guidelines on the management of suspected pneumonia, fever, and diarrhea align with WHO Integrated Management of Child Illness (IMCI) guidelines, including use of low-osmolality ORS and zinc in the management of diarrhea, antibiotics for management of ARI, and artemisinin combination therapy (ACT) for treatment of malaria. Guidelines on the management of fever were revised in 2013 to include parasitological confirmation of malaria at government health facilities (8).

The public sector dominates health service delivery in Zambia. The government manages 90% of health facilities either directly or through service agreements with the Churches Health Association of Zambia. There is growing private sector involvement in

urban centers (10). Health services are free for children <5 years at all government facilities, including referral services to hospitals with presentation of a referral letter (11). Community based health agents (CBAs) may participate in task shifting at government health centers and health posts and deploy a variable package of community-based interventions, including diagnosis and treatment of malaria and treatment of diarrhea with oral rehydration solution (ORS) (12). IMCI has been implemented in all districts since the 1990s; however by the late 2000s only about 65% of health facilities had been staffed by an IMCI-trained clinician (13).

2.2. Study Design, Participants, and Data Collection

The study included two components; 1) a household survey on care-seeking for child illness, and 2) an assessment of provider readiness. The study area was defined as the catchment population of five government health facilities in and around Choma town, and stratified into urban and rural populations.

Health care providers were identified and asked to participate in the readiness assessment. Care providers were defined as public, private, informal or traditional source of care, including government health workers, private clinics, pharmacies, shops, and traditional or faith healers. In each catchment area, community leaders and health workers generated a listing of commonly utilized care providers offering medicine or alternative treatment for sick children. These providers were approached to participate in the provider assessment. During the household enrollment survey, participating mothers were also asked to identify common sources of care for treating illness in their children <5 years to ensure all providers were included in the provider assessment. Most sources of care reported by mothers had been previously identified through the consultation with

local leaders. Two additional providers, both government health facilities outside the study area, were identified through the enrollment survey and included in the study.

All public and private facilities, pharmacies, and government CBAs offering child curative services, and the most commonly utilized traditional practitioners and informal drug outlets in the study area participated in the readiness assessment (Fig 1). Interviewers asked consenting providers a series of questions about their individual or facility's readiness to provide curative services for children <5 years. At facilities and pharmacies with multiple staff, the questionnaire was administered to the most senior staff member. The questionnaire was modeled off the WHO Service Availability and Readiness Assessment (SARA) general and child health questionnaire (14) and adapted for use with facility-based, community-based, public, private, and informal providers. The questionnaire included additional questions about staff supervision, operating hours, and user fees. Health care provider knowledge was assessed using clinical case scenarios developed for use in the evaluation of the IMCI program (15). Providers were read four clinical case scenarios and asked how they would manage each hypothetical sick child. At outlets with multiple clinical staff, up to three staff members within a cadre of clinical health workers were randomly selected among those available at the time of the assessment to respond to case scenarios.

Information was collected on how providers managed sick children brought for treatment. Participating providers were given a smart phone with an application for recording information on the symptoms, testing, diagnosis, and treatment of a sick child. Providers were instructed to record this information for children participating in the household survey, identified through presentation of a study identification card at the

time of treatment. Government and private health facilities, CBAs, and some traditional practitioners collected data on management of sick children. Treatment information was transmitted via cellular data in real-time. Where data could not be transmitted due to inconsistent cellular signal, data were manually extracted from the study phones at the end of the data collection period.

Concurrent to the provider assessment, households with children <5 years were enrolled in the study (January 18 – February 13, 2016). Households were randomly sampled from the catchment area of three rural health facilities using an existing household listing created in 2014 (16). Urban households were sampled from a census of households conducted immediately prior to the household enrollment phase. Households were eligible to participate in the study if a woman of reproductive age (15-49 years) with at least one biological child < 58 months resided in the household. These criteria were selected to correlate with the DHS requirements for the Women's Questionnaire and ensure participating children were under 5 years of age at the time of the follow-up household survey. In consenting households, a brief survey was conducted on household assets, demographics, and maternal preferences in seeking care for sick children. All enrolled children < 58 months were assigned a laminated card with a unique barcode number. In the event curative services were sought for a sick child, household members were instructed to present the card at the source of care.

Approximately four to six weeks after enrollment, participating households were revisited and the follow-up care-seeking survey was administered (March 3 – 20, 2016). Mothers were asked a series of questions on child illness and care seeking identical to those asked in the Zambia DHS (ZDHS). Participating mothers were asked about the

presence of diarrhea, fever, or suspected ARI in each of their children <5 years in the preceding two weeks. If a child experienced one or more of these illnesses, the mother was asked if any care was sought, the source of care, and treatment received. Following the completion of the series of ZDHS care-seeking questions, an additional questionnaire was administered to ascertain the name of the specific source of care and sequence of care-seeking events. Specific names of health care providers were pre-coded in the survey instrument based on the listing of commonly utilized providers, with an option to enter other providers as a string variable. If the mother was unsure of the name of the source of care, data collectors were instructed to probe on the location of the provider and other identifying features.

2.3. Primary Outcome

The primary study outcome was coverage of appropriate management of child illness. Coverage of appropriate management was calculated by linking information on source of care for child illness, collected through the household survey, with an estimate of the specific source of care's preparedness to appropriately manage a child illness. Source of care was defined as maternal-reported source of care collected through the ZDHS section of the household survey. A provider's preparedness, or likelihood of appropriately managing a child illness, was defined using information from the provider readiness assessments. Each sick child was assigned the preparedness score for the specific source(s) of care from which care was sought, based on the name of the facility, outlet, or provider stated by the mother during the household survey.

Measures of provider preparedness to correctly manage a child illness were constructed using information collected through the readiness assessment questionnaire

and case scenario responses. Each source of care (either individual or outlet) received a likelihood of appropriate management (LAM) score. Three LAM score constructions were evaluated; 1) a score using standard general and child health SARA domains; 2) an essential readiness score including only those indicators deemed necessary for correct management of a child illness; and 3) a basic commodities score based on diagnostic capacity and medicines for managing uncomplicated malaria, diarrhea, and ARI (Box 1).

Additional outcomes related to the feasibility of data collection for the exact-match linking method, care-seeking behavior, and management of sick children were also assessed. Overall rates of care-seeking, care-seeking from a skilled provider, and availability of basic commodities at the source of care were assessed by type of illness. In this context, skilled providers included government, mission, and private hospitals, health centers, and health posts, private doctors, and government community based agents. Coverage of treatment of child illness was also calculated based on maternal-reported treatment captured through the household survey and compared against the linked estimates of coverage.

2.4. Sample Size and Stratification

The sample size was calculated to estimate the validity of maternal report of care-seeking for child illness presented in Paper 1. We estimated a sample of 107 documented care-seeking events for child illness in the preceding 2 weeks was needed in both strata to estimate the sensitivity and specificity of maternal report with a precision of ±8.0%. The sample size estimate was based on a type-1 error probability of 5% (two-tailed test), an underlying sensitivity and specificity of 80%, and a design effect of 1.1 for limited clustering within the health facility catchment area due to correlation in source of care.

Approximately 560 children under 5 per strata were needed to capture 107 care-seeking events assuming 27.8% of children experienced a DHS illness in the 2 weeks preceding the survey (17), mothers reported seeking care for 81% of those illnesses (17), 10% of care-seeking events would occur at a provider not participating in the care-seeking event tracking, and the mothers of 5% of children would be unavailable at the time of the follow-up survey. To enroll 560 children per stratum, 700 households were sampled in each stratum assuming 90% of sampled households would be available and willing to participate and a household on average has 0.88 children <5 years (16).

2.5. Analysis

The study analysis was conducted in Stata 14.2. The primary outcome of coverage of appropriate management of child illness was calculated using an exact-match linking method where each sick child was assigned the LAM score for the specific source(s) of care from which care was sought. If care was reportedly sought from more than one source, two methods were used to assigning the child a score for likelihood of appropriate management; 1) the child was assigned the average score for all providers from which care was sought, and 2) the child was assigned the highest readiness score of the providers from which care was sought. The average estimate is presented throughout this paper. The estimate generated using the highest scoring provider is presented in Supplementary Tables 1-3. If no care was sought for the illness, the child was assigned a likelihood of appropriate management score of zero. Coverage was calculated using a generalized linear model to estimate the average LAM score across all sick children.

Each LAM score was constructed using the approach employed by the SARA; each indicator received one point if requirements were met and zero if not, and each

domain received equal weight (14). Scores were constructed in two ways; 1) scoring all providers against the standard of readiness for government health facilities; and 2) scoring providers against the expected requirements for their specific outlet type. Each score was also evaluated with and without inclusion of a domain for provider knowledge of child illness management based on performance on the case management scenarios. The knowledge domain was calculated as an average score of provider performance on the four case scenarios. Correct responses to the case scenarios were defined based on Zambian IMCI guidelines (18) in consultation with a Zambian physician and clinical medicine lecturer. Referral was considered correct treatment for those providers that lacked the capacity to manage a severe illness presented in the case scenarios.

LAM scores were evaluated against a measure of correct management of child illness. The measure of correct management was based on provider-reported management of sick children participating in the household survey and brought to the provider for care. For each child the provider reported treating, correct management was assessed on three parameters: 1) correct testing based on reported symptoms, 2) correct diagnosis based on symptoms and test results, and 3) correct treatment based on diagnosis. Correct management on each of the three parameters was defined using the Zambian IMCI guidelines (18) and current national policy (19) for malaria diagnosis based on parasitological confirmation. On each parameter, providers received one point for correct management and zero for incorrect management, for a maximum score of three points per child treated. The correct management scores for all children managed by the provider were averaged to generate the provider's correct management score. Providers that

recorded management information on fewer than 10 children were excluded from the analysis.

Each of the LAM score constructs was assessed against the correct management score. LAM score domains were treated as independent variables for predicting the dependent outcome of correct management using a linear regression model. The fit of each score was evaluated on the basis of the magnitude of the coefficient of determination, or how well the score domains accounted for the variance in the dependent outcome of correct management. The predictive accuracy of each score was assessed using k-fold cross-validation to assess the score's ability to fit out-of-sample data. In this method, the model was systematically fit leaving out one provider. The estimated parameters were used to predict the correct management score for the remaining providers based on the domain score values. The average and range of the root-mean-square error (RMSE) of the iterations was used to assess the predictive accuracy of each score. Additionally, the association between each domain and the correct management score was assessed. Each provider's domain scores were plotted against the correct management score and a linear prediction line was fit. Systematic LAM score model fitting was used to identify score domains most correlated with the outcome of correct management, using a cut-off of $p<0.05$.

Coverage of maternal-reported treatment of sick children was calculated using relevant questions from the household survey. Coverage was calculated as the proportion of children with fever, diarrhea, or ARI that received treatment based on maternal-reported care. Coverage measures were defined using current global guidelines for

reporting management of malaria (20), diarrhea, and ARI (21) and recent standard DHS indicators.

The feasibility of exact-match linking data collection was evaluated on the proportion of sources of care reported during the household care-seeking survey that could not by identified and assessed. The methods for identifying providers were assessed on 1) the proportion of sources of care that were not identified in advance of the household survey and 2) the proportion of providers that were identified as "common" sources of care that were not reported as a source during the care-seeking survey.

3. Results

A total of 325 rural household and 436 urban households were approached to participate in the care-seeking survey. Four rural and 10 urban households refused to participate in the care-seeking survey. Characteristics of participating children and mothers are shown in Table 1. There was an approximately equal distribution of children by age and gender. There were slightly fewer children under one year of age due to the lag period between enrollment and the care-seeking survey, which excluded neonates born within the follow-up period. The mean age of mothers was 29.6 years in the rural area and 27.1 years in the urban area. Mothers in the urban area on average had slightly higher education (66.5% with some secondary or higher) compared to mothers in the rural area (44.5% with some secondary or higher).

Among the 1,084 children included in the care-seeking survey, 34.6% of urban children and 36.4% of rural children experienced at least one illness meeting DHS criteria in the 2 weeks preceding the survey (Table 2). Fever was the most commonly

experienced symptom in both the rural and urban areas. Among those children that experienced a DHS illness, mother's reported care was sought for 78.9% of rural children and 66.7% of urban children. Reported care-seeking from more than one source was uncommon (5% of children taken for care). Among those children taken for care, mothers most often reported their child was taken to a skilled provider (95.2% rural care-seeking events, 91.5% urban care-seeking events).

3.1. Feasibility

Approximately140 health care providers that treated sick children were initially identified through consultation with village leaders. This initial listing excluded most shops. In urban Choma, a large number of informal shops stocked one or two unregulated drugs, such as paracetamol, in addition to grocery items. It was not feasible to identify all shops because they were numerous and treated a relatively small number of children. The initial listing was reduced to 80 providers, or approximately 15 providers per HFCA, by asking community leaders to identify only those providers that treated the greatest number of children in the community. This reduced listing included all government health facilities and CBAs trained in child curative services, private facilities, and pharmacies within the study area. Thirty traditional practitioners and two churches were also selected. All providers agreed to participate in the provider assessment.

During the care-seeking survey, mothers reported seeking care for their sick child from 39 unique providers. Among the 23 unique sources of care utilized by the rural study population, 19 had been identified prior to the household enrollment through consultation with local leaders. These 19 providers accounted for 92.1% of care-seeking events in the rural area. The urban population utilized 16 unique sources of care; seven

were identified prior to the household survey. The seven identified providers accounted for 93% of care-seeking events in the urban population. The remaining 9 urban providers not previously identified through the consultation included shops and one unnamed CBA each accounting for a single care-seeking event. Of the 80 providers identified through the consultation and included in the readiness assessment, only 32% (26 / 80) were reported as a source of care during the household care-seeking survey.

During the household enrollment survey, 24 providers were identified as "usual" sources of care and more than 100 providers were identified as occasional sources of care in managing a child illness. The 24 "usual" providers identified during the household enrollment included all public facilities, 7 government CBAs, one private facility, and 7 traditional practitioners. The listing of "usual" providers produced two additional sources of care that had not been identified during the consultation with local leaders. Two additional government facilities outside of the study area were identified which provided services to a segment of households participating in the study. The provider assessment was conducted for these two government facilities during the follow-up period. These two facilities accounted for an additional 6.6% of rural care-seeking events. Among the 23 unique sources of care utilized by the rural study population, 13 had been identified as usual sources of care during the enrollment survey and accounted for 89.7% of care-seeking events. Among the 16 unique sources of care utilized by the urban study population, only 4 had been identified as usual sources of care but accounted for 90.7% of care-seeking events. Of the 24 providers identified as a "usual" source of care and included in the readiness assessment, 16 (66%) were reported as a source of care during the household care-seeking survey.

During the household care-seeking survey, mothers reported a small number of care-seeking events with providers that had not been identified and assessed during the consultation or household enrollment phase. In the rural area, two care-seeking events were reported with providers that had not been identified prior to the survey, including one traditional practitioner and one pharmacy outside the study area. The mother was able to report the name of the traditional practitioner, but the individual could not be located. The name of the pharmacy could not be recalled and was reportedly located outside of the study area. In the urban area, 10 care-seeking event were reported with previously unidentified providers including one unidentified government CBA and nine unidentified shops or market stalls. The mother could not recall the name of the CBA. One mother was able to report the name of the shop and its location. The shop was located and included in the provider assessment. Mothers were unable to report the name of the remaining 8 shops or the shop had no formal name. Additional information on shop location was not sufficient to identify the providers.

3.2. Provider Preparedness to Manage Child Illness

Different types of providers offered a range of services for sick children (Table 3). Government and private health facilities treated all common child illnesses. The majority of government CBAs diagnosed and treated malaria, while less than half managed diarrhea and/or malnutrition. CBAs in the study area were not allowed to carry antibiotics or manage ARI. Half of pharmacies reported performing some form of sick child consultation in addition to selling medicines. Informal shops only sold medicines. Traditional practitioners, including faith healers, treated a range of conditions and often provided some form of traditional medicine.

Three LAM scores were evaluated with and without a provider knowledge domain, and using standard and provider-specific requirements. The median domain scores for the SARA score (Table 4), Essential Readiness score (Table 5), and Basic Commodities score (Table 6) are presented using both standard and provider-specific requirements. Across all three scores, non-facility providers scored much higher when judged against the provider-specific requirements compared to the facility standard.

Across all score constructions, government and private facilities had the highest LAM scores. Pharmacies performed slightly better than CBAs on the SARA and Basic Commodities score due to the scores' emphasis on drug availability. Informal shops and traditional practitioners consistently performed poorly across all LAM scores. Facilities performed the poorest on domains related to training and guidelines, and availability of medicines for managing severe disease. CBAs performed poorly on domains related to infrastructure and equipment, availability of basic medicines, training and guidelines, and management capacity. Pharmacies excelled on measures of medicine availability, but failed on all other measures. Shops and traditional practitioners performed poorly on all domains.

Government CBAs and the hospital performed well on the knowledge assessment. Other government and private facilities performed moderately, with little variation within the category. The majority of pharmacies, shops, and traditional practitioners performed poorly, with high variation within the category. Inclusion of the knowledge domain reduced scores for all providers, with the exception of most CBAs.

Each LAM score construction was evaluated against a measure of correct management of child illness created from provider-reported treatment of sick children

participating in the study. Overall, 24 providers registered information on treatment of at least one child in the study. However, only ten providers met the threshold reporting treatment for at least 10 children for generation of a correct management score. This included 4 government health facilities and 6 CBAs. These ten providers accounted for 76% of maternal-reported care-seeking events. Scores ranged from zero (completely incorrect) to 1 (completely correct) management of sick children. The average facility correct management score was 0.78 and ranged from 0.68 to 0.95 (data not shown). The average CBA correct management score was 0.85 and ranged from 0.57 to 0.98 (data not shown).

Correlation between each score domain and the correct management score was evaluated for each of the three LAM constructions. Across all three scores, the knowledge domain showed the strongest positive correlation with correct management (Fig 2). The knowledge domain showed the strongest positive, and only consistently significant, association with correct management in the evaluation of the domains within each score.

Each model was evaluated on model fit and predictive accuracy. The coefficient of determination and average RMSE of the cross-validation for each score in estimating correct treatment are presented in Table 7. There was no difference in the fit of the basic score based on requirements. The SARA score had a better fit using the standard facility requirements versus the provider-specific requirements, potentially due to indicator correlation with category of provider. The Essential Readiness score fit improved greatly when using provider-specific requirements. All score fits and predictive accuracy improved with inclusion of the knowledge domain. Overall the SARA standard, SARA

provider-specific, and Essential Readiness provider-specific scores with the knowledge domain had the highest model fit. The SARA provider-specific and Essential Readiness provider-specific scores had the strongest predictive accuracy. The Essential Readiness and SARA provider-specific scores with the knowledge domain performed well on both measures of score performance. However, the Essential Readiness score was more concise and interpretable than the SARA score. Based on these score performance measures, the provider-specific Essential Readiness score with the knowledge domain was selected as the final LAM measure to be used in the linking analysis.

3.3. Exact-Match Linking

Using the selected LAM score, coverage of appropriate management of child illness was calculated based on reported source of care (Table 8). Government health centers were the primary source of care in both the urban (59.7%) and rural (60.8%) areas. In the rural area, 17.6% of children were taken to a government CBA for care. Care was sought for a small number of children from shops and traditional practitioners in the rural area. In the urban area, care was sought for 5% of children from informal shops. Hospitals, pharmacies, and private facilities accounted for a small number of care-seeking events in the urban area.

Overall, 78.9% of rural children and 66.7% of urban children with an illness were taken for care (Table 9). Less than perfect preparedness for treating child illness at the sources of care reduced the estimated coverage of appropriate management of child illness to 60.3% in the rural area and 49% in the urban area. Estimated coverage of appropriate management by LAM domain is presented in Table 9. In the rural area, inconsistent stocks of medicines for managing complex or severe disease and low

provider knowledge for managing child illness reduced overall estimates of coverage of appropriate management. In the urban area, low provider knowledge and inconsistent provider training, supervision, and access to job aids limited coverage of appropriate management of child illness.

Coverage of appropriate management of child illness was estimated at 54.9% (95% CI: 51.2 – 58.5%) based on the primary LAM measure. Estimates of coverage generated with alternative LAM scores varied slightly (Table 10). The Essential Readiness and SARA scores produced the similar coverage estimates, while the Basic Commodities scores produced the slightly higher coverage estimates. Scores using provider-specific requirements generated slightly higher estimates than those employing a facility standard. Inclusion of the knowledge score slightly reduced coverage estimates. The overall coverage estimates ranged from 52.7% (standard Essential Readiness score with knowledge domain; 95% CI 49.1 – 56.3%) to 61.8% (provider-specific Basic Commodities score; 95% CI 57.6 – 66.1%). These estimates had low precision and were not significantly different. All scores produced estimates of coverage that were lower than looking at coverage of care-seeking from a skilled provider alone.

Care-seeking varied by child illness (Table 11). Care was sought for a greater proportion of children with fever (81.7%) and / or ARI (78.7%) compared to children with diarrhea (60.5%). The availability of appropriate commodities to treat uncomplicated illness at each source of care was assessed, including commodities for managing malaria (malaria diagnostics and ACT), diarrhea (ORS), and ARI (antibiotics). The source of care and availability of illness-specific commodities by source are presented in Table 12. Most children with fever were taken to a provider with malaria

diagnostics and ACT (71.3%). Despite high rates of skilled care seeking among rural children, many were treated by providers stocked out of either ACTs or malaria tests including approximately 10% of children treated at a government facility and 35% treated by a CBA. Only half of children with diarrhea were taken to a provider with ORS in stock (53.1%). In the urban area, less than half of children with diarrhea were taken to a skilled provider for care. Skilled care-seeking for diarrhea was higher in the urban area, however 15.6% of children were taken to a CBA for care and none stocked ORS. All children with ARI that were taken for care were taken to a provider with antibiotics. Most children with ARI were taken to a public facility (all stocking antibiotics), although some visited a CBA or traditional practitioner initially. Care-seeking with providers with all basic commodities ranged from 51% of children with diarrhea to 74% of children with ARI. The likelihood of appropriate management by illness type ranged from 45.3% of children with diarrhea to 62.8% of children with ARI, based on provider-specific Essential Readiness scores.

3.4. Maternal-reported coverage of illness management

Coverage of management of child illness was calculated based on maternal-reported care (Table 13). Based on mothers' report, fewer than half of children with fever were tested for malaria (rural: 41.6%, urban: 18.2%) and very few received an ACT (rural: 5%, urban: 0.8%). Maternal-reported testing and treatment were higher in the rural areas. Most children with fever sought care from a provider with both malaria testing and treatment available (rural: 68.9%, urban: 74.4%). Coverage of appropriate management of fever was 61.2% based on the LAM score.

Over half of mothers of children with diarrhea reported their child was given ORS or RHF during the episode (rural: 60.3%; urban: 50.6%). A roughly equivalent number were taken to a provider that stocked ORS (rural: 59.3%, urban: 47.7%). Approximately a quarter of mothers continued feeding in addition to giving ORS. Coverage of appropriate management of diarrhea was 45.3% based on the LAM score.

The majority of children with symptoms of ARI were taken to a provider that stocked antibiotics (rural: 80.6%; urban: 75%). Slightly fewer mothers reported their child received an antibiotic during the episode (rural: 66.7%; urban: 62.5%), roughly corresponding to the to the estimated coverage of correct management of ARI based on LAM score.

4. Discussion

The study found high rates of care-seeking for child illness, including 70% of sick children seeking care from skilled providers. However, the estimated coverage of appropriate management of child illness, calculated using the primary LAM score, fell short of this level at 55%. The 15-point gap in coverage between seeking skilled care and appropriate management was attributable to health care providers' less than adequate preparedness to manage child illness. Insufficient provider knowledge, training, and support were the biggest detractors from appropriate management among skilled providers. Stock outs of basic medicines were also an issue for community-based providers. Other studies have documented inconsistent drug stocks, infrequent supervision, and provider knowledge gaps as barriers to appropriate treatment (22,23). Children with ARI had the highest likelihood of being appropriately managed due to high

skilled care-seeking rates and availability of antibiotics. Skilled care-seeking for fever and ACT availability was also high. Skilled care-seeking for children with diarrhea was much lower, and many CBAs did not stock ORS despite being a common source of skilled care in rural areas.

The exact-match linking methodology was effective at this small scale. The accuracy of any linking method is dependent on the accuracy of maternal-reported source of care. In this setting, the accuracy of maternal report of care-seeking was high (Paper 1). Over 96% of care-seeking events took place with a provider included in the readiness assessment. The majority of care-seeking events took place with government facilities or a handful of CBAs. Both consultation with local leaders and asking participating mothers about common sources of care generated comprehensive listings of providers managing sick children in the study area. Mothers' report was more successful at identifying those most commonly utilized providers while minimizing the number of excess assessments conducted with providers that ultimately were not utilized by the study population. Both methods failed to identify some minor sources of care, primarily informal shops in the urban area and providers outside of the study area. However, informal shops had very low potential for appropriate management of child illness suggesting exclusion of these providers from the provider assessment may be justified. However, in settings with greater diversity in sources of care, ability to identify and assess private and community-based providers may be a limiting factor.

It was challenging to develop an accurate measure of provider likelihood of appropriate management of a sick child. Multiple LAM score constructions were evaluated, but a large number of additional constructs are possible. Each score reflected

various aspects of provider preparedness to treat sick children. Although multiple scores were evaluated, all generated similar estimates of provider preparedness. The SARA represents current global best practice for measuring health sector readiness; however, the tool is extensive, difficult to administer, and not all components may correspond directly to appropriate management of child illness in every context. The Essential Readiness LAM score was designed to reflect those indicators that are most predictive of a provider's correct management of a sick child. Availability of basic child health commodities, including diagnostic tools and medicines, is essential for a sick child to be correctly managed. However, appropriate training and support is also needed to ensure quality health worker performance (24–27). Various measures of commodity availability, training, supervision, and provider knowledge have been used to assess provider preparedness in multiple settings (15,28–33). An assessment of data from the IMCI evaluation in Brazil, Tanzania, and Uganda found basic commodity availability and health worker knowledge were positively associated with correct assessment of sick children (32). Studies in Kenya and Benin found availability of guidelines, training, and supervision were associated with better quality treatment of children with malaria (28,33). However studies in Zambia and Central African Republic found no association (29,33). The relative importance of each of these factors varies by context.

LAM measures were assessed against a measure of correct management of child illness. However, this measure was based on provider-reported care, which is subject to self-reporting bias, and falls short of the gold standard quality of care measure of case observation with reassessment (34). Additionally, this measure was only available for a subset of providers. As a result, the overall LAM score was assessed using a subsample

that was not reflective of all providers. A score derived from observation of sick child case management would likely be the strongest predictor of correct management, but direct observation is subject to the Hawthorne effect, prohibitively expensive and time-consuming at a large scale. There is a need for a systematic assessment of readiness indicators against a gold-standard measure of care to identify those measures that are most predictive of correct management of sick children.

The ultimate goal of linking household and service provider data is to generate more accurate and useful estimates of coverage to inform health program planning and decision-making. In this context, the linking analysis generated similar estimates of treatment coverage compared to estimates based on maternal-reported care alone. Mother-reported treatment with ORS and antibiotics roughly aligned with the proportion of children taken to providers with ORS and LAM estimated coverage, respectively. However, estimates of correct management of fever based on maternal reported care were much lower than estimates of appropriate management based on LAM scores. In this low-prevalence area, it is not incorrect for such a small proportion of children to be treated with an antimalarial and ACTs were used exclusively in malaria treatment. However, current national malaria treatment and IMCI guidelines state all children with fever should be tested for malaria (18,19). Management of uncomplicated diarrhea poses an additional issue. Correct treatment of diarrhea without dehydration is increased fluids with continued feeding (35), which does not require treatment outside of the home. RHF may be prepared in the home. Therefore, estimates of coverage of appropriate management based on interaction with the health system may not accurately reflect appropriate home management of diarrhea. Additionally, previous research has

demonstrated the current survey indicator for symptoms of ARI does not accurately identify cases of pneumonia (2). Therefore, maternal reported symptoms of ARI may not accurately gauge the level of care a child requires, although it may be a sufficient measure for needing to seek care.

This study suggests that exact-match linking may be a feasible method for producing more informative estimates of coverage of appropriate management of child illness. This methodology is promising because it utilizes existing data collection mechanisms to generate a more complete picture of the management of child illness. This study was conducted on a small scale in an area with high rates of care-seeking for child illness from public sector providers. More studies need to be done at a larger scale and in areas with a more diverse health care provider landscape to further evaluate the feasibility of the linking methodology. Another linking study is ongoing with the MICS in the Savanes district of Côte d'Ivoire to assess the feasibility of exact-match linking at a regional scale in conjunction with a standard household survey. Additional research will support the development of guidelines for conducting linking assessments and potentially integrating this methodology into existing data collection mechanisms.

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Box 1. LAM Score Components

SARA SCORE	ESSENTIAL READINESS SCORE	BASIC COMMODITIES
Basic Amenities	**Diagnostics**	**Malaria**
• Power	• Malaria Diagnostic	• ACT
• Improved water source	• Malnutrition Diagnostic	• Malaria Diagnostic
• Audio-Visual Privacy	• ARI Diagnostic	**Diarrhea**
• Adequate Sanitation Facilities	• General microscopy	• ORS
• Communication	**Basic Medicines**	• Zinc
• Computer with internet	• ORS	**ARI**
• Ambulance	• Zinc	• Antibiotic
Basic Equipment	• ACT	• ARI Diagnostic
• Adult Scale	• Oral antibiotic	
• Child Scale	**Severe / Complicated Illness Medicines**	
• Thermometer	• IV fluids	
• Blood pressure apparatus	• Injectable quinine or artesunate	
• Light source	• Injectable antibiotics	
Infection Prevention	**Human Resources**	
• Safe final disposal of sharps	• Training	
• Safe final disposal of infectious wastes	• Guidelines	
• Appropriate storage of sharps waste	• Supervision	
• Appropriate storage of infectious waste	**Management Capacity**	
• Disinfectant	• Diagnosis and treat malaria (by pathology)	
• Disposable syringe	• Diagnosis and treat diarrhea (by pathology)	
• Soap and running water or alcohol rub	• Diagnosis and treat ARI (by pathology)	
• Latex gloves	• Diagnosis and treat malnutrition (by pathology)	
• Infection prevention guidelines	• Facilitated referral capacity	
Child Health Training and Guidelines		
• Guidelines for IMCI		
• Staff trained in IMCI		
• IMCI job aid *		
• Malaria treatment guidelines		
• Staff trained in malaria diagnosis		
• Staff trained in malaria treatment		
Child Health Equipment		
• Child and infant scale		
• Length/height measuring equipment		
• Thermometer		
• Stethoscope		
• Growth chart		
Child Health Diagnostics		
• General microscopy		
• Malaria diagnostic capacity		
• ARI diagnostics *		
• Malnutrition diagnostics *		
Child Health Medicines		
• ORS		
• Amoxicillin		
• Cotrimoxazole		
• Paracetamol		
• Vitamin A		
• Mebendazole or albendazole		
• Zinc		
• ACT *		
Infectious disease medicines		
• Mebendazole or albendazole		
• Amoxicillin		
• Ceftriaxone injection		
• Cotrimoxazole		
• Ciprofloxacin		
• Fluconazole		
• Metronidazole		
• Quinine or artesunate	* NOT INCLUDED IN SARA QUESTIONNAIRE	

Figure 1. Map of Provider Locations

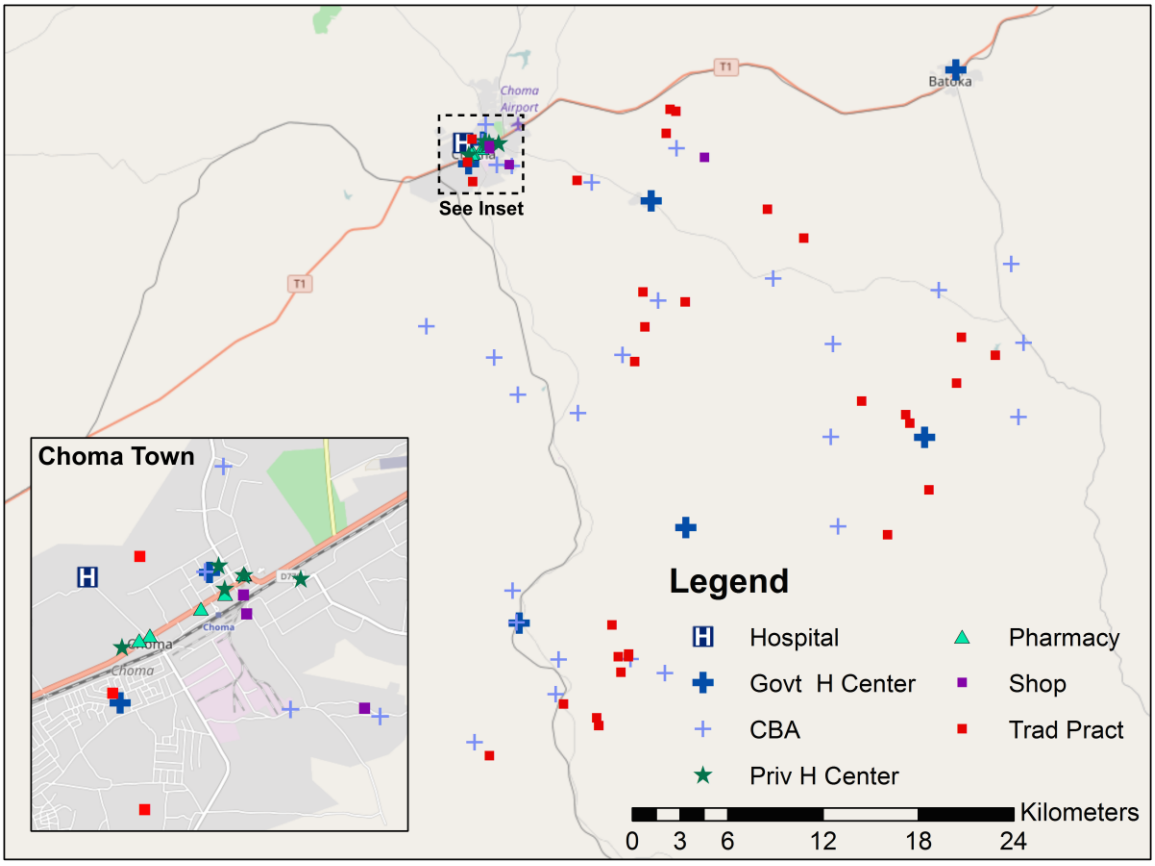

Table 1. Characteristics of participating children, mothers, households and health care providers, by strata

	Rural			Urban			Overall		
	n	%	[95% CI]	n	%	[95% CI]	n	%	[95% CI]
Child Age (in years)	547			537			1084		
0	102	18.6	[15.6-22.1]	102	19	[15.9-22.5]	204	18.8	[16.6-21.3]
1	115	21	[17.8-24.6]	121	22.5	[19.2-26.3]	236	21.8	[19.4-24.3]
2	115	21	[17.8-24.6]	107	19.9	[16.8-23.5]	222	20.5	[18.2-23.0]
3	109	19.9	[16.8-23.5]	100	18.6	[15.5-22.1]	209	19.3	[17.0-21.7]
4	106	19.4	[16.3-22.9]	107	19.9	[16.8-23.5]	213	19.6	[17.4-22.1]
Child Sex									
Female	547			537			1084		
Male	274	50.1	[45.9-54.3]	277	51.6	[47.3-55.8]	551	50.8	[47.9-53.8]
Maternal Age (in years)	387			451			838		
15-19	47	12.1	[9.2-15.8]	51	11.3	[8.7-14.6]	98	11.7	[9.7-14.1]
20-29	155	40.1	[35.3-45.0]	253	56.1	[51.5-60.6]	408	48.7	[45.3-52.1]
30-39	126	32.6	[28.1-37.4]	127	28.2	[24.2-32.5]	253	30.2	[27.2-33.4]
40-49	59	15.2	[12.0-19.2]	20	4.4	[2.9-6.8]	79	9.4	[7.6-11.6]
Maternal Education	387			451			838		
None or primary incomplete	97	25.1	[21.0-29.6]	82	18.2	[14.9-22.0]	179	21.4	[18.7-24.3]
Primary complete	118	30.5	[26.1-35.3]	69	15.3	[12.3-18.9]	187	22.3	[19.6-25.3]
Secondary incomplete	138	35.7	[31.0-40.6]	171	37.9	[33.5-42.5]	309	36.9	[33.7-40.2]
Secondary complete or higher	34	8.8	[6.3-12.1]	129	28.6	[24.6-33.0]	163	19.5	[16.9-22.3]
Providers	54			29			83		
Govt Hospital	0			1			1		
Govt health center	5			2			7		
Govt CBA / fieldworker	19			9			28		
Pvt hospital / clinic	0			5			5		
Pharmacy	0			6			6		
Shop	1			3			4		
Traditional practitioner / Church / Other	29			3			32		

Table 2. Characteristics of reported child illness and care-seeking events, by strata

	Rural			Urban			Overall		
	n	%	[95% CI]	n	%	[95% CI]	n	%	[95% CI]
	547			537			1084		
Proportion of children with at least one reported DHS illness	199	36.4	[32.4-40.5]	186	34.6	[30.7-38.8]	385	35.5	[32.7-38.4]
Reported child illness	199			186			385		
Fever	23	11.6	[7.8-16.8]	50	26.9	[21.0-33.7]	73	19	[15.3-23.2]
Diarrhea	117	58.8	[51.8-65.4]	85	45.7	[38.7-52.9]	202	52.5	[47.5-57.4]
ARI[1]	6	3	[1.4-6.6]	3	1.6	[0.5-4.9]	9	2.3	[1.2-4.4]
Diarrhea & Fever	28	14.1	[9.9-19.6]	35	18.8	[13.8-25.1]	63	16.4	[13.0-20.4]
Diarrhea & ARI	3	1.5	[0.5-4.6]	0	0		3	0.8	[0.3-2.4]
Fever & ARI	17	8.5	[5.4-13.3]	10	5.4	[2.9-9.7]	27	7	[4.9-10.0]
Diarrhea, Fever, & ARI	5	2.5	[1.0-5.9]	3	1.6	[0.5-4.9]	8	2.1	[1.0-4.1]
Proportion of illnesses for which mother reported seeking care	157	78.9	[72.7-84.0]	124	66.7	[59.6-73.1]	281	73	[68.3-77.2]
Maternal reported number of sources of care among children taken for care[2]	157			124			281		
1	148	94.3	[89.3-97.0]	119	96	[90.7-98.3]	267	95	[91.8-97.0]
2	9	5.7	[3.0-10.7]	5	4	[1.7-9.3]	14	5	[3.0-8.2]
Maternal Reported Care-Seeking Events									
Any provider	166			129			295		
Participating provider	164	98.8	[95.3-99.7]	120	93	[87.1-96.3]	284	96.3	[93.4-97.9]
Skilled provider[3]	158	95.2	[90.7-97.6]	118	91.5	[85.2-95.2]	276	93.6	[90.1-95.9]

[1] ARI defined as cough with chest-related difficulty breathing

[2] There was a maximum of two reported care-seeking events for a single illness

[3] Skilled provider defined as government, mission, and private hospitals, health centers, and health posts, private doctors, and government community based agents

Table 3. Proportion of providers offering management of common childhood illness, by category and strata

Provider Category		Sample Size	Provide Consultation		Provide Medicines		Manage:							
							Malaria		Diarrhea		ARI		Malnutrition	
		N	n	%	n	%	n	%	n	%	n	%	n	%
Hospital		1	1	100	1	100	1	100	1	100	1	100	1	100
Govt health center	Urban	2	2	100	2	100	2	100	2	100	2	100	2	100
	Rural	5	5	100	5	100	5	100	5	100	5	100	5	100
Govt CBA	Urban	9	9	100	8	88.89	9	100	3	33.33	0	0	3	33.33
	Rural	19	19	100	17	89.47	14	73.68	9	47.37	0	0	7	36.84
Pvt clinic		5	5	100	5	100	5	100	5	100	5	100	4	80
Pharmacy		6	3	50	6	100	3	50	2	33.33	2	33.33	2	33.33
Shop	Urban	3	0	0	3	100	0	0	0	0	0	0	0	0
	Rural	1	0	0	1	100	0	0	0	0	0	0	0	0
Traditional or Faith Healer	Urban	3	3	100	0	0	0	0	0	0	0	0	1	33.33
	Rural	29	29	100	21	72.41	4	13.79	3	10.34	7	24.14	13	44.83

Table 4. Median SARA readiness domain score by provider type (each category score out of one by provider)

Provider-specific requirements																	
		SS		**Basic Amenities**			**Basic Equipment**			**Infection Control**			**Guidelines & Training**			**Equipment**	
		N	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)
Hospital		1	1	85.7	(85.7-85.7)	1	100	(100-100)	1	88.9	(88.9-88.9)	1	60	(60-60)	1	60	(60-60)
Govt health center	Urban	2	2	92.9	(85.7-100)	2	100	(100-100)	2	94.4	(88.9-100)	2	60	(40-80)	2	100	(100-100)
	Rural	5	5	71.4	(57.1-85.7)	5	83.3	(83.3-100)	5	100	(100-100)	5	80	(80-80)	5	100	(100-100)
Govt CBA	Urban	9	9	28.6	(14.3-42.9)	0	-	-	9	62.5	(62.5-75)	9	50	(50-50)	0	-	-
	Rural	19	19	42.9	(28.6-57.1)	0	-	-	14	75	(62.5-87.5)	14	100	(100-100)	0	-	-
Pvt clinic		5	5	85.7	(71.4-85.7)	5	100	(100-100)	5	100	(100-100)	5	50	(0-60)	5	60	(40-60)
Pharmacy		6	6	57.1	(57.1-71.4)	0	-	-	3	87.5	(62.5-100)	3	0	(0-50)	0	-	-
Shop	Urban	3	3	28.6	(14.3-57.1)	0	-	-	0	-	-	0	-	-	0	-	-
	Rural	1	1	42.9	(42.9-42.9)	0	-	-	0	-	-	0	-	-	0	-	-
Traditional or Faith Healer	Urban	3	3	42.9	(42.9-71.4)	0	-	-	0	-	-	0	-	-	0	-	-
	Rural	29	29	28.6	(14.3-42.9)	0	-	-	4	6.2	(0-25)	4	0	(0-0)	0	-	-

Standard requirements																	
		SS		**Basic Amenities**			**Basic Equipment**			**Infection Control**			**Guidelines & Training**			**Equipment**	
		N	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)
Hospital		1	1	85.7	(85.7-85.7)	1	100	(100-100)	1	88.9	(88.9-88.9)	1	60	(60-60)	1	60	(60-60)
Govt health center	Urban	2	2	92.9	(85.7-100)	2	100	(100-100)	2	94.4	(88.9-100)	2	60	(40-80)	2	100	(100-100)
	Rural	5	5	71.4	(57.1-85.7)	5	83.3	(83.3-100)	5	100	(100-100)	5	80	(80-80)	5	100	(100-100)
Govt CBA	Urban	9	9	28.6	(14.3-42.9)	9	16.7	(16.7-16.7)	9	55.6	(55.6-66.7)	9	25	(25-50)	9	0	(0-20)
	Rural	19	19	42.9	(28.6-57.1)	19	16.7	(16.7-16.7)	19	66.7	(55.6-77.8)	19	60	(60-80)	19	0	(0-20)
Pvt clinic		5	5	85.7	(71.4-85.7)	5	100	(100-100)	5	100	(100-100)	5	50	(0-60)	5	60	(40-60)
Pharmacy		6	6	57.1	(57.1-71.4)	6	16.7	(0-33.3)	6	77.8	(55.6-88.9)	6	0	(0-0)	6	0	(0-0)
Shop	Urban	3	3	28.6	(14.3-57.1)	3	0	(0-16.7)	3	0	(0-0)	3	0	(0-0)	3	0	(0-0)
	Rural	1	1	42.9	(42.9-42.9)	1	0	(0-0)	1	0	(0-0)	1	0	(0-0)	1	0	(0-0)
Traditional or Faith Healer	Urban	3	3	42.9	(42.9-71.4)	3	0	(0-33.3)	3	0	(0-55.6)	3	0	(0-25)	3	0	(0-40)
	Rural	29	29	28.6	(14.3-42.9)	29	0	(0-0)	29	0	(0-0)	29	0	(0-0)	29	0	(0-0)

Table 4. Median SARA readiness domain score by provider type (each category score out of one by provider), continued

Provider-specific requirements

		Diagnostics			Medicines			ID Medicines			Knowledge			Composite Score			Composite Score + Knowledge		
		n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)
Hospital		1	100	(100-100)	1	85.7	(85.7-85.7)	1	87.5	(87.5-87.5)	1	82.7	(82.7-82.7)	1	83.5	(83.5-83.5)	1	83.4	(83.4-83.4)
Govt health center	Urban	2	100	(100-100)	2	92.9	(85.7-100)	2	75	(62.5-87.5)	2	54.3	(47.2-61.5)	2	89.4	(87.8-91)	2	85.5	(84.8-86.2)
	Rural	5	50	(50-100)	5	100	(85.7-100)	5	75	(62.5-75)	5	48.5	(47.1-55)	5	82.3	(80.7-85)	5	79.2	(77.2-81.6)
Govt CBA	Urban	9	100	(100-100)	9	0	(0-0)	0	-	-	9	100	(100-100)	9	50.7	(45.7-53.6)	9	58.9	(54.8-61.3)
	Rural	14	100	(100-100)	18	0	(0-25)	0	-	-	19	100	(100-100)	19	58.2	(38.2-65.7)	19	65.2	(53-70.9)
Pvt clinic		5	50	(50-100)	5	100	(71.4-100)	5	87.5	(62.5-87.5)	5	54.3	(45.8-56.8)	5	76.7	(62.6-86.7)	5	73.2	(63.3-83.3)
Pharmacy		3	0	(0-0)	6	85.7	(71.4-85.7)	6	81.2	(62.5-87.5)	6	0	(0-78.6)	6	67	(60.1-72.6)	6	53	(51.3-67.3)
Shop	Urban	0	-	-	0	-	-	0	-	-	3	0	(0-0)	3	28.6	(14.3-57.1)	3	14.3	(7.1-28.6)
	Rural	0	-	-	0	-	-	0	-	-	1	0	(0-0)	1	42.9	(42.9-42.9)	1	21.4	(21.4-21.4)
Traditional or Faith Healer	Urban	0	-	-	0	-	-	0	-	-	3	0	(0-100)	3	42.9	(42.9-71.4)	3	21.4	(21.4-85.7)
	Rural	4	0	(0-0)	8	0	(0-0)	0	-	-	29	25	(0-50)	29	28.6	(5.4-42.9)	29	25	(14.3-33.9)

Standard requirements

		Diagnostics			Medicines			ID Medicines			Knowledge			Composite Score			Composite Score + Knowledge		
		n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)
Hospital		1	100	(100-100)	1	85.7	(85.7-85.7)	1	87.5	(87.5-87.5)	1	82.7	(82.7-82.7)	1	83.5	(83.5-83.5)	1	83.4	(83.4-83.4)
Govt health center	Urban	2	100	(100-100)	2	92.9	(85.7-100)	2	75	(62.5-87.5)	2	54.3	(47.2-61.5)	2	89.4	(87.8-91)	2	85.5	(84.8-86.2)
	Rural	5	50	(50-100)	5	100	(85.7-100)	5	75	(62.5-75)	5	48.5	(47.1-55)	5	82.3	(80.7-85)	5	79.2	(77.2-81.6)
Govt CBA	Urban	9	50	(50-50)	9	0	(0-0)	9	0	(0-0)	9	100	(100-100)	9	24.6	(23.1-26.1)	9	32	(31.6-34.3)
	Rural	19	50	(50-50)	19	0	(0-14.3)	19	0	(0-0)	19	100	(100-100)	19	27.7	(24.6-33.1)	19	35.8	(32.9-40.5)
Pvt clinic		5	50	(50-100)	5	100	(71.4-100)	5	87.5	(62.5-87.5)	5	54.3	(45.8-56.8)	5	76.7	(62.6-86.7)	5	73.2	(63.3-83.3)
Pharmacy		6	0	(0-0)	6	85.7	(71.4-85.7)	6	81.2	(62.5-87.5)	6	0	(0-78.6)	6	39.5	(34-45.3)	6	39	(30.2-41.1)
Shop	Urban	3	0	(0-0)	3	14.3	(14.3-14.3)	3	0	(0-0)	3	0	(0-0)	3	7.4	(3.6-8.9)	3	6.6	(3.2-7.9)
	Rural	1	0	(0-0)	1	14.3	(14.3-14.3)	1	0	(0-0)	1	0	(0-0)	1	7.1	(7.1-7.1)	1	6.3	(6.3-6.3)
Traditional or Faith Healer	Urban	3	0	(0-0)	3	0	(0-0)	3	0	(0-0)	3	0	(0-100)	3	5.4	(5.4-28.2)	3	4.8	(4.8-36.1)
	Rural	29	0	(0-0)	29	0	(0-0)	29	0	(0-0)	29	25	(0-50)	29	4.3	(1.8-5.4)	29	6.6	(4.8-10.3)

Table 5. Median Essential Readiness domain scores by provider type (each category score out of one by provider)

Provider-specific requirements

		SS		Diagnostic Commodities		Basic Medicines			Medicines for Severe Disease			Human Resources			Management Capacity			Knowledge		
		N	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)
Hospital		1	1	100	(100-100)	1	75	(75-75)	1	100	(100-100)	0	.	(.- .)	1	100	(100-100)	1	82.7	(82.7-82.7)
Govt health center	Urban	2	2	100	(100-100)	2	87.5	(75-100)	2	83.3	(66.7-100)	2	50	(33.3-66.7)	2	100	(100-100)	2	54.3	(47.2-61.5)
	Rural	5	5	83.3	(83.3-100)	5	100	(75-100)	5	66.7	(66.7-100)	5	66.7	(66.7-66.7)	5	100	(100-100)	5	48.5	(47.1-55)
Govt CBA	Urban	9	9	100	(100-100)	9	100	(33.3-100)	0	.	(.- .)	9	33.3	(33.3-33.3)	9	50	(25-50)	9	100	(100-100)
	Rural	19	15	100	(50-100)	17	50	(33.3-100)	0	.	(.- .)	19	66.7	(66.7-66.7)	19	50	(25-50)	19	100	(100-100)
Pvt clinic		5	5	80	(66.7-83.3)	5	100	(75-100)	5	66.7	(66.7-66.7)	5	33.3	(33.3-33.3)	5	100	(100-100)	5	54.3	(45.8-56.8)
Pharmacy		6	3	33.3	(0-50)	6	100	(75-100)	6	66.7	(33.3-66.7)	3	33.3	(0-66.7)	6	25	(0-75)	6	0	(0-78.6)
Shop	Urban	3	0	-	-	0	-	-	0	-	-	0	-	-	3	0	(0-0)	3	0	(0-0)
	Rural	1	0	-	-	0	-	-	0	-	-	0	-	-	1	0	(0-0)	1	0	(0-0)
Traditional or Faith Healer	Urban	3	1	100	(100-100)	0	-	-	0	-	-	3	0	(0-50)	3	0	(0-25)	3	0	(0-100)
	Rural	29	15	0	(0-50)	8	0	(0-0)	0	-	-	29	0	(0-0)	29	25	(0-25)	29	25	(0-50)

Standard requirements

		SS		Diagnostic Commodities		Basic Medicines			Medicines for Severe Disease			Human Resources			Management Capacity			Knowledge		
		N	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)
Hospital		1	1	100	(100-100)	1	75	(75-75)	1	100	(100-100)	1	0	(0-0)	1	100	(100-100)	1	82.7	(82.7-82.7)
Govt health center	Urban	2	2	100	(100-100)	2	87.5	(75-100)	2	83.3	(66.7-100)	2	50	(33.3-66.7)	2	100	(100-100)	2	54.3	(47.2-61.5)
	Rural	5	5	83.3	(83.3-100)	5	100	(75-100)	5	66.7	(66.7-100)	5	66.7	(66.7-66.7)	5	100	(100-100)	5	48.5	(47.1-55)
Govt CBA	Urban	9	9	33.3	(33.3-50)	9	25	(25-25)	9	0	(0-0)	9	33.3	(33.3-33.3)	9	50	(25-50)	9	100	(100-100)
	Rural	19	19	33.3	(33.3-33.3)	19	25	(0-25)	19	0	(0-0)	19	66.7	(66.7-66.7)	19	50	(25-50)	19	100	(100-100)
Pvt clinic		5	5	66.7	(66.7-83.3)	5	100	(75-100)	5	66.7	(66.7-66.7)	5	33.3	(33.3-33.3)	5	100	(100-100)	5	54.3	(45.8-56.8)
Pharmacy		6	6	16.7	(16.7-16.7)	6	100	(75-100)	6	66.7	(33.3-66.7)	6	0	(0-33.3)	6	25	(0-75)	6	0	(0-78.6)
Shop	Urban	3	3	16.7	(16.7-16.7)	3	0	(0-0)	3	0	(0-0)	3	0	(0-0)	3	0	(0-0)	3	0	(0-0)
	Rural	1	1	16.7	(16.7-16.7)	1	0	(0-0)	1	0	(0-0)	1	0	(0-0)	1	0	(0-0)	1	0	(0-0)
Traditional or Faith Healer	Urban	3	3	16.7	(16.7-50)	3	0	(0-0)	3	0	(0-0)	3	0	(0-33.3)	3	0	(0-25)	3	0	(0-100)
	Rural	29	29	16.7	(16.7-16.7)	29	0	(0-0)	29	0	(0-0)	29	0	(0-0)	29	25	(0-25)	29	25	(0-50)

Table 5. Median Essential Readiness domain scores by provider type (each category score out of one by provider), continued

Provider-specific requirements							
		Composite Score			**Composite Score + Knowledge**		
		n	Med	(IQR)	n	Med	(IQR)
Hospital		1	95	(95-95)	1	93	(93-93)
Govt health center	Urban	2	86.8	(84.7-88.9)	2	82.2	(81.4-82.9)
	Rural	5	91.7	(81.9-91.7)	5	85.3	(75.4-88.2)
Govt CBA	Urban	9	51.7	(45-51.7)	9	59.7	(54.2-59.7)
	Rural	19	53.3	(35-56.7)	19	60.9	(48.6-61.1)
Pvt clinic		5	77.8	(52.8-83.3)	5	73.2	(52.2-79.2)
Pharmacy		6	51.4	(44.4-55.6)	6	41.5	(33.3-61.3)
Shop	Urban	3	0	(0-0)	3	0	(0-0)
	Rural	1	0	(0-0)	1	0	(0-0)
Traditional or Faith Healer	Urban	3	0	(0-43.8)	3	0	(0-55)
	Rural	29	6.2	(0-20)	29	12.5	(5-25)

Standard requirements							
		Composite Score			**Composite Score + Knowledge**		
		n	Med	(IQR)	n	Med	(IQR)
Hospital		1	79.2	(79.2-79.2)	1	79.7	(79.7-79.7)
Govt health center	Urban	2	86.8	(84.7-88.9)	2	82.2	(81.4-82.9)
	Rural	5	91.7	(81.9-91.7)	5	85.3	(75.4-88.2)
Govt CBA	Urban	9	23.6	(19.4-27.8)	9	34.5	(31-38.1)
	Rural	19	29.2	(20.8-33.3)	19	39.3	(32.1-41.7)
Pvt clinic		5	77.8	(52.8-83.3)	5	73.2	(50.3-79.2)
Pharmacy		6	28.5	(25-52.8)	6	30	(21.4-45.2)
Shop	Urban	3	2.8	(2.8-2.8)	3	2.4	(2.4-2.4)
	Rural	1	2.8	(2.8-2.8)	1	2.4	(2.4-2.4)
Traditional or Faith Healer	Urban	3	2.8	(2.8-18.1)	3	2.4	(2.4-29.8)
	Rural	29	6.9	(2.8-11.1)	29	9.5	(6-16.7)

Table 6. Median Basic Commodities domain score by provider type (each category score out of one by provider)

Provider-specific requirements

		SS	Diagnostic Commodities			Basic Medicines			Medicines for Severe Disease			Human Resources			Management Capacity			Knowledge		
		N	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)
Hospital		1	1	100	(100-100)	1	50	(50-50)	1	100	(100-100)	1	82.7	(82.7-82.7)	1	83.3	(83.3-83.3)	1	83.2	(83.2-83.2)
Govt health center	Urban	2	2	100	(100-100)	2	75	(50-100)	2	100	(100-100)	2	54.3	(47.2-61.5)	2	91.7	(83.3-100)	2	82.3	(77.9-86.8)
	Rural	5	5	100	(100-100)	5	100	(100-100)	5	100	(100-100)	5	48.5	(47.1-55)	5	100	(83.3-100)	5	86.8	(74.6-88.7)
Govt CBA	Urban	9	9	100	(100-100)	3	0	(0-50)	0	-	-	9	100	(100-100)	9	100	(50-100)	9	100	(66.7-100)
	Rural	19	14	100	(100-100)	9	0	(0-0)	0	-	-	19	100	(100-100)	17	50	(50-100)	19	75	(66.7-100)
Pvt clinic		5	5	50	(50-100)	5	100	(100-100)	5	100	(100-100)	5	54.3	(45.8-56.8)	5	83.3	(83.3-100)	5	79.7	(74-88.6)
Pharmacy		6	6	50	(50-50)	6	100	(50-100)	6	100	(100-100)	6	0	(0-78.6)	6	83.3	(66.7-83.3)	6	62.5	(50-82.1)
Shop	Urban	3	0	-	-	0	-	-	0	-	-	3	0	(0-0)	0	-	-	3	0	(0-0)
	Rural	1	0	-	-	0	-	-	0	-	-	1	0	(0-0)	0	-	-	1	0	(0-0)
Traditional or Faith Healer	Urban	3	0	-	-	0	-	-	0	-	-	3	0	(0-100)	0	-	-	3	0	(0-100)
	Rural	29	4	0	(0-0)	3	0	(0-0)	7	50	(50-50)	29	25	(0-50)	8	33.3	(16.7-50)	29	25	(0-50)

Standard requirements

		SS	Diagnostic Commodities			Basic Medicines			Medicines for Severe Disease			Human Resources			Management Capacity			Knowledge		
		N	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)	n	Med	(IQR)
Hospital		1	1	100	(100-100)	1	50	(50-50)	1	100	(100-100)	1	82.7	(82.7-82.7)	1	83.3	(83.3-83.3)	1	83.2	(83.2-83.2)
Govt health center	Urban	2	2	100	(100-100)	2	75	(50-100)	2	100	(100-100)	2	54.3	(47.2-61.5)	2	91.7	(83.3-100)	2	82.3	(77.9-86.8)
	Rural	5	5	100	(100-100)	5	100	(100-100)	5	100	(100-100)	5	48.5	(47.1-55)	5	100	(83.3-100)	5	86.8	(74.6-88.7)
Govt CBA	Urban	9	9	100	(100-100)	9	0	(0-0)	9	50	(50-50)	9	100	(100-100)	9	50	(50-50)	9	62.5	(62.5-62.5)
	Rural	19	19	100	(50-100)	19	0	(0-0)	19	50	(50-50)	19	100	(100-100)	19	50	(33.3-50)	19	62.5	(50-62.5)
Pvt clinic		5	5	50	(50-100)	5	100	(100-100)	5	100	(100-100)	5	54.3	(45.8-56.8)	5	83.3	(83.3-100)	5	79.7	(74-88.6)
Pharmacy		6	6	50	(50-50)	6	100	(50-100)	6	100	(100-100)	6	0	(0-78.6)	6	83.3	(66.7-83.3)	6	62.5	(50-82.1)
Shop	Urban	3	3	0	(0-0)	3	0	(0-0)	3	50	(50-50)	3	0	(0-0)	3	16.7	(16.7-16.7)	3	12.5	(12.5-12.5)
	Rural	1	1	0	(0-0)	1	0	(0-0)	1	50	(50-50)	1	0	(0-0)	1	16.7	(16.7-16.7)	1	12.5	(12.5-12.5)
Traditional or Faith Healer	Urban	3	3	0	(0-0)	3	0	(0-0)	3	50	(50-50)	3	0	(0-100)	3	16.7	(16.7-16.7)	3	12.5	(12.5-37.5)
	Rural	29	29	0	(0-0)	29	0	(0-0)	29	50	(50-50)	29	25	(0-50)	29	16.7	(16.7-16.7)	29	18.8	(12.5-25)

Figure 2. Correlation between LAM score domains and correct management score

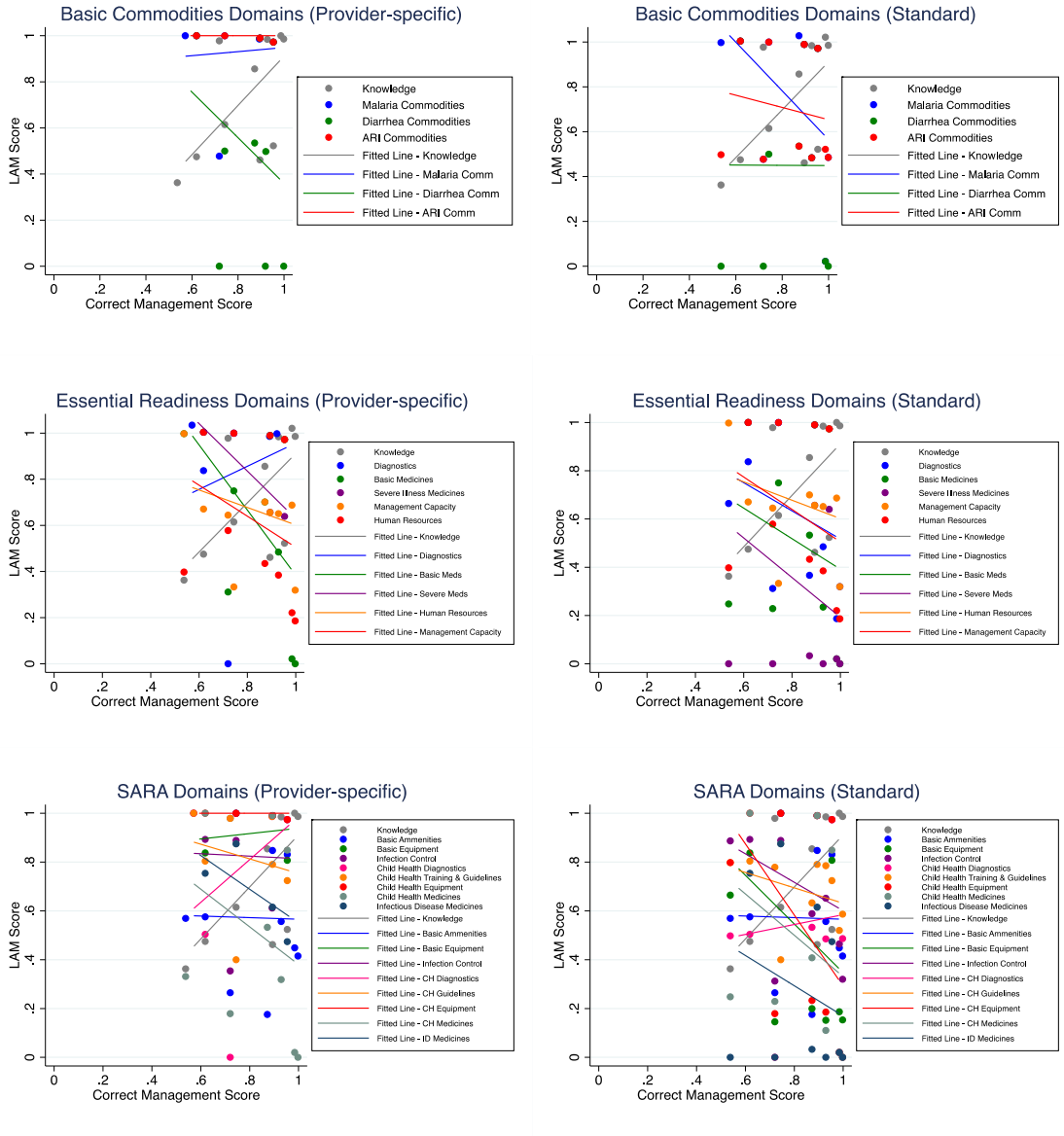

Table 7. LAM score performance evaluation: model fit and predictive accuracy

Score			Model Fit (Coefficient of Determination) R^2	Predictive Accuracy (RMSE) Average	(Range)
Basic	Standard	No Knowledge	0.38	0.16	(0.09 - 0.24)
		Knowledge	0.55	0.15	(0.01 - 0.27)
	Provider Specific	No Knowledge	0.36	0.15	(0.02 - 0.27)
		Knowledge	0.61	0.17	(0.06 - 0.24)
SARA	Standard	No Knowledge	0.94	0.29	(0.18 - 0.44)
		Knowledge	1	0.36	(0.15 - 0.46)
	Provider Specific	No Knowledge	0.8	0.26	(0.03 - 0.38)
		Knowledge	1	0.1	(0.03 - 0.29)
Essential	Standard	No Knowledge	0.25	0.45	(0.08 - 1.29)
		Knowledge	0.82	0.36	(0.15 - 0.78)
	Provider Specific	No Knowledge	0.79	0.17	(0.04 - 0.36)
		Knowledge	0.98	0.09	(0.02 - 0.23)

Table 8. Maternal-reported source of care for childhood illness, by category and strata

Provider Category		Rural		Urban		Overall	
		n	%	n	%	n	%
Public Sector							
Hospital		0	0	5	2.7	5	1.3
Govt health center	Urban	2*	1	111	59.7	113	29.4
	Rural	120	60.3	0	0	120	31.2
Govt CBA	Urban	0	0	1	0.5	1	0.3
	Rural	36	18.1	0	0	36	9.4
Private Sector							
Pvt clinic		0	0	1	0.5	1	0.3
Pharmacy		1	0.5	2	1.1	3	0.8
Informal Sector							
Shop	Urban	0	0	9	4.8	9	2.3
	Rural	2	1	0	0	2	0.5
Traditional or Faith Healer	Urban	0	0	0	0	0	
	Rural	5	2.5	0	0	5	1.3

* Two children in rural area sought care from an urban health center

Table 9. Coverage of appropriate management of childhood illness by key domain estimated through exact-match linking, by strata

Strata		Sought Care		Skilled Provider		Essential Readiness Domains: Diagnosis		Basic Medicines		Complex Medicines		Human Resources		Txt by Pathology		Knowledge		Likelihood of Appropriate Management	
	n	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Rural	199	78.9	(72.7-84.0)	75.9	(69.5-81.3)	66.7	(61.0-72.4)	66.5	(60.5-72.5)	48.3	(42.6-54.0)	58	(52.8-63.3)	66.9	(61.1-72.8)	43.6	(39.6-47.5)	60.3	(55.6-65.1)
Urban	186	66.7	(59.6-73.1)	62.4	(55.2-69.0)	61.8	(54.9-68.8)	51	(45.2-56.8)	57.2	(50.6-63.8)	24.7	(21.4-27.9)	61.2	(54.3-68.1)	36.9	(32.6-41.1)	49	(43.6-54.5)
Overall	385	73	(68.3-77.2)	69.4	(64.6-73.8)	64.4	(59.9-68.8)	59	(54.8-63.2)	52.6	(48.2-56.9)	41.9	(38.4-45.5)	64.2	(59.7-68.7)	40.3	(37.4-43.2)	54.9	(51.2-58.5)

Table 10. Coverage of appropriate management of child illness using alternative LAM scores

LAM Measure	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
SARA (standard)	55.1	[50.3 - 60.0]	54.7	[48.6 - 60.7]	54.9	[51.0 - 58.8]
SARA + Knowledge (standard)	53.9	[49.3 - 58.4]	52.7	[46.8 - 58.5]	53.3	[49.6 - 57.0]
SARA (specific)	59.3	[54.6 - 64.0]	56.2	[50.2 - 62.1]	57.8	[54.0 - 61.5]
SARA + Knowledge (specific)	57.8	[53.4 - 62.3]	53.5	[47.7 - 59.3]	55.7	[52.1 - 59.4]
Essential Readiness (standard)	59.2	[53.9 - 64.5]	50.9	[45.2 - 56.6]	55.2	[51.3 - 59.1]
Essential Readiness + Knowledge (standard)	56.6	[51.8 - 61.4]	48.6	[43.2 - 54.0]	52.7	[49.1 - 56.3]
Essential Readiness (specific)	63.4	[58.2 - 68.6]	51.5	[45.7 - 57.2]	57.6	[53.7 - 61.6]
Essential Readiness + Knowledge (specific)	60.3	[55.6 - 65.1]	49	[43.6 - 54.5]	54.9	[51.2 - 58.5]
Basic Commodities (standard)	65.8	[60.2 - 71.4]	54.8	[48.8 - 60.8]	60.5	[56.4 - 64.6]
Basic Commodities + Knowledge (standard)	60.2	[55.4 - 65.1]	50.3	[44.9 - 55.8]	55.5	[51.8 - 59.1]
Basic Commodities (specific)	68.5	[62.7 - 74.4]	54.7	[48.6 - 60.8]	61.8	[57.6 - 66.1]
Basic Commodities + Knowledge (specific)	62.6	[57.7 - 67.5]	49.9	[44.3 - 55.5]	56.5	[52.7 - 60.2]

Table 11. Coverage of appropriate management of childhood illness estimated through exact-match linking, by illness type (fever, ARI, diarrhea separately)

Illness	Size	Sought Care		Skilled Provider		Provider w Illness-specific commodities		Provider w All Basic Commodities		LAM Score	
	n	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Fever	300	81.7	(76.9-85.6)	77.7	(72.6-82.0)	71.3	(66.0-76.2)	67.3	(61.8-72.4)	61.2	(57.4-64.9)
Diarrhea	147	60.5	(52.4-68.1)	57.1	(49.0-64.9)	52.4	(44.3-60.3)	54.4	(46.3-62.3)	45.3	(39.0-51.6)
ARI	47	78.7	(64.8-88.2)	76.6	(62.5-86.5)	78.7	(64.8-88.2)	76.6	(62.5-86.5)	62.8	(53.0-72.6)

Table 12. Source of care and availability of illness-specific commodities by illness type and strata

Fever: Source of Care							
		Rural		Urban		Overall	
		% Care-seeking Events	% Events w ACT/Test Stocked	% Care-seeking Events	% Events w ACT/Test Stocked	% Care-seeking Events	% Events w ACT/Test Stocked
Hospital		0	--	2.9	100	1.3	100
Govt health center	Urban	1.1	100	69.3	100	31	100
	Rural	59.1	91.3	0	--	33.2	91.3
Govt CBA	Urban	0	--	0.7	100	0.3	100
	Rural	19.3	64.7	0	--	10.9	64.7
Pvt clinic		0	--	0.7	0	0.3	0
Pharmacy		0.6	0	1.5	0	1	0
Shop	Urban	0	--	5.8	0	2.6	0
	Rural	1.1	0	0	--	0.6	0
Traditional or Faith Healer	Urban	0	--	0	--	0	--
	Rural	2.3	0	0	--	1.3	0
No Care Sought		16.5	--	19	--	17.6	--

Diarrhea: Source of Care							
		Rural		Urban		Overall	
		% Care-seeking Events	% Events w ORS Stocked	% Care-seeking Events	% Events w ORS Stocked	% Care-seeking Events	% Events w ORS Stocked
Hospital		0	--	0	--	0	--
Govt health center	Urban	0	--	47.7	100	27.6	100
	Rural	54.7	100	0	--	23	100
Govt CBA	Urban	0	--	1.1	0	0.7	0
	Rural	15.6	0	0	--	6.6	0
Pvt clinic		0	--	0	--	0	--
Pharmacy		0	--	0	--	0	--
Shop	Urban	0	--	3.4	0	2	0
	Rural	0	--	0	--	0	--
Traditional or Faith Healer	Urban		--		--		--
	Rural	4.7	0	0	--	2	0
No Care Sought		25		47.7		38.2	

ARI: Source of Care							
		Rural		Urban		Overall	
		% Care-seeking Events	% Events w Antibiotics Stocked	% Care-seeking Events	% Events w Antibiotics Stocked	% Care-seeking Events	% Events w Antibiotics Stocked
Hospital		0	--	10.5	100	3.8	100
Govt health center	Urban	3	100	63.2	100	25	100
	Rural	69.7	100	0	--	44.2	100
Govt CBA	Urban	0	--	0	--	0	--
	Rural	3	0	0	--	1.9	0
Pvt clinic		0	--	0	--	0	--
Pharmacy		3	100	5.3	100	3.8	100
Shop	Urban	0	--	0	--	0	--
	Rural	0	--	0	--	0	--
Traditional or Faith Healer	Urban		--		--		--
	Rural	3	0	0	--	1.9	0
No Care Sought		18.2	--	21.1	--	19.2	--

Table 13. Coverage of management of child illness based on maternal-reported care, by strata

Illness	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Fever						
Sought care skilled provider	79.6	[72.9 - 85.1]	75.2	[67.2 - 81.8]	77.7	[72.6 - 82.0]
Received a malaria test	41.6	[34.3 - 49.2]	18.2	[12.5 - 25.7]	31.2	[26.2 - 36.7]
Received ACT	5	[2.5 - 9.6]	0.8	[0.1 - 5.2]	3.1	[1.6 - 5.8]
Received ACT among those treated with any medicine	5.6	[2.8 - 10.8]	0.8	[0.1 - 5.7]	3.4	[1.8 - 6.5]
Received a malaria test or ACT	42.5	[35.1 - 50.3]	18.5	[12.7 - 26.1]	31.7	[26.6 - 37.3]
Sought care provider with test and ACT*	68.9	[61.4 - 75.4]	74.4	[66.4 - 81.1]	71.3	[66.0 - 76.2]
Likely to be correctly managed*	62.9	[58.0 - 67.8]	59	[53.3 - 64.8]	61.2	[57.4 - 64.9]
Diarrhea						
Sought care skilled provider	69.5	[56.7 - 79.9]	48.9	[38.6 - 59.2]	57.1	[49.0 - 64.9]
Received ORT (ORS or RHF)	60.3	[47.3 - 72.0]	50.6	[40.2 - 60.9]	54.5	[46.3 - 62.4]
Received ORT or increased fluids	67.2	[54.3 - 78.0]	56.3	[45.8 - 66.3]	60.7	[52.5 - 68.3]
Received ORT + continued feeding	29.3	[19.1 - 42.2]	23	[15.3 - 33.0]	25.5	[19.1 - 33.2]
Received ORT/increased fluids + continued feeding	31	[20.5 - 44.0]	25.3	[17.3 - 35.4]	27.6	[20.9 - 35.4]
Sought care provider with ORS*	59.3	[46.5 - 71.0]	47.7	[37.5 - 58.1]	52.4	[44.3 - 60.3]
Likely to be correctly managed*	55.8	[46.5 - 65.1]	38.2	[30.0 - 46.5]	45.3	[39.0 - 51.6]
ARI						
Sought care skilled provider	77.4	[59.6 - 88.8]	75	[49.2 - 90.3]	76.6	[62.5 - 86.5]
Received antibiotic	66.7	[48.4 - 81.0]	62.5	[37.7 - 82.1]	65.2	[50.5 - 77.5]
Sought care provider with antibiotic*	80.6	[63.1 - 91.0]	75	[49.2 - 90.3]	78.7	[64.8 - 88.2]
Likely to be correctly managed*	64.9	[52.9 - 76.9]	58.6	[41.2 - 76.0]	62.8	[53.0 - 72.6]

* Based on exact-match linking analysis

Sup Table 1. Coverage of appropriate management of childhood illness by key domain estimated through exact-match linking with highest score, by strata

Strata	n	Sought Care		Skilled Provider		Essential Readiness Domains: Diagnosis		Basic Medicines		Complex Medicines		Human Resources		Txt by Pathology		Knowledge		Likelihood of Appropriate Management	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Rural	199	78.9	(72.7-84.0)	75.9	(69.5-81.3)	67.9	(62.2-73.7)	67.7	(61.6-73.7)	50	(44.3-55.8)	59	(53.6-64.3)	68.4	(62.5-74.3)	44.6	(40.5-48.7)	61	(56.2-65.8)
Urban	186	66.7	(59.6-73.1)	62.4	(55.2-69.0)	62.1	(55.1-69.1)	51.1	(45.3-56.8)	57.3	(50.7-64.0)	25.1	(21.8-28.4)	62	(55.0-69.0)	37.5	(33.2-41.7)	49.6	(44.1-55.2)
Overall	385	73	(68.3-77.2)	69.4	(64.6-73.8)	65.1	(60.6-69.6)	59.6	(55.4-63.9)	53.6	(49.2-57.9)	42.6	(39.0-46.2)	65.3	(60.8-69.9)	41.1	(38.2-44.1)	55.5	(51.9-59.2)

Sup Table 2. Coverage of appropriate management of child illness using alternative LAM scores with highest score

LAM Measure	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
SARA (standard)	56.3	[51.4 - 61.3]	55.3	[49.2 - 61.4]	55.8	[51.9 - 59.7]
SARA + Knowledge (standard)	54.9	[50.3 - 59.5]	53.3	[47.4 - 59.1]	54.1	[50.4 - 57.8]
SARA (specific)	59.9	[55.1 - 64.7]	56.5	[50.5 - 62.5]	58.3	[54.5 - 62.1]
SARA + Knowledge (specific)	58.4	[53.9 - 62.9]	54	[48.1 - 59.8]	56.3	[52.6 - 59.9]
Essential Readiness (standard)	60.5	[55.2 - 65.9]	51.5	[45.8 - 57.3]	56.2	[52.3 - 60.1]
Essential Readiness + Knowledge (standard)	57.7	[52.8 - 62.5]	49.1	[43.7 - 54.6]	53.5	[49.9 - 57.2]
Essential Readiness (specific)	64.3	[59.1 - 69.6]	52.1	[46.3 - 57.9]	58.4	[54.5 - 62.3]
Essential Readiness + Knowledge (specific)	61	[56.2 - 65.8]	49.6	[44.1 - 55.2]	55.5	[51.9 - 59.2]
Basic Commodities (standard)	67.1	[61.4 - 72.8]	55.3	[49.3 - 61.3]	61.4	[57.2 - 65.6]
Basic Commodities + Knowledge (standard)	61.1	[56.2 - 66.0]	50.8	[45.3 - 56.3]	56.1	[52.4 - 59.8]
Basic Commodities (specific)	69.6	[63.8 - 75.5]	54.8	[48.7 - 60.9]	62.5	[58.2 - 66.8]
Basic Commodities + Knowledge (specific)	63.5	[58.5 - 68.4]	50.4	[44.8 - 56.0]	57.2	[53.4 - 60.9]

Sup Table 3. Coverage of appropriate management of childhood illness estimated through exact-match linking using highest score, by illness type (fever, ARI, diarrhea separately)

Illness	Size	Sought Care		Skilled Provider		Provider w Illness-specific commodities		Provider w All Basic Commodities		LAM Score	
	n	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Fever	300	81.7	(76.9-85.6)	77.7	(72.6-82.0)	71.3	(66.0-76.2)	67.3	(61.8-72.4)	62	(58.2-65.8)
Diarrhea	147	60.5	(52.4-68.1)	57.1	(49.0-64.9)	52.4	(44.3-60.3)	54.4	(46.3-62.3)	45.9	(39.5-52.3)
ARI	47	78.7	(64.8-88.2)	76.6	(62.5-86.5)	78.7	(64.8-88.2)	76.6	(62.5-86.5)	64.8	(54.9-74.8)

Paper 3: Ecological Linking to Estimate Coverage of Appropriate Management of Child Illness

1. Background

Existing population-based household surveys have limited accuracy for estimating the coverage of appropriate management of child illness (1–3). Linking information on the source of care collected through a household survey with health care provider assessments of the quality and extent of services has been proposed as a means of generating more informative population-level estimates of the coverage of key health interventions (4). Linking household and provider data can provide a more accurate picture of the quality of care received from a provider while maintaining a population-representative sample through the household survey. However, poorly designed and analyzed linking studies can result in inaccurate or misleading estimates.

A recent systematic review found almost 60 studies published since 1990 have linked information from household surveys and service environment assessments to address coverage of reproductive, maternal, newborn, and child health (RMNCH) interventions in LMICs (5). The linking methodology and sources of household and provider data varied greatly across studies, each presenting unique issues including temporal and geographic disconnects in data sets, non-representative samples, and lack of information on all sources of care. The majority of studies (51 / 59) performed ecological linking by assigning an individual or household to all or the nearest health care providers based on geographic proximity. Ecological linking may result in households or individuals being assigned to a provider that was not the true source of care, and may not accurately reflect the availability or quality of services accessed by an individual.

However, ecological linking requires less arduous data collection than the alternative exact-match linking, which requires information on the specific source of care. As a result, ecological linking is a more feasible method for combining household and provider data at a large scale or in conjunction with existing global health data collection mechanisms.

Service Provision Assessment (SPAs) and Service Availability and Readiness Assessment (SARA) surveys are the most common source of data on provider readiness, and the only standardized and routinely collected sources of provider data. Over a quarter of reviewed linking studies used SPA (or predecessor Service Availability Module) provider survey data in the linking (5). SPA surveys, as well as SARA surveys, only collect information on public and private health facilities, potentially excluding common sources of care that are not facility based (6). Of particular relevance are public sector community-based health workers that are often trained and supported to treat child illnesses. Lack of information on potentially skilled health care providers may result in underestimation of coverage of correct management of child illness. Additionally, the SPA and SARA only collect readiness data on a sample of facilities.

Linking household and provider data may generate more informative estimates of coverage of appropriate management of child illness. However, the most rigorous linking methods requiring information on the specific source of care and data from all provider types may not be feasible in many contexts. It is important to quantify the degree of bias and variance introduced to estimates generated using less rigorous methods, including ecological linking and utilization of existing facility assessments. This analysis compares

estimates generated through exact-match linking (Aim 2) with estimates from multiple ecological linking methods and facility-only data.

2. Methods

Ethical approval for the study was obtained from the Institutional Review Boards of Johns Hopkins Bloomberg School of Public Health and Excellence in Research Ethics and Science (ERES) Converge in Zambia.

2.1. Study Site

The study was conducted in Choma District in Southern Province, Zambia, between January 18 and March 20, 2016. The economy of Choma District is primarily agrarian, although Choma town is a growing commercial hub and provincial capital (7). Zambia experiences three seasons, a cool dry season from May to August, a hot dry season from September to October, and a warm rainy season from November to April (8).

Child under five mortality rates in Southern Province have declined dramatically over the past 2 decades from 134 deaths per 1,000 live births in 1992 to 68 deaths per 1,000 live births in 2013-2014 (8). Pneumonia, diarrhea, and malaria remain the leading causes of child under five mortality in the post-neonatal period (8). The 2013 Zambia Demographic and Health Survey (ZDHS) found high variability in the two-week prevalence of illness among children less than 5 years, with 21 percent experiencing fever, 18 percent experiencing diarrhea, and 4 percent of children experiencing symptoms of ARI. Seasonality in child illness exists in the region, with ARI cases peaking in the dry season, diarrhea most prevalent during the rainy season, and malaria rates peaking late in the rainy season (8). Southern Province is classified as an area with sustained malaria

control resulting in malaria parasite prevalence under 10% in children under 5 years at peak transmission (9). Reported care-seeking for child illness is high in Southern Province, with approximately 70 percent of mothers reporting they sought care for their child with fever (68.5%), diarrhea (70%), or ARI symptoms (68%). National guidelines on the management of suspected pneumonia, fever, and diarrhea align with WHO IMCI guidelines, including use of low-osmolality ORS and zinc in the management of diarrhea, antibiotics for management of ARI, and ACT for treatment of malaria. Guidelines on the management of fever were revised in 2013 to include RDT confirmation of malaria at government health facilities (8).

The public sector dominates health service delivery in Zambia. The government manages 90% of health facilities either directly or through service agreements with the Churches Health Association of Zambia. There is growing private sector involvement in urban centers (10). Health services are free for children <5 years at all government facilities, including referral services to hospitals with presentation of a referral letter (11). Community based health agents (CBAs) may participate in task shifting at government health centers and health posts and deploy a variable package of community-based interventions, including diagnosis and treatment of malaria and treatment of diarrhea with oral rehydration solution (ORS) (12). (10). IMCI has been implemented in all districts since the 1990s; however only about 65% of health facilities are staffed by an IMCI-trained clinician (13).

2.2. Study Design, Participants, and Data Collection

The study included two components; 1) a household survey on care-seeking for child illness, and 2) an assessment of provider readiness. The study area was defined as

the catchment population of five government health facilities in and around Choma town, and stratified into urban and rural populations.

Health care providers were identified and asked to participate in the readiness assessment. Care providers were defined as public, private, informal or traditional source of care, including government health workers, private clinics, pharmacies, shops, and traditional or faith healers. In each catchment area, community leaders and health workers generated a listing of commonly utilized care providers offering medicine or alternative treatment for sick children. During the household enrollment survey, participating mothers were asked to identify common sources of care for treating illness in their children <5 years to ensure all providers were included in the provider assessment.

All public and private facilities, pharmacies, and government CBAs offering child curative services, and the most commonly utilized traditional practitioners and informal drug outlets in the study area participated in the readiness assessment (Fig 1). Interviewers asked consenting providers a series of questions about their individual or facility's readiness to provide curative services for children <5 years. At facilities and pharmacies with multiple staff, the questionnaire was administered to the most senior staff member. The questionnaire was modeled off the SARA general and child health questionnaire and adapted for use with facility-based, community-based, public, private, and informal providers. The questionnaire included additional questions about staff supervision, operating hours, and user fees. Health care provider knowledge was assessed using clinical case scenarios developed for use in the evaluation of the IMCI program (14). Providers were read four clinical case scenarios and asked how they would manage each hypothetical sick child. At outlets with multiple clinical staff, up to three staff

members within a cadre of clinical health workers were randomly selected among those available at the time of the assessment to respond to case scenarios.

Information was collected on how providers managed sick children brought for treatment. Participating providers were given a smart phone with an application for recording information on the symptoms, testing, diagnosis, and treatment of a sick child. Providers were instructed to record this information for children participating in the household survey, identified through presentation of a study identification card at the time of treatment. Government and private health facilities, CBAs, and some traditional practitioners collected data on management of sick children. Treatment information was transmitted via cellular data in real-time. Where data could not be transmitted due to inconsistent cellular signal, data were manually extracted from the study phones at the end of the data collection period.

Concurrent to the provider assessment, households with children <5 years were enrolled in the study (January 18 – February 13, 2016). Households were randomly sampled from the catchment area of three rural health facilities using an existing household listing created in 2014 (15). Urban households were sampled from a census of households conducted immediately prior to the household enrollment phase. Households were eligible to participate in the study if a woman of reproductive age (15-49 years) with at least one biological child < 58 months resided in the household. These criteria were selected to correlate with the DHS requirements for the Women's Questionnaire and ensure participating children were under 5 years of age at the time of the follow-up household survey. In consenting households, a brief survey was conducted on household assets, demographics, and maternal preferences in seeking care for sick children. All

enrolled children < 58 months were assigned a laminated card with a unique barcode number. In the event curative services were sought for a sick child, household members were instructed to present the card at the source of care.

Approximately four to six weeks after enrollment, participating households were revisited and the follow-up care-seeking survey was administered (March 3 – 20, 2016). Mothers were asked a series of questions on child illness and care seeking identical to those asked in the Zambia DHS. Participating mothers were asked about the presence of diarrhea, fever, or suspected ARI in each of their children <5 years in the preceding two weeks. If a child experienced one or more of these illnesses, the mother was asked if any care was sought, the source of care, and treatment received. Following the completion of the series of DHS care-seeking questions, an additional questionnaire was administered to ascertain the name of the specific source of care and sequence of care-seeking events. If the mother was unsure of the name of the source of care, data collectors were instructed to probe on the location of the provider and other identifying features.

2.3. Primary outcomes

The primary outcomes were coverage of appropriate management of child illness estimated using exact-match linking, ecologocial linking, and each linking method using facility-only data and deviatation of those estimates from the most precise estimate derived from exact-match linking with all provider data.

Using exact-match linking, coverage of appropriate management was calculated by linking information on source of care for child illness, collected through the household survey, with an estimate of the specific source of care's preparedness to appropriately manage a child illness. A provider's preparedness, or likelihood of appropriately

managing a child illness, was defined using information from the provider readiness assessments. Each sick child was assigned the likelihood of appropriate management (LAM) score for the specific source(s) of care from which care was sought, based on the name of the facility, outlet, or provider stated by the mother during the household survey.

Using ecological linking, each child was assigned the LAM score of the closest or average of multiple close providers based on various measures of geographic proximity. Six methods for ecological linking were employed, depicted in Figure 2:

1. Nearest Absolute Distance: Closest provider by straight-line distance. Child was linked to the single closest provider within the reported category of source of care based on absolute distance. This is the simplest method for assigning a child to a specific provider.
2. Nearest Travel Distance: Closest provider by road distance. Child was linked to the single closest provider within the reported category of source of care based on road distance. Method is designed to model the effect of road access and quality on care-seeking.
3. Radius (5 Kilometer): All providers within a 5 km radius of the child's house. Child was linked to all providers within the category of source of care within a 5 km radius of the child's home. This method is designed to approximate a 1 hour walking distance from a household to a provider in any direction.
4. Administrative Unit (HFCA): All providers within the HFCA. Each child was linked to all providers with the category of source of care within the HFCA in which the child resides. Designed to mimic the effect of useing aggregate data as a small scale (enumeration area / cluster).

5. Administrative Unit (Study Area): All providers within the study area. Each child was linked to all providers with the category of source of care included in the study readiness assessment. Designed to mimic the effect of using aggregate data as a medium scale (sub-district).
6. Kernal Density Estimation (KDE): Weighted pull of all providers. This method attempts to account for various forces exerting pressure on care-seeking decision making, specifically distance to a provider and provider preparedness to correctly manage a child illness. The method was designed to reflect the pull, or level of draw, a provider exerts over households within their catchment area as a source of care for a child illness. KDE allows the radius and intensity of pull that the provider exerts to vary depending on characteristics of the provider, such as provider type and LAM. Each child was linked exclusively or partially to providers based on the relative "pull" they exerted over distance, weighted by the LAM and provider type. Information on source of care from the household survey was excluded because the method models care-seeking behavior.

Coverage was also estimated using only health facility readiness data to mimic the effect of using SPA or SARA data for a linking analysis. Children that sought care from a health facility were linked to a provider or providers using exact-match linking and each of the ecological linking methods. Children that sought care from non-facility providers were treated as if no care was sought.

Coverage of appropriate managment of child illness was estimated for each linking method as the average LAM score across all sick children. Coverage was

estimated by strata and illness type. Descriptive statistics on each linking method were reported.

The final outocome of interest was the degree of bias introduced through estimating coverage based on ecological linking and using facility-only data, compared to exact-match linking with information on all providers. The difference in coverage estimated using the exact-match linking method (Aim 2) versus coverage estimated using the six ecological linking methods and facility-only data was calculated.

2.4. Sample Size and Stratification

The sample size was calculated to estimate the validity of maternal report of care-seeking for child illness presented in Paper 1. We estimated a sample of 107 documented care-seeking events for child illness in the preceding 2 weeks was needed in both strata to estimate the sensitivity and specificity of maternal report with a precision of ±8.0%. The sample size estimate was based on a type-1 error probability of 5% (two-tailed test), an underlying sensitivity and specificity of 80%, and a design effect of 1.1 for limited clustering within the health facility catchment area due to correlation in source of care. Approximately 560 children under 5 per strata were needed to capture 107 care-seeking events assuming 27.8% of children experienced a DHS illness in the 2 weeks preceding the survey (16), mothers reported seeking care for 81% of those illnesses (16), 10% of care-seeking events would occur at a provider not participating in the care-seeking event tracking, and the mothers of 5% of children would be unavailable at the time of the follow-up survey. To enroll 560 children per stratum, 700 households were sampled in each stratum assuming 90% of sampled households would be available and willing to participate and a household on average has 0.88 children <5 years (17).

2.5. Analysis

The primary study analysis was conducted in Stata 14.2. Coverage of appropriate management of child illness was calculated using the exact-match linking method. Each sick child was assigned the LAM score for the specific source(s) of care from which care was sought. If care was reportedly sought from more than one source, the child was assigned the average score for all providers from which care was sought. If no care was sought for the illness, the child was assigned a LAM score of zero. Coverage was calculated using a generalized linear model to estimate the average LAM score across all sick children.

The LAM score, or estimate of a provider's preparedness to appropriately managing a child illness, was defined using information from the provider readiness assessments. The score assessed availability of commodities and human resources needed to appropriately manage common child illnesses (Box 1). A provider received one point for each indicator if requirements were met and zero if not, and each domain received equal weight. The knowledge domain was calculated as an average score of provider performance on the four case scenarios. Each provider was assessed against the expected requirements for their specific outlet type. Additional information on the development and evaluation of the LAM score and exact-match linking methodology is presented in Paper 2.

Measures of geographic proximity employed in the ecological linking were adapted from the work of Skiles and colleagues (18). All non-KDE ecological linking methods maintained the reported category of source of care. In other words, a child could not be linked to a provider from a category of source of care other than the category

reported by the mother (e.g. a child that was taken to a government CBA can only be linked to government CBAs, although the specific CBA(s) may vary depending on the measure of geographic proximity). Categories of source of care are presented in Box 2.

Geographic proximity was calculated using ArcGIS 10.1. The longitude and latitude of the location of households with sick children and health care providers were input as XY data in decimal degrees and converted to point features by applying a geographic coordinate system (WGS 1984). Location data were converted to a geodatabase with a planar system (2-dimensional Cartesian plane) by projecting the data frame to the appropriate planar coordinate system for Zambia (universal transverse Mercator (UTM) zone 35S). Separate shape files were generated for each category of provider. These features were used in calculating geographic proximity:

1. Nearest Absolute Distance: A household with a sick child was linked to the closest provider within the reported category of source of care using the Near Features tool. Household location was used as the input feature and the provider location (by category) was the near feature. The procedure generated a variable in the household attribute table of the ID for the closest provider by absolute distance. This procedures was repeated with each of the 7 categories of providers and the household locations of children that sought care from those provider categories.
2. Nearest Travel Distance: A household with sick child was linked to the closest provider by road using the Closest Facility Analysis tool within the Network Analyst suite. Road network information for the study area was imported from Open Street Maps (OSM). As only roads were included in the OSM file, large trails and dirt paths were manually added to the road network based on satelite imagery. Provider

locations (by category) were classified as "facilities" and households were defined as "incidents." The analysis tool calculated the fastest route from each incident (household) to a facility (provider) along the road network. Distance from the household to the closest road was treated as zero. The analysis accounted for the quality of the road on potential routes to providers. The hierarchy attribute was used to weight preference for better quality roads – mimicking the effect of faster travel times and greater availability of vehicular transportation. Graded dirt roads were given preference over ungraded roads and walking trails, while paved roads were given preference over dirt roads. No additional barriers or restrictions were used, other than breaks in the road network. Time was defined as the cost attribute for the impedence, resulting in calculation of the route with the minimal time from houshold to provider. Data on the starting household and closest provider by road was stored in the Route attribute table. This procedure was repeated with each of the 7 categories of providers and the household locations of children that sought care from those provider categories.

3. Radius (5 Kilometer): A household with a sick child was linked to all providers within the source of care category within a 5 km radius of the child's home using the Buffer and Interect tool. The planar method was used to generate a Euclidean buffer around each household with a straight-line radius of 5 km. Household locations were used as the input feature with a buffer distance of 5 km. The Interect tool was used to compute the geometric intersection of the resulting household buffer layer and the locations of providers. The household buffer polygon feature and the provider location point feature were used as the inputs. The resulting output feature attribute

table identified all providers falling within the 5 km radius (intersecting the buffer) of each household. This procedure was repeated with each of the 7 categories of providers and the household locations of children that sought care from those provider categories.

4. KDE: A household with a sick child was linked to provider(s) exerting the strongest pull over distance weighted by LAM score and provider type using the Kernel Density tool within the Spatial Analyst suite. KDE parameters were defined using those employed by Skiles (18). Kernel size was defined by provider type with higher-order facilities receiving a larger kernel size:

    - Hospitals: 10 km radius
    - Government and private health facilities: 5 km radius
    - Government CBAs and pharmacies: 2 km radius
    - Traditional practitioners and informal shops: 1 km radius

    The location of providers (by category) was used as the input feature. The provider LAM score was specified as the "population," or density, value. The search radius, or kernel size, varied by the provider type as specified above. The procedure generated an output raster with a cell size of 500 m. The "Extract values to points" function was then used to calculate the raster value at the point location of each household. The household attribute table then contained the weighted pull value exerted by the category of provider at the location of the household. This procedure was repeated with each of the 7 categories of providers and the household locations of children that sought care from those provider categories. Two methods were used to assign a child a LAM score based on the "pull" values generated through the KDE:

- Each child was linked to the closest provider within the source of care category exerting the strongest pull.
- Each child was linked to the closest provider within all categories of source of care exerting any pull on the household. The LAM score assigned to each child was weighted based on the level of draw exerted by the category of provider.

Relevant attribute tables for proximity measures generated in ArcGIS were exported as CSV files. The CSV was converted to a Stata data set and merged with the child illness household survey data set for analysis in Stata. Two additional measures of geographic proximity were generated in Stata 14.2:

1. Administrative Unit (HFCA): Each sick child was assigned the average LAM score of all providers within the source of care category within the HFCA in which the household resides. The average LAM score for all providers within a category in each HFCA was calculated. This average score was then linked to each sick child based on the HFCA of the household location and the reported category of source of care (e.g. a sick child in Mochipapa HFCA treated by a CBA was assigned an average LAM score of all CBAs within Mochipapa HFCA).
2. Administrative Unit (Study Area): Each sick child was assigned the average LAM score of all providers within the source of care category within the total study area. The average LAM score for all providers within a category was calculated. This average score was then linked to each sick child based on the reported category of

source of care (e.g. a sick child in Mochipapa HFCA treated by a CBA was assigned an average LAM score of all CBAs within the total study area).

Subsequent analyses to estimate coverage using the ecologically linked data were conducted in Stata 14.2. The primary outcome of coverage of appropriate management of child illness was calculated using each ecologically linked data set. Each child was assigned the likelihood of appropriate management (LAM) score for the linked source of care. No care-seeking and care-seeking from multiple sources were handled the same way as the exact-match linking analysis. Coverage was calculated using a generalized linear model to estimate the average LAM score across all sick children.

Descriptive statistics on each linking method were estimated. For single nearest provider linking methods, the proportion of children linked to their true source of care (defined through the exact –match linking) was calculated. For aggregate linking methods, the average number of links and proportion of children linked to any source of care was estimated by type of provider and strata. The distribution of sources of care estimated through the KDE method were also reported.

Coverage of appropriate management of child illness was estimated using facility-only data. Coverage was estimated using the exact-match linking method and each of the ecological linking methods with only facility LAM scores. Health facilities were defined as either a government or private clinic or hospital, in line with those providers included in the SARA and SPA surveys. Using the exact-match, nearest provider, and aggregate ecological linking methods, children that did not recieve treatment from a health facility were assigned a LAM score of zero, equivalent to seeking no care. Children that sought care from a health facility were assigned a LAM score using the exact-match linking

method and each of the ecological linking methods. All other components of the linking methodology remained the same. Using the KDE methods, data on non-facility providers were excluded while modeling care-seeking behavior. Only facility providers could exert a pull on sick children. Coverage was calculated using a generalized linear model to estimate the average LAM score across all sick children.

A one-sample t-test was used to calculate the significance of the difference between the exact-match linking coverage estimates and each ecological linking and facility-only coverage estimate by strata.

3. Results

A total of 325 rural household and 436 urban households were approached to participate in the care-seeking survey. Four rural and 10 urban households refused to participate in the care-seeking survey. Characteristics of participating children, mothers, and households are shown in Table 1. There was an approximately equal distribution of children by age and gender. There were slightly fewer children under one year of age due to the lag period between enrollment and the care-seeking survey, which excluded neonates born within the follow-up period. The mean age of mothers was 29.6 years in the rural area and 27.1 years in the urban area. Mothers in the urban area on average had slightly higher education (66.5% with some secondary or higher) compared to mothers in the rural area (44.5% with some secondary or higher). All public and private facilities, pharmacies, and government CBAs offering child curative services, and the most commonly utilized traditional practitioners and informal drug outlets in the study area were included in the provider assessment.

Among the 1,084 children included in the care-seeking survey, 34.6% of urban children and 36.4% of rural children experienced at least one illness meeting DHS criteria in the 2 weeks preceding the survey (Table 2). Fever was the most commonly experienced symptom in both the rural and urban areas. Among those children that experienced a DHS illness, mother's reported care was sought for 78.9% of rural children and 66.7% of urban children. Reported care-seeking from more than one source was uncommon (5% of children taken for care). Among those children taken for care, mothers most often reported their child was taken to a skilled provider (95.2% rural care-seeking events, 91.5% urban care-seeking events).

3.1. Likelihood of Appropriate Management Scores

Each child was assigned the LAM score of the linked source(s) of care. LAM scores varied most by types of providers, but did not vary greatly within a provider category (Table 3). Government health facilities had the highest LAM scores, followed by private facilities, CBAs, and pharmacies. Informal shops and the majority of traditional practitioners had low LAM scores, or scores of zero.

3.2. Exact-match Linking: All Provider Data

Using the exact-match linking method, each sick child was linked to the specific source(s) of care stated during the household survey. Based on maternal-reported source of care, 79% of rural children and 67% of urban children were linked to at least one source of care (Table 4A). Government health centers were the primary source of care in both the urban (60%) and rural (61%) areas (Table 5A). In the rural area, 18% of children were taken to a CBA for care. A small number of children were linked to shops and

traditional practitioners in the rural area. In the urban area, care was sought for 5% of children from informal shops. Hospitals, pharmacies, and private facilities accounted for a small number of care-seeking events in the urban area. During the household care-seeking survey, mothers reported a small number of care-seeking events with providers that could not be identified. In the rural area, one care-seeking event with a traditional practitioner and a pharmacy outside the study area each could not be linked to the specific source of care. In the urban area, 9 care-seeking event were reported with unidentifiable providers including one government CBA and eight shops or market stalls. These children were assigned the average LAM score for the category of source of care.

Using the exact-match linking method to assign each child the LAM score of the specific source(s) of care utilized, coverage of appropriate management of child illness was estimated at 60.3% (95% CI: 55.6 – 65.1) in the rural area and 49% (95% CI: 43.6 – 54.5) in the urban area (Table 6A). Using exact match linking, a greater proportion of children with symptoms of fever and/or ARI received appropriate management (61% and 63% respectively) compared to children with diarrhea (45%) (Table 7A). This difference in coverage of appropriate management was most pronounced in the urban area, where only 38% of children with diarrhea were appropriately managed due to a low proportion taken to a skilled provider (see Paper 2, Table 12).

3.3. Ecological Linking: All Provider Data

Each child was linked to one or more health care providers based on geographic proximity. All methods, with the exception of the KDE linking methods, linked children to providers within the reported category of source of care from the household survey. As

a result, single nearest match and aggregate match estimates of care-seeking and skilled care could not exceed exact-match care-seeking rates (Table 4A).

Most children were linked to their original source(s) of care using the single nearest provider links (Table 8A). The nearest absolute measure linked approximately 89% of sick child to their original source of care used in the exact-match linking. The nearest by travel distance measure linked approximately 78% of sick child to their original source of care. A slightly higher proportion of rural children, compared to urban children, were linked to their original source(s) of care using either method. Children that were taken to a public health facility or traditional practitioner were most likely to be linked to their original source of care. Care-seeking events with private sector providers and CBAs were less likely to be linked to the original source of care. Using these two methods, all children for whom care was sought were linked to a provider resulting in a care-seeking rate equal to the rate estimated using the exact-match (Table 4A). Children were only linked to more than one provider if the mother reported the child was taken to more than one type of provider for care.

Children were linked to all providers within the reported category of care within a 5 km radius of their household, all providers within the HFCA, and all providers within the study area. Using the 5 km radius measure, some children were linked to multiple providers and others were not linked to any provider. In the rural area, 42% of children that sought care were not linked to a provider, including almost half of children that sought care from a public facility (Table 9A). Due to the high number of children that could not be linked to a provider, the overall proportion of rural children that were linked to a provider, or taken for care based on the linking method, was reduced to 51% (Table

4A). However, all children that sought care in the urban area were linked to at least one provider because of the high density of providers. Both administrative unit boundary measures ensured children that sought care were linked to at least one provider (Table 9A). Using the total study area boundary, all children that sought care were linked to at least one provider within the reported category of care. Using the HFCA boundary, only one rural child reportedly taken to a pharmacy was not linked to a provider because there were no pharmacies within the HFCA.

Using the 5 km radius, children were linked with between 0 and 8 providers (Table 10A). Urban children on average were linked to more providers than rural children (1.48 and 0.74 providers respectively). Using the HFCA administrative boundaries, children were linked with between 0 and 11 providers. Rural children on average were linked to more providers than urban children (1.97 and 0.85 providers respectively). The total area boundary measure resulted in the greatest number of links. Children were linked with between 0 and 39 providers. Similar to the HFCA boundary measure, rural children on average were linked to more providers than urban children (10.59 and 4.64 providers respectively). This could be attributed to the greater number of rural children that sought care from provider categories with a greater number of providers (i.e. CBAs and traditional practitioners).

Using the KDE methods, all urban children and 80% of rural children were linked to at least one source of care (Table 4A). The KDE single link method linked 70% of rural children and 84% of urban children to a skilled care provider. The KDE single link method reproduced the care-seeking behavior of over almost 40% of rural children but only 1% of urban children (Table 11A). Among those children reportedly taken for care

during the household survey, 46% of rural children were linked to their original source of care (at least one of the sources, if multiple) but only 2% of urban children were linked to their original source. In the rural area, most children were linked to a government health facility (37%) or CBA (33%). One in ten rural children were linked to a traditional practitioner and 20% were not linked to any provider. In the urban area, children were most often linked to CBAs (35%), private health facilities (31%), the district hospital (18%), and pharmacies (16%).

The KDE weighted linking method assigned each child to one or more providers, based on the weighted pull by provider category. On average, each child in the rural area was linked to one provider (range 0 - 4) while children in the urban area were linked to 5 providers on average (range: 3 – 6) (Table 13A). Most rural children were linked in full or partially to government health centers (46%) and CBAs (35%) (Table 14A). Some were linked to traditional practitioners (18%) or the hospital (3%). In the urban area, all children were at least partially linked to the district hospital, a public health center, and a private facility. Over 80% were linked to a pharmacy and 65% were linked to a CBA. Just under half were linked to a traditional practitioner or church. No children were linked to a shop due to the preparedness score of zero.

Coverage of appropriate management of childhood illness was assessed as the average of LAM scores among sick children by linking method (Table 6A). The two nearest provider ecological linking methods generated similar coverage estimates to the exact-match linking method. Based on the absolute nearest provider linking method, 61.1% (95% CI 56.3 - 65.9) of rural children and 49.1% (95% CI 43.7 - 54.6) of urban children received appropriate care. The nearest provider by travel distance method

estimated 58.8% (95% CI 54.1 - 63.5) of rural children and 48.7% (95% CI 43.2 - 54.1) of urban children received appropriate management. The HFCA boundary and total study area aggregate linking methods generated similar estimates of coverage. The 5 km radius method generated similar coverage estimates in the urban area, however, it greatly underestimated coverage of appropriate management in the rural area (38.8%, 95% CI 33.4 – 44.2). Both KDE linking methods generated similar estimates of coverage in the rural area (55%), but overestimated coverage in the urban area (KDE single link: 71.8%, KDE weighted link: 74.3%).

Coverage of appropriate management was estimated for each of the three primary symptoms by ecological linking method (Table 7A). The single nearest link and aggregate link measures produced similar estimates to the exact-match linking method. A smaller proportion of children with diarrhea received appropriate treatment because maintenance of the original maternal-reported category of care linked fewer children with diarrhea to a skilled provider. Both KDE methods obscured this relationship, as modeled care-seeking behavior did not vary by illness type. Both KDE methods generated coverage estimates that did not vary significantly by type of illness.

3.4. Exact-match Linking: Facility Only Data

Exact-match linking was performed using only health facility data, including hospital, public health center, and private clinic information. As facility providers were all skilled providers, estimates of any care-seeking and skilled care were equal and presented as any care-seeking in Table 4B. Using the exact match linking method, the proportion of rural children taken to a skilled provider was reduced from 76% to 61% (Table 4B), due to exclusion of CBAs (Table 5B). However, estimates of skilled care-

seeking remained similar among urban children (62.4% using all providers, 61.8% using facility-only data).

Exact-match linking estimates of coverage of appropriate management in rural areas were greatly reduced using facility-only data (Table 6B). Coverage fell from 60.3% of children correctly managed to 50.2% (95% CI: 44.6-55.8). Estimates of coverage in the urban area were unaffected. Use of facility-only data reduced the estimated of coverage of appropriate management of diarrhea (-7 points) and fever (-11 points) in the rural area (Table 7B). However, coverage of appropriate management of ARI fell only slightly because facilities accounted for most care-seeking events for children with ARI (see Paper 2, Table 12). Illness-specific coverage estimates in the urban area were unchanged.

3.5. Ecological Linking: Facility Only Data

The single nearest and aggregate ecological linking was performed maintaining the categories of source of care. Use of facility only data further reduced the number of children that were linked to their true source of care through the single link methods (76% absolute nearest, 67% travel distance) by excluding care-seeking events with CBAs and other community-based providers (Table 8B). Using the aggregate methods, children were linked to fewer providers on average compared to using data on all providers (Table 10B). Under the 5 km radius linking method, the proportion of rural children that could not be linked to a provider increased to 61% while the proportion of urban children that could not be linked remained low at 9% (Table 9B). The proportion of children not linked using the HFCA and total area aggregate methods mirrored the exact-match linking method.

Using the KDE single link method, 100% of urban children remained linked to a provider although the source of care shifted from CBAs and pharmacies to private facilities (Table 12B). In the rural area, a greater proportion of children were linked to public health centers compared to using all provider data, however, most children formerly linked to a CBA or traditional practitioner were no longer linked to any provider. Under the KDE weighted link, partial links to CBAs, pharmacies, and traditional practitioners were dropped while all children remained linked to the hospital, public health centers, and private facilities (Table 14B). In the rural area, links to the hospital and government health center were maintained while links to CBAs and traditional practitioners were dropped.

Estimates of coverage of appropriate management based on LAM score in rural areas were greatly reduced across all linking methods using facility-only data (Table 6B). Estimates of coverage in the urban area were unaffected, with the exception of the KDE weighted link. Coverage estimated using the KDE weighted link increased due to the removal of partial links to providers with lower LAM scores (pharmacies, traditional practitioners, etc.). Estimates of coverage by illness type paralleled the overall effect of using the facility-only data (Table 7B). Estimates of coverage for each of the three illnesses fell for rural children, but remained largely unchanged for urban children. Coverage estimates improved slightly for urban children using the KDE weighted link.

3.6. Coverage Estimate Comparison

Variation in coverage estimates generated using exact-match linking, ecological linking, and facility-only data is shown in Fig 8. The differences in estimates from the

exact-match all provider data estimate, the most precise measure of coverage, are presented in Table 15.

Coverage of appropriate management of child illness did not vary greatly in the urban area with use of only facility data or use of non-KDE ecological linking methods. Both KDE methods overestimated coverage of appropriate management using all provider and facility-only data by overestimating the proportion of sick children taken for care in the urban area.

Using all provider data, estimates of coverage in the rural area did not vary significantly by ecological linking method with the exception of the 5 km radius link. The 5 km radius method greatly underestimated coverage of appropriate management of child illness in the rural area relative to the exact-match coverage estimate (-21.5 points, $p<0.001$). The 5 km radius estimate was low because 46% of children originally taken to government health centers could not be linked to a provider because they lived >5 km from any health center and received a LAM score of zero. In this setting, rural children on average travelled 5.4 km, up to a maximum of 16 km, to access a rural government facility (Sup Table 1).

Use of facility-only data reduced coverage estimates using all linking methods in the rural area. The exact-match linking estimate in the rural area generated with facility-only data was 10 absolute percentage points lower ($p<0.001$) than the exact-match link using all provider data. The difference in the ecological facility-only estimates from the exact-match all provider estimate ranged from -8.8 to -21.7 in the rural area. Exclusion of data on CBAs, a skilled source of care for 18% of sick rural children, accounted for the reduction in estimated coverage of appropriate management in the rural area.

4. Discussion

Coverage of appropriate management of child illness can be estimated by linking information on source of care for child illness, collected through a household survey, with assessment of health care provider preparedness to manage sick children. Sick children can be linked to providers based on the specific source of care or other measures of geographic proximity to a provider. Exact-match linking on the specific source of care using information on all health care providers produces the most precise linked coverage estimates. In this study area where the majority of sick children were taken to the closest government health center for care, nearest provider linking methods were able to effectively reproduce this behavior and exact-match estimates of coverage. Additionally, low variation in LAM scores within a category of source of care meant methods that linked children to an aggregation of providers within the category of care produced similar estimates to the nearest provider and exact-match linking methods.

However, in areas with a low density of providers, ecological linking methods that cap the maximum link distance between a household and provider may reduce the number of children that can be linked to a source of care. Capping link distance may underestimate true care-seeking behavior and reduce estimates of coverage of appropriate management. Conversely, KDE methods may overestimate care-seeking behavior and coverage of appropriate management in areas with a high density of skilled providers due to an overestimation of the pull exerted by providers. Maintenance of the category of source of care was important due to variation in preparedness between categories of providers. A number of analyses have used ecological linking methods to assess access to primary care or the effect of service environment on utilization of curative services

including KDE (19), administrative unit (20,21), travel (22–24) and absolute distance (23,25). However, none assessed the accuracy of links against a measure of true source of care.

The availability of preparedness data for all providers versus only health facilities can affect estimates of coverage. Use of facility-only service assessment data, like that available through SPA and SARA surveys, can significantly underestimate coverage of appropriate management in areas where community-based or non-health facility providers offer effective care and are a substantial source of care for sick children. Additionally, SPA and SARA surveys often only collect readiness data on a sample of facilities. Our study was too small to explore the effect of sampling on coverage estimates, however, a study by Skiles and colleagues found ecological linking with a sample of facilities resulted in high misclassification of links to closest providers and inaccurate estimates of service environment when compared to a facility census (18).

The study was limited by low diversity in sources of care for child illness. Very few children were taken to a private sector provider for care, despite the presence of multiple private sector providers in the study area. The public sector is the primary source of care for child illness in many sub-Saharan African countries (26). However, this provider landscape may not be representative in urban areas or in other regions, limiting the generalizability of these findings. Additionally, the study was conducted in a small geographic area. This limited our ability to assess variation in preparedness across a wider sample of providers, the potential effect of provider bypassing on ecological linking estimates, and the effect of using aggregate administrative unit linking at a district or provincial level.

Linking household and provider data may generate more informative estimates of coverage of appropriate management of child illness. Exact-matching linking with all provider data generates the most precise estimates of coverage of appropriate management, however, collection of information on the specific source of care and assessment of all providers may not be feasible in many contexts. These results suggest ecological linking with provider preparedness data on at least a sample of all skilled providers maybe as effective as exact-match linking in areas with low variation in preparedness within a provider category or minimal provider bypassing. Assessment of non-facility providers is important in areas where these providers are a significant source of skilled care for sick children. Additionally, ecological linking methods must maintain or effectively reproduce apportionment of source of care by type of provider. This methodology is promising because it utilizes existing data collection mechanisms to generate a more complete picture of the management of child illness. This study was conducted on a small scale in an area with high rates of care-seeking for child illness from public sector providers. More studies are needed at a larger scale and in areas with a more diverse health care provider landscape to further evaluate the feasibility of the linking methodology. Additional research will support the development of guidelines for conducting linking assessments and potentially integrating this methodology into existing data collection mechanisms.

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Figure 1. Map of Provider Locations

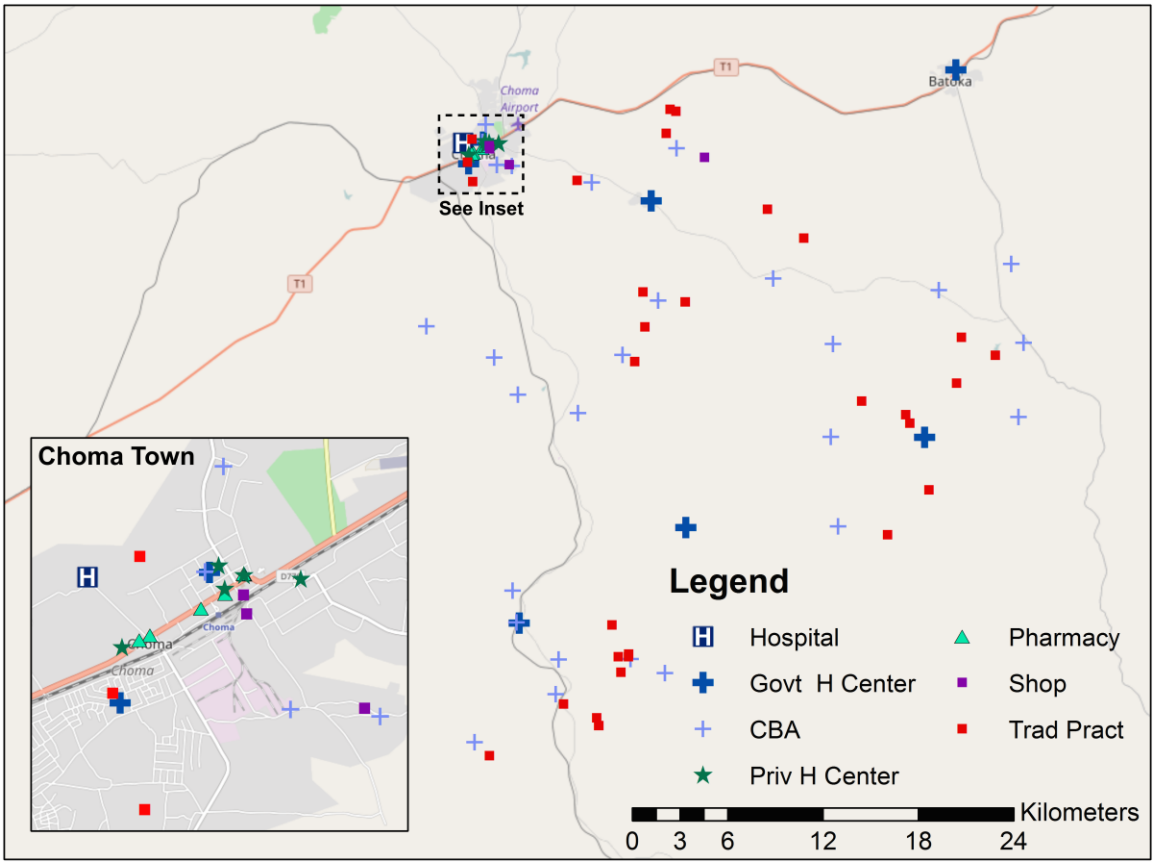
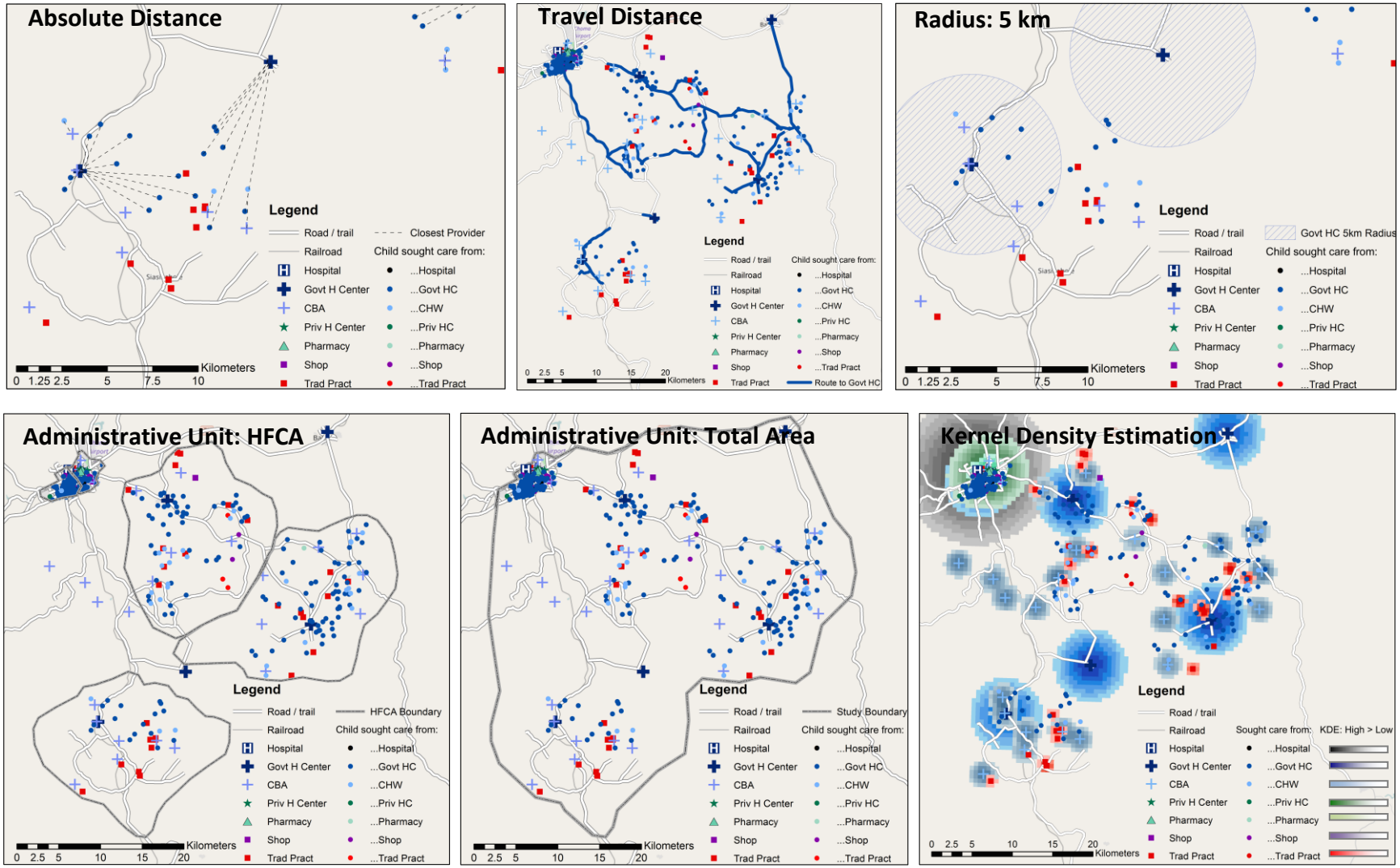


Figure 2. Ecological Linking Methods (Household locations have been displaced in this figure to protect participant confidentiality)



Box 1. Likelihood of appropriate management (LAM) score components

Diagnostics

- Malaria Diagnostic (RDTs or microscopy)
- Malnutrition Diagnostic (MUAC or Scale + Height board + Growth chart)
- ARI Diagnostic (Stethoscope or respiratory timer)
- General microscopy (Functioning microscope and slides)

Basic Medicines

- ORS
- Zinc
- ACT
- Oral antibiotic

Severe / Complicated Illness Medicines

- IV fluids
- Injectable quinine or artesunate
- Injectable antibiotics

Human Resources

- Training (At least one staff member with IMCI or relevant training)
- Guidelines (IMCI guidelines or relevant guidelines or job aid available)
- Supervision (Supervision visit with case management observation in last 3 months)

Management Capacity

- Diagnosis and treat malaria (by pathology)
- Diagnosis and treat diarrhea (by pathology)
- Diagnosis and treat ARI (by pathology)
- Diagnosis and treat malnutrition (by pathology)
- Facilitated referral capacity

Box 2. Categories of health care providers

Public Sector

- Govt hospital
- Govt health center / post
- Mobile hospital / clinic
- Community based agent / fieldworker
- Other public sector

Private Medical Sector

- Pvt Hospital / clinic
- Mission hospital / clinic
- Pharmacy
- Pvt doctor
- Mobile hospital / clinic
- Community based agent / fieldworker
- Other private sector

Other Source

- Shop
- Traditional Practitioner
- Market

Table 1. Characteristics of participating children, mothers, households and health care providers, by strata

	Rural			Urban			Overall		
	n	%	[95% CI]	n	%	[95% CI]	n	%	[95% CI]
Child Age (in years)	547			537			1084		
0	102	18.6	[15.6-22.1]	102	19	[15.9-22.5]	204	18.8	[16.6-21.3]
1	115	21	[17.8-24.6]	121	22.5	[19.2-26.3]	236	21.8	[19.4-24.3]
2	115	21	[17.8-24.6]	107	19.9	[16.8-23.5]	222	20.5	[18.2-23.0]
3	109	19.9	[16.8-23.5]	100	18.6	[15.5-22.1]	209	19.3	[17.0-21.7]
4	106	19.4	[16.3-22.9]	107	19.9	[16.8-23.5]	213	19.6	[17.4-22.1]
Child Sex									
Female	547			537			1084		
Male	274	50.1	[45.9-54.3]	277	51.6	[47.3-55.8]	551	50.8	[47.9-53.8]
Maternal Age (in years)	387			451			838		
15-19	47	12.1	[9.2-15.8]	51	11.3	[8.7-14.6]	98	11.7	[9.7-14.1]
20-29	155	40.1	[35.3-45.0]	253	56.1	[51.5-60.6]	408	48.7	[45.3-52.1]
30-39	126	32.6	[28.1-37.4]	127	28.2	[24.2-32.5]	253	30.2	[27.2-33.4]
40-49	59	15.2	[12.0-19.2]	20	4.4	[2.9-6.8]	79	9.4	[7.6-11.6]
Maternal Education	387			451			838		
None or primary incomplete	97	25.1	[21.0-29.6]	82	18.2	[14.9-22.0]	179	21.4	[18.7-24.3]
Primary complete	118	30.5	[26.1-35.3]	69	15.3	[12.3-18.9]	187	22.3	[19.6-25.3]
Secondary incomplete	138	35.7	[31.0-40.6]	171	37.9	[33.5-42.5]	309	36.9	[33.7-40.2]
Secondary complete or higher	34	8.8	[6.3-12.1]	129	28.6	[24.6-33.0]	163	19.5	[16.9-22.3]
Providers	54			29			83		
Govt Hospital	0			1			1		
Govt health center	5			2			7		
Govt CBA / fieldworker	19			9			28		
Pvt hospital / clinic	0			5			5		
Pharmacy	0			6			6		
Shop	1			3			4		
Traditional practitioner / Church / Other	29			3			32		

Table 2. Characteristics of reported child illness and care-seeking events, by strata

	Rural			Urban			Overall		
	n	%	[95% CI]	n	%	[95% CI]	n	%	[95% CI]
	547			537			1084		
Proportion of children with at least one reported DHS illness	199	36.4	[32.4-40.5]	186	34.6	[30.7-38.8]	385	35.5	[32.7-38.4]
Reported child illness	199			186			385		
Fever	23	11.6	[7.8-16.8]	50	26.9	[21.0-33.7]	73	19	[15.3-23.2]
Diarrhea	117	58.8	[51.8-65.4]	85	45.7	[38.7-52.9]	202	52.5	[47.5-57.4]
ARI[1]	6	3	[1.4-6.6]	3	1.6	[0.5-4.9]	9	2.3	[1.2-4.4]
Diarrhea & Fever	28	14.1	[9.9-19.6]	35	18.8	[13.8-25.1]	63	16.4	[13.0-20.4]
Diarrhea & ARI	3	1.5	[0.5-4.6]	0	0		3	0.8	[0.3-2.4]
Fever & ARI	17	8.5	[5.4-13.3]	10	5.4	[2.9-9.7]	27	7	[4.9-10.0]
Diarrhea, Fever, & ARI	5	2.5	[1.0-5.9]	3	1.6	[0.5-4.9]	8	2.1	[1.0-4.1]
Proportion of illnesses for which mother reported seeking care	157	78.9	[72.7-84.0]	124	66.7	[59.6-73.1]	281	73	[68.3-77.2]
Maternal reported number of sources of care among children taken for care[2]	157			124			281		
1	148	94.3	[89.3-97.0]	119	96	[90.7-98.3]	267	95	[91.8-97.0]
2	9	5.7	[3.0-10.7]	5	4	[1.7-9.3]	14	5	[3.0-8.2]
Maternal Reported Care-Seeking Events									
Any provider	166			129			295		
Participating provider	164	98.8	[95.3-99.7]	120	93	[87.1-96.3]	284	96.3	[93.4-97.9]
Skilled provider[3]	158	95.2	[90.7-97.6]	118	91.5	[85.2-95.2]	276	93.6	[90.1-95.9]

[1] ARI defined as cough with chest-related difficulty breathing

[2] There was a maximum of two reported care-seeking events for a single illness

[3] Skilled provider defined as government, mission, and private hospitals, health centers, and health posts, private doctors, and government community based agents

Table 3. Median and IQR of LAM scores by provider type

Provider Category		Sample Size	Median	IQR
Public Sector				
Hospital		1	93	(93-93)
Govt health center	Urban	2	82.2	(81.4-82.9)
	Rural	5	85.3	(75.4-88.2)
Govt CBA	Urban	9	59.7	(54.2-59.7)
	Rural	19	60.9	(48.6-61.1)
Private Sector				
Pvt clinic		5	73.2	(52.2-79.2)
Pharmacy		6	41.5	(33.3-61.3)
Informal Sector				
Shop	Urban	3	0	(0-0)
	Rural	1	0	(0-0)
Traditional or Faith Healer	Urban	3	0	(0-55)
	Rural	29	12.5	(5-25)

Table 4A. Proportion of sick children linked to any provider and skilled provider using all provider data, by strata and linking method

Linking Method	Rural				Urban				Overall			
	Sought Care		Sought Care from Skilled Provider		Sought Care		Sought Care from Skilled Provider		Sought Care		Sought Care from Skilled Provider	
	%	[95% CI]	%	[95% CI]	%	[95% CI]	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	78.9	[72.7 - 84.0]	75.9	[69.5 - 81.3]	66.7	[59.6 - 73.1]	62.4	[55.2 - 69.0]	73	[68.3 - 77.2]	69.4	[64.6 - 73.8]
Single Match												
Nearest - Absolute Distance*	78.9	[72.7 - 84.0]	75.9	[69.5 - 81.3]	66.7	[59.6 - 73.1]	62.4	[55.2 - 69.0]	73	[68.3 - 77.2]	69.4	[64.6 - 73.8]
Nearest - Travel distance*	78.9	[72.7 - 84.0]	75.9	[69.5 - 81.3]	66.7	[59.6 - 73.1]	62.4	[55.2 - 69.0]	73	[68.3 - 77.2]	69.4	[64.6 - 73.8]
Aggregate Match												
Radius - 5 km*	51.3	[44.3 - 58.2]	50.8	[43.8 - 57.7]	66.7	[59.9 - 73.5]	62.4	[55.4 - 69.3]	58.7	[53.8 - 63.6]	56.4	[51.4 - 61.3]
Administrative unit - HFCA*	78.4	[72.6-84.1]	75.9	[69.5 - 81.3]	66.6	[59.8 - 73.5]	62.4	[55.2 - 69.0]	72.7	[68.2-77.2]	69.4	[64.6 - 73.8]
Administrative unit - Total Area*	78.9	[72.7 - 84.0]	75.9	[69.5 - 81.3]	66.7	[59.6 - 73.1]	62.4	[55.2 - 69.0]	73	[68.3 - 77.2]	69.4	[64.6 - 73.8]
KDE												
Single Highest	79.9	[73.8 - 84.9]	69.8	[63.1 - 75.8]	100	-	84.4	[78.5 - 88.9]	89.6	(86.1-92.3)	76.9	[72.4 - 80.8]
Weighted Aggregate	79.9	[73.8-84.9]	73.4	[66.8 - 79.0]	100	-	100	-	89.6	[86.1-92.3]	86.2	[82.4-89.3]

*Cannot exceed exact-match care-seeking rates

Table 4B. Proportion of sick children linked to any provider and skilled provider using all provider data, by strata and linking method

Linking Method	Rural		Urban		Overall	
	Sought Care		Sought Care		Sought Care	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	61.3	[54.4 - 67.8]	61.8	[54.6 - 68.5]	61.6	[56.6 - 66.3]
Single Match						
Nearest - Absolute Distance *	61.3	[54.4 - 67.8]	61.8	[54.6 - 68.5]	61.6	[56.6 - 66.3]
Nearest - Travel distance *	61.3	[54.4 - 67.8]	61.8	[54.6 - 68.5]	61.6	[56.6 - 66.3]
Aggregate Match						
Radius - 5 km *	32.7	[26.1 - 39.2]	61.8	[54.8 - 68.9]	46.8	[41.7 - 51.8]
Administrative unit - HFCA *	61.3	[54.5-68.1]	61.8	[54.8-68.8]	61.5	[56.7-66.4]
Administrative unit - Total Area *	61.3	[54.5-68.1]	61.8	[54.8-68.8]	61.6	[56.7-66.4]
KDE						
Single Highest	46.2	[39.4-53.2]	100	-	72.2	[67.5-76.5]
Weighted Aggregate	47.8	[41.0-54.6]	100	-	86	[83.3-88.3]

*Cannot exceed exact-match care-seeking rates

Table 5A. Exact-match linking source of care for childhood illness from household survey using all provider data, by category and strata

Provider Category		Rural			Urban			Overall		
		# of events	% children taken to source	% linked to exact source	# of events	% children taken to source	% linked to exact source	# of events	% children taken to source	% linked to exact source
Public Sector		199			186			385		
Hospital		0	0	-	5	2.7	100	5	1.3	100
Govt health center	Urban	2	1	100	111	59.7	100	113	29.4	100
	Rural	120	60.3	100	0	0	-	120	31.2	100
Govt CBA	Urban	0	0	-	1	0.5	0	1	0.3	0
	Rural	36	18.1	100	0	0	-	36	9.4	100
Private Sector										
Pvt hospital / clinic		0	0	-	1	0.5	100	1	0.3	100
Pharmacy		1	0.5	0	2	1.1	100	3	0.8	66.7
Informal Sector										
Shop	Urban	0	0	-	9	4.8	11.1	9	2.3	11.1
	Rural	2	1	100	0	0	-	2	0.5	100
Traditional or Faith Based Healer	Urban	0	0	-	0	0	-	0	0	-
	Rural	5	2.5	80	0	0	-	5	1.3	80
No Care Sought		42	21.1	-	62	33.3	-	104	27	-
All Care-seeking Events		166		98.8	129		93	295		96.3

Table 5B. Exact-match linking source of care for childhood illness from household survey using facility-only data, by category and strata

Provider Category		Rural			Urban			Overall		
		# of events	% children taken to source	% linked to exact source	# of events	% children taken to source	% linked to exact source	# of events	% children taken to source	% linked to exact source
Public Sector		199			186			385		
Hospital		0	0	-	5	2.7	100	5	1.3	100
Govt health center	Urban	2	1	100	111	59.7	100	113	29.4	100
	Rural	120	60.3	100	0	0	-	120	31.2	100
Govt CBA	Urban	0	0	-	0	0	0	0	0	-
	Rural	0	0	0	0	0	-	0	0	-
Private Sector										
Pvt hospital / clinic		0	0	-	1	0.5	100	1	0.3	100
Pharmacy		0	0	0	0	0	0	0	0	-
Informal Sector										
Shop	Urban	0	0	-	0	0	0	0	0	-
	Rural	0	0	0	0	0	-	0	0	-
Traditional or Faith Based Healer	Urban	0	0	-	0	0	-	0	0	-
	Rural	0	0	0	0	0	-	0	0	-
No Care Sought		77	38.7	-	71	38.2	-	148	38.4	-
All Care-seeking Events		166		73.5	129		90.7	295		81

Table 6A. Coverage of appropriate management of child illness using all provider data, by linking method and strata

Linking Method	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	60.3	[55.6 - 65.1]	49	[43.6 - 54.5]	54.9	[51.2 - 58.5]
Single Match						
Nearest - Absolute Distance *	61.1	[56.3 - 65.9]	49.1	[43.7 - 54.6]	55.3	[51.7 - 59.0]
Nearest - Travel distance *	58.8	[54.1 - 63.5]	48.7	[43.2 - 54.1]	53.9	[50.3 - 57.5]
Aggregate Match						
Radius - 5 km *	38.8	[33.4 - 44.2]	49.2	[43.7 - 54.7]	43.8	[39.9 - 47.7]
Administrative unit - HFCA *	59.5	[54.8 - 64.3]	49	[43.6 - 54.5]	54.5	[50.8 - 58.1]
Administrative unit - Total Area *	57.9	[53.4 - 62.4]	49.4	[43.9 - 54.9]	53.8	[50.2 - 57.3]
KDE						
Single Highest	55	[50.4 - 59.6]	71.8	[69.3 - 74.2]	63.1	[60.3 - 65.9]
Weighted Aggregate	54.9	[50.4 - 59.5]	74.3	[73.2 - 75.5]	64.3	[61.7 - 66.9]

Table 6B. Coverage of appropriate management of child illness using facility-only data, by linking method and strata

Linking Method	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	50.2	[44.6 - 55.8]	48.4	[42.8 - 53.9]	49.3	[45.4 - 53.3]
Single Match						
Nearest - Absolute Distance *	51.5	[45.8 - 57.3]	48.9	[43.4 - 54.4]	50.3	[46.3 - 54.3]
Nearest - Travel distance *	49.9	[44.3 - 55.4]	48.8	[43.2 - 54.3]	49.3	[45.4 - 53.3]
Aggregate Match						
Radius - 5 km *	27.3	[21.8 - 32.7]	49.2	[43.6 - 54.7]	37.8	[33.8 - 41.9]
Administrative unit - HFCA *	51	[45.3 - 56.7]	48.9	[43.4 - 54.5]	50	[46.0 - 54.0]
Administrative unit - Total Area *	48.7	[43.3 - 54.1]	49.3	[43.7 - 54.9]	49	[45.1 - 52.9]
KDE						
Single Highest	38.6	[32.8 - 44.4]	79	[77.8 - 80.3]	58.1	[54.5 - 61.8]
Weighted Aggregate	38.6	[32.8 - 44.4]	82.4	[81.9 - 82.9]	59.8	[56.0 - 63.5]

Table 7A. Coverage of appropriate management by child illness using all provider data, by strata and linking method

DIARRHEA	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	55.8	[46.5 - 65.1]	38.2	[30.0 - 46.5]	45.3	[39.0 - 51.6]
Single Match						
Nearest - Absolute Distance *	55.9	[46.5 - 65.3]	38.2	[30.0 - 46.4]	45.3	[39.0 - 51.6]
Nearest - Travel distance *	54.5	[45.2 - 63.7]	37.7	[29.5 - 45.9]	44.4	[38.1 - 50.7]
Aggregate Match						
Radius - 5 km *	34.2	[24.3 - 44.1]	38.5	[30.2 - 46.8]	36.8	[30.4 - 43.1]
Administrative unit - HFCA *	55.2	[45.8 - 64.5]	38.3	[30.1 - 46.5]	45.1	[38.7 - 51.4]
Administrative unit - Total Area *	53.2	[44.3 - 62.1]	38.7	[30.3 - 47.0]	44.5	[38.3 - 50.7]
KDE						
Single Highest	52.4	[43.2 - 61.6]	72.8	[69.3 - 76.2]	64.6	[60.1 - 69.1]
Weighted Aggregate	52.8	[43.7 - 61.9]	74.4	[72.8 - 76.1]	65.8	[61.6 - 69.9]

FEVER	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	62.9	[58.0 - 67.8]	59	[53.3 - 64.8]	61.2	[57.4 - 64.9]
Single Match						
Nearest - Absolute Distance *	63.8	[58.9 - 68.8]	59.2	[53.4 - 65.0]	61.8	[58.0 - 65.5]
Nearest - Travel distance *	61.3	[56.5 - 66.2]	58.6	[52.8 - 64.4]	60.1	[56.4 - 63.9]
Aggregate Match						
Radius - 5 km *	41.3	[35.4 - 47.2]	59.2	[53.4 - 65.0]	49.3	[45.0 - 53.5]
Administrative unit - HFCA *	62.1	[57.2 - 67.0]	59.1	[53.3 - 64.8]	60.8	[57.0 - 64.5]
Administrative unit - Total Area *	60.4	[55.8 - 65.0]	59.4	[53.6 - 65.3]	60	[56.4 - 63.6]
KDE						
Single Highest	54.7	[49.7 - 59.8]	72.3	[69.3 - 75.3]	62.5	[59.3 - 65.8]
Weighted Aggregate	54.6	[49.6 - 59.5]	75	[73.7 - 76.3]	63.6	[60.6 - 66.7]

ARI	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	64.9	[52.9 - 76.9]	58.6	[41.2 - 76.0]	62.8	[53.0 - 72.6]
Single Match						
Nearest - Absolute Distance *	66.2	[54.2 - 78.2]	59.9	[42.4 - 77.5]	64.1	[54.2 - 73.9]
Nearest - Travel distance *	62.7	[51.0 - 74.5]	58.7	[41.5 - 76.0]	61.4	[51.7 - 71.0]
Aggregate Match						
Radius - 5 km *	33.3	[19.1 - 47.5]	59.1	[41.6 - 76.5]	42.1	[30.5 - 53.6]
Administrative unit - HFCA *	64.1	[51.5 - 76.7]	59	[41.6 - 76.4]	62.4	[52.3 - 72.5]
Administrative unit - Total Area *	61.7	[50.5 - 72.9]	59.3	[41.8 - 76.7]	60.9	[51.5 - 70.2]
KDE						
Single Highest	53.2	[40.9 - 65.5]	74.6	[67.8 - 81.3]	60.5	[51.6 - 69.3]
Weighted Aggregate	54.1	[42.0 - 66.2]	75.2	[71.1 - 79.2]	61.3	[52.7 - 69.8]

Table 7B. Coverage of appropriate management by child illness using facility-only data, by strata and linking method

DIARRHEA	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	48	[37.6 - 58.3]	37.5	[29.2 - 45.7]	41.7	[35.2 - 48.2]
Single Match						
Nearest - Absolute Distance *	49.9	[39.2 - 60.5]	37.5	[29.2 - 45.7]	42.4	[35.9 - 49.0]
Nearest - Travel distance *	48.7	[38.2 - 59.1]	37.4	[29.2 - 45.6]	41.9	[35.4 - 48.4]
Aggregate Match						
Radius - 5 km *	23	[13.3 - 32.6]	37.8	[29.5 - 46.1]	31.8	[25.4 - 38.2]
Administrative unit - HFCA *	49.7	[39.1 - 60.4]	37.5	[29.2 - 45.7]	42.4	[35.8 - 49.0]
Administrative unit - Total Area *	47.1	[37.1 - 57.2]	37.9	[29.6 - 46.3]	41.6	[35.2 - 48.1]
KDE						
Single Highest	38.2	[27.5 - 49.0]	78.8	[77.0 - 80.7]	62.5	[57.1 - 68.0]
Weighted Aggregate	38.2	[27.5 - 48.9]	82.4	[81.7 - 83.1]	64.7	[59.1 - 70.2]

FEVER	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	51.5	[45.4 - 57.6]	58.1	[52.2 - 64.0]	54.4	[50.1 - 58.7]
Single Match						
Nearest - Absolute Distance *	53	[46.8 - 59.3]	58.9	[53.0 - 64.8]	55.6	[51.3 - 60.0]
Nearest - Travel distance *	51.2	[45.2 - 57.3]	58.7	[52.8 - 64.6]	54.6	[50.3 - 58.8]
Aggregate Match						
Radius - 5 km *	28	[22.0 - 34.0]	59.2	[53.2 - 65.1]	41.8	[37.2 - 46.4]
Administrative unit - HFCA *	52.4	[46.3 - 58.6]	58.9	[53.0 - 64.8]	55.3	[51.0 - 59.6]
Administrative unit - Total Area *	50	[44.1 - 55.8]	59.4	[53.4 - 65.3]	54.1	[49.9 - 58.3]
KDE						
Single Highest	38	[31.7 - 44.4]	79.6	[78.2 - 81.1]	56.5	[52.2 - 60.8]
Weighted Aggregate	38	[31.7 - 44.4]	82.6	[82.1 - 83.2]	57.8	[53.5 - 62.1]

ARI	Rural		Urban		Overall	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Exact-Match	63.5	[50.9 - 76.1]	58.6	[41.2 - 76.0]	61.8	[51.7 - 72.0]
Single Match						
Nearest - Absolute Distance *	65.7	[53.0 - 78.5]	60.1	[42.5 - 77.6]	63.8	[53.6 - 74.0]
Nearest - Travel distance *	63.4	[51.0 - 75.8]	59.6	[42.1 - 77.0]	62.1	[52.1 - 72.1]
Aggregate Match						
Radius - 5 km *	32.4	[17.8 - 47.0]	60.2	[42.6 - 77.8]	41.8	[30.0 - 53.7]
Administrative unit - HFCA *	65.5	[52.8 - 78.2]	60.1	[42.5 - 77.6]	63.6	[53.4 - 73.8]
Administrative unit - Total Area *	61.5	[49.6 - 73.4]	60.4	[42.7 - 78.0]	61.1	[51.4 - 70.9]
KDE						
Single Highest	48.7	[33.8 - 63.6]	77.9	[73.4 - 82.3]	58.6	[48.0 - 69.3]
Weighted Aggregate	48.7	[33.8 - 63.6]	81.9	[80.3 - 83.4]	60	[49.2 - 70.8]

Table 8A. Proportion of care-seeking events linked to original source of care by single-link method using all provider data, by provider type and strata

Nearest Absolute		**Rural**			**Urban**			**Overall**		
		# Original Source	# Linked to Original	% Linked to Original	# Original Source	# Linked to Original	% Linked to Original	# Original Source	# Linked to Original	% Linked to Original
Hospital		0	-	-	5	5	100	5	5	100
Govt health center	Urban	2	0	0	111	100	90.1	113	100	88.5
	Rural	120	111	92.5	0	-	-	120	111	92.5
Govt CBA	Urban	0	-	-	0*	-	-	0*	-	-
	Rural	36	29	80.6	0	-	-	36	29	80.6
Pvt hospital / clinic		0	-	-	1	0	0	1	0	0
Pharmacy		0*	-	-	2	1	50	2*	1	50
Shop	Urban	0	-	-	1*	0	0	1*	0	0
	Rural	2	2	100	0	-	-	2	2	100
Traditional or Faith Based Healer	Urban	0	-	-	0	-	-	0	-	-
	Rural	4*	4	100	0	-	-	4*	4	100
All Sources of Care		164	146	89	120	106	88.3%	284	252	88.7%

Nearest Travel distance		**Rural**			**Urban**			**Overall**		
		# Original Source	# Linked to Original	% Linked to Original	# Original Source	# Linked to Original	% Linked to Original	# Original Source	# Linked to Original	% Linked to Original
Hospital		0	-	-	5	5	100	5	5	100
Govt health center	Urban	2	2	100	111	86	77.5	113	88	77.9
	Rural	120	98	81.7	0	-	-	120	98	81.7
Govt CBA	Urban	0	-	0	0*	-	-	0*	-	-
	Rural	36	24	66.7	0	-	-	36	24	66.7
Pvt hospital / clinic		0	-	-	1	0	0	1	0	0
Pharmacy		0*	-	-	2	0	0	2*	0	0
Shop	Urban	0	-	-	1*	1	11.1	1*	1	11.1
	Rural	2	2	100	0	-	-	2	2	100
Traditional or Faith Based Healer	Urban	0	-	-	0	-	-	0	-	-
	Rural	4*	2	50	0	-	-	4*	2	40
All Sources of Care		164	128	78.0%	120	92	76.7%	284	220	77.5%

Table 8B. Proportion of care-seeking events linked to original source of care by single-link method using facility-only data, by provider type and strata

Nearest Absolute		**Rural**			**Urban**			**Overall**		
		# Original Source	# Linked to Original	% Linked to Original	# Original Source	# Linked to Original	% Linked to Original	# Original Source	# Linked to Original	% Linked to Original
Hospital		0	-	-	5	5	100	5	5	100
Govt health center	Urban	2	0	0	111	100	90.1	113	100	88.5
	Rural	120	111	92.5	0	-	-	120	111	92.5
Govt CBA	Urban	0	-	-	0*	-	-	0*	-	-
	Rural	36	0	0	0	-	-	36	0	0
Pvt hospital / clinic		0	-	-	1	0	0	1	0	0
Pharmacy		0*	-	-	2	0	0	2*	0	0
Shop	Urban	0	-	-	1*	0	0	1*	0	0
	Rural	2	0	0	0	-	-	2	0	0
Traditional or Faith Based Healer	Urban	0	-	-	0	-	-	0	-	-
	Rural	4*	0	0	0	-	-	4*	0	0
All Sources of Care		164	111	67.7	120	106	88.3	284	216	76.1

Nearest Travel distance		**Rural**			**Urban**			**Overall**		
		# Original Source	# Linked to Original	% Linked to Original	# Original Source	# Linked to Original	% Linked to Original	# Original Source	# Linked to Original	% Linked to Original
Hospital		0	-	-	5	5	100	5	5	100
Govt health center	Urban	2	2	100	111	86	77.5	113	88	77.9
	Rural	120	98	81	0	-	-	120	98	81.7
Govt CBA	Urban	0	-	0	0*	-	-	0*	-	-
	Rural	36	0	0	0	-	-	36	0	0
Pvt hospital / clinic		0	-	-	1	0	0	1	0	0
Pharmacy		0*	-	-	2	0	0	2*	0	0
Shop	Urban	0	-	-	1*	0	0	1*	0	0
	Rural	2	0	0	0	-	-	2	0	0
Traditional or Faith Based Healer	Urban	0	-	-	0	-	-	0	-	-
	Rural	4*	0	0	0	-	-	4*	0	0
All Sources of Care		164	100	61	120	91	75.8	284	191	67.3

Table 9A. Proportion of children that were not linked to any provider using all provider data, by original source provider type and strata

Radius – 5 km		**Rural**			**Urban**			**Overall**		
		# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match
Hospital		0	-	-	5	5	100	5	5	100
Govt health center	Urban	2	0	0	111	100	90.1	113	100	88.5
	Rural	120	111	92.5	0	-	-	120	111	92.5
Govt CBA	Urban	0	-	-	0*	-	-	0*	-	-
	Rural	36	29	80.6	0	-	-	36	29	80.6
Pvt clinic		0	-	-	1	0	0	1	0	0
Pharmacy		0*	-	-	2	1	50	2*	1	50
Shop	Urban	0	-	-	1*	0	0	1*	0	0
	Rural	2	2	100	0	-	-	2	2	100
Traditional or Faith Healer	Urban	0	-	-	0	-	-	0	-	-
	Rural	4*	4	100	0	-	-	4*	4	100
All Sources		164	146	89	120	106	88.3	284	252	88.7

Administrative Unit – HFCA		**Rural**			**Urban**			**Overall**		
		# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match
Hospital		0	-		5	0	0	5	0	0
Govt health center	Urban	2	0	0	111	0	0	113	0	0
	Rural	120	0	0	0	-	-	120	0	0
Govt CBA	Urban	0	-		1	0	0	1	0	0
	Rural	36	0	0	0	-	-	36	0	0
Pvt clinic		0	-		1	0	0	1	0	0
Pharmacy		1	1	100	2	0	0	3	1	33
Shop	Urban	0	-		9	0	0	9	0	0
	Rural	2	0	0	0	-	-	2	0	0
Traditional or Faith Healer	Urban	0	-		0	-	-	0	-	-
	Rural	5	0	0	0	-	-	5	0	0
All Sources		166	1	0.6	129	0	0	295	1	0.3

Administrative Unit – Total		**Rural**			**Urban**			**Overall**		
		# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match
Hospital		0	-		5	0	0	5	0	0
Govt health center	Urban	2	0	0	111	0	0	113	0	0
	Rural	120	0	0	0	-	-	120	0	0
Govt CBA	Urban	0	-		1	0	0	1	0	0
	Rural	36	0	0	0	-	-	36	0	0
Pvt clinic		0	-		1	0	0	1	0	0
Pharmacy		1	0	0	2	0	0	3	0	0
Shop	Urban	0	-		9	0	0	9	0	0
	Rural	2	0	0	0	-	-	2	0	0
Traditional or Faith Healer	Urban	0	-		0	-	-	0	-	-
	Rural	5	0	0	0	-	-	5	0	0
All Sources		166	0	0	129	0	0	295	0	0

Table 9B. Proportion of children that were not linked to any provider using facility-only data, by original source provider type and strata

Radius – 5 km		**Rural**			**Urban**			**Overall**		
		# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match
Hospital		0	-	-	5	0	0	5	0	0
Govt health center	Urban	2	2	100	111	0	0	113	2	2
	Rural	120	55	46	0	-	-	120	55	46
Govt CBA	Urban	0	-	-	1	1	100	1	1	0
	Rural	36	36	100	0	-	-	36	36	100
Pvt clinic		0	-	-	1	0	0	1	0	0
Pharmacy		1	1	100	2	2	100	3	3	100
Shop	Urban	0	-	-	9	9	100	9	9	0
	Rural	2	2	100	0	-	-	2	2	100
Traditional or Faith Healer	Urban	0	-	-	0	-	-	0	-	-
	Rural	5	5	100	0	-	-	5	5	100
All Sources		166	101	61	129	12	9	295	113	38

Administrative Unit – HFCA		**Rural**			**Urban**			**Overall**		
		# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match
Hospital		0	-		5	0	0	5	0	0
Govt health center	Urban	2	0	0	111	0	0	113	0	0
	Rural	120	0	0	0	-	-	120	0	0
Govt CBA	Urban	0	-		1	1	100	1	1	100
	Rural	36	36	100	0	-	-	36	36	100
Pvt clinic		0	-		1	0	0	1	0	0
Pharmacy		1	1	100	2	2	100	3	3	100
Shop	Urban	0	-		9	9	100	9	9	100
	Rural	2	2	100	0	-	-	2	2	100
Traditional or Faith Healer	Urban	0	-		0	-	-	0	-	-
	Rural	5	5	100	0	-	-	5	5	100
All Sources		166	44	27	129	12	9.3	295	56	19

Administrative Unit – Total		**Rural**			**Urban**			**Overall**		
		# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match	# CS Events	# Not Match	% Not Match
Hospital		0	-		5	0	0	5	0	0
Govt health center	Urban	2	0	0	111	0	0	113	0	0
	Rural	121	0	0	0	-	-	120	0	0
Govt CBA	Urban	0	-		1	1	100	1	1	100
	Rural	35	35	100	0	-	-	36	35	100
Pvt clinic		0	-		1	0	0	1	0	0
Pharmacy		1	1	100	2	2	100	3	3	100
Shop	Urban	0	-		9	9	100	9	9	100
	Rural	2	2	100	0	-	-	2	2	100
Traditional or Faith Healer	Urban	0	-		0	-	-	0	-	-
	Rural	5	5	100	0	-	-	5	5	100
All Sources		166	43	25.9	129	12	9.3	295	55	18.6

Table 10A. Average number of provider links among children linked to source of care using all provider data, by provider type and strata

Radius - 5 km		**Rural**		**Urban**		**Overall**	
		Mean #	[Range]	Mean #	[Range]	Mean #	[Range]
Hospital		--		1		1	
Govt health center	Urban	0		2		2	
	Rural	1		--		1	
Govt CBA	Urban	--		5		5	
	Rural	2.03		--		2.03	
Pvt clinic		--		5		5	
Pharmacy		0		6		6	
Shop	Urban	--		3		3	
	Rural	0		--		0	
Traditional or Faith Healer	Urban	--		--		--	
	Rural	3.33		--		3.33	
Among All Children*		0.74	[0-5]	1.480	[0-8]	1.1	[0-8]
Among Children Linked to Source		1.45	[1-5]	2.23	[1-8]	1.88	[1-8]

Administrative Unit - HFCA		**Rural**		**Urban**		**Overall**	
		Mean #	[Range]	Mean #	[Range]	Mean #	[Range]
Hospital		--		1		1	
Govt health center	Urban	1		1		1	
	Rural	1		--		1	
Govt CBA	Urban	--		4		4	
	Rural	6.11		--		6.11	
Pvt clinic		--		2		2	
Pharmacy		0		5		5.00	
Shop	Urban	--		3		3	
	Rural	1		--		1	
Traditional or Faith Healer	Urban	--		--		--	
	Rural	9.8		--		9.8	
Among All Children*		1.97	[0-11]	0.85	[0-6]	1.43	[0-11]
Among Children Linked to Source		2.52	[1-11]	1.28	[1-6]	1.97	[1-11]

Administrative Unit - Total Area		**Rural**		**Urban**		**Overall**	
		Mean #	[Range]	Mean #	[Range]	Mean #	[Range]
Hospital		--		1		1	
Govt health center	Urban	7		7		7	
	Rural	7		--		7	
Govt CBA	Urban	--		28		28	
	Rural	28		--		28	
Pvt clinic		--		5		5	
Pharmacy		6		6		6	
Shop	Urban	--		4		4	
	Rural	4		--		4	
Traditional or Faith Healer	Urban	--		--		--	
	Rural	32		--		32	
Among All Children*		10.59	[0-39]	4.640	[0-28]	7.53	[0-39]
Among Children Linked to Source		12.97	[4-39]	6.96	[1-28]	10.32	[1-39]

*Includes children that were not linked because no provider met linking requirements or no care reported

Table 10B. Average number of provider links among children linked to source of care using facility-only data, by provider type and strata

Radius - 5 km		**Rural**		**Urban**		**Overall**	
		Mean #	[Range]	Mean #	[Range]	Mean #	[Range]
Hospital		--		1		1	
Govt health center	Urban	0		2		2	
	Rural	1		--		1	
Govt CBA	Urban	--		5		5	
	Rural	0		--		0	
Pvt clinic		--		0		0	
Pharmacy		0		0		0	
Shop	Urban	--		0		0	
	Rural	0		--		0	
Traditional or Faith Healer	Urban	--		--		--	
	Rural	0		--		0	
Among All Children*		0.33	[0-1]	1.250	[0-5]	0.77	[0-5]
Among Children Linked to Source		1	[1-1]	2.02	[1-5]	1.65	[1-5]

Administrative Unit - HFCA		**Rural**		**Urban**		**Overall**	
		Mean #	[Range]	Mean #	[Range]	Mean #	[Range]
Hospital		--		1		1	
Govt health center	Urban	1		1		1	
	Rural	1		--		1	
Govt CBA	Urban	--		0		0	
	Rural	0		--		0	
Pvt clinic		--		2		2	
Pharmacy		0		0		0	
Shop	Urban	--		0		0	
	Rural	0		--		0	
Traditional or Faith Healer	Urban	--		--		--	
	Rural	0		--		0	
Among All Children*		0.61	[0-1]	0.63	[0-2]	0.62	[0-2]
Among Children Linked to Source		1	[1-1]	1.03	[1-2]	1.01	[1-2]

Administrative Unit - Total Area		**Rural**		**Urban**		**Overall**	
		Mean #	[Range]	Mean #	[Range]	Mean #	[Range]
Hospital		--		1		1	
Govt health center	Urban	7		7		7	
	Rural	7		--		7	
Govt CBA	Urban	--		--		--	
	Rural	--		--		--	
Pvt clinic		--		5		5	
Pharmacy		--		--		--	
Shop	Urban	--		--		--	
	Rural	--		--		--	
Traditional or Faith Healer	Urban	--		--		--	
	Rural	--		--		--	
Among All Children*		4.29	[0-7]	4.23	[0-8]	4.26	[0-8]
Among Children Linked to Source		7	[7-7]	6.84	[1-8]	6.92	[1-8]

*Includes children that were not linked because no provider met linking requirements or no care reported

Table 11A. Proportion of children linked to original source of care by KDE single link method using all provider data, by strata

	Rural				Urban				Overall			
	Total Linked	# Match	% Match	[95% CI]	Total Linked	# Match	% Match	[95% CI]	Total Linked	# Match	% Match	[95% CI]
Among all sick children	199	78	39.2	[32.4 - 46.0]	186	2	1.1	[-0.4 - 2.6]	385	80	20.8	[16.7 - 24.8]
Among children with reported care-seeking during household survey	157	73	46.5	[38.7 - 54.3]	124	2	1.6	[-0.6 - 3.8]	281	75	26.7	[21.5 - 31.9]

Table 11B. Proportion of children linked to original source of care by KDE single link method using facility-only data, by strata

	Rural				Urban				Overall			
	Total Linked	# Match	% Match	[95% CI]	Total Linked	# Match	% Match	[95% CI]	Total Linked	# Match	% Match	[95% CI]
Among all sick children	199	83	41.7	[34.8 - 48.6]	186	2	1.1	[-0.4 - 2.6]	385	85	22.1	[17.9 - 26.2]
Among children with reported care-seeking during household survey	157	64	40.8	[33.1 - 48.5]	124	2	1.6	[-0.6 - 3.8]	281	66	23.5	[18.5 - 28.5]

Table 12A. Source of care by provider type, modeled through KDE single link method by strata using all provider data

Provider Category		Rural		Urban		Overall	
		# of children	% of children linked	# of children	% of children linked	# of children	% of children linked
		199		186		385	
Hospital		0	0	34	18.3	34	8.8
Govt health center	Urban	0	0	0	0	0	0
	Rural	74	37.2	0	0	74	19.2
Govt CBA	Urban	0	0	66	35.5	66	17.1
	Rural	65	32.7	0	0	65	16.9
Pvt clinic		0	0	57	30.6	57	14.8
Pharmacy		0	0	29	15.6	29	7.5
Shop	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Traditional or Faith Healer	Urban	0	0	0	0	0	0
	Rural	20	10.1	0	0	20	5.2
No Care Sought		40	20.1	0	0	40	10.4

Table 12B. Source of care by provider type, modeled through KDE single link method by strata using facility-only data

Provider Category		Rural		Urban		Overall	
		# of children	% of children linked	# of children	% of children linked	# of children	% of children linked
		199		186		385	
Hospital		3	1.5	34	18.3	37	9.6
Govt health center	Urban	0	0	0	0	0	0
	Rural	89	44.7	0	0	89	23.1
Govt CBA	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Pvt clinic		0	0	152	81.7	152	39.5
Pharmacy		0	0	0	0	0	0
Shop	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Traditional or Faith Healer	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
No Care Sought		107	53.8	0	0	107	27.8

Table 13A. Average number of provider links using KDE weighted aggregate method with all provider data, by strata

	Rural		Urban		Overall	
	Mean # Links	[Range]	Mean # Links	[Range]	Mean # Links	[Range]
Among All Children	1.015	[0-4]	4.91	[3-6]	2.90	[0-6]
Among Children Linked to Source	1.27	[1-4]	4.91	[3-6]	3.23	[1 - 6]

Table 13B. Average number of provider links using KDE weighted aggregate method with facility-only data, by strata

	Rural		Urban		Overall	
	Mean # Links	[Range]	Mean # Links	[Range]	Mean # Links	[Range]
Among All Children	0.49	[0-2]	3	[3-3]	1.7	[0-3]
Among Children Linked to Source	1.06	[1-2]	3	[3-3]	2.36	[1-3]

Table 14A. Source of care by provider type, modeled through KDE weighted aggregate method with all provider data

Provider Category		Rural		Urban		Overall	
		# of children	% of children linked	# of children	% of children linked	# of children	% of children linked
		199		186		385	
Hospital		6	3.0	186	100	192	49.9
Govt health center	Urban	0	0	186	100	186	48.3
	Rural	92	46.2	0	0	92	23.9
Govt CBA	Urban	0	0	121	65.1	121	31.4
	Rural	69	34.7	0	0	69	17.9
Pvt clinic		0	0	186	100	186	48.3
Pharmacy		0	0	150	80.6	150	39.0
Shop	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Traditional or Faith Healer	Urban	0	0	85	45.7	85	22.1
	Rural	35	17.6	0	0	35	9.1
No Care Sought		40	20.1	0	0	40	10.4

Table 14B. Source of care by provider type, modeled through KDE weighted aggregate method with facility-only data

Provider Category		Rural		Urban		Overall	
		# of children	% of children linked	# of children	% of children linked	# of children	% of children linked
		199		186		385	
Hospital		6	3.0	186	100	192	49.9
Govt health center	Urban	0	0	186	100	186	48.3
	Rural	92	46.2	0	0	92	23.9
Govt CBA	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Pvt clinic		0	0	186	100	186	48.3
Pharmacy		0	0	0	0	0	0
Shop	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Traditional or Faith Healer	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
No Care Sought		107	53.8	0	0	107	27.8

Figures 3. Coverage of appropriate management of child illness by linking method and strata

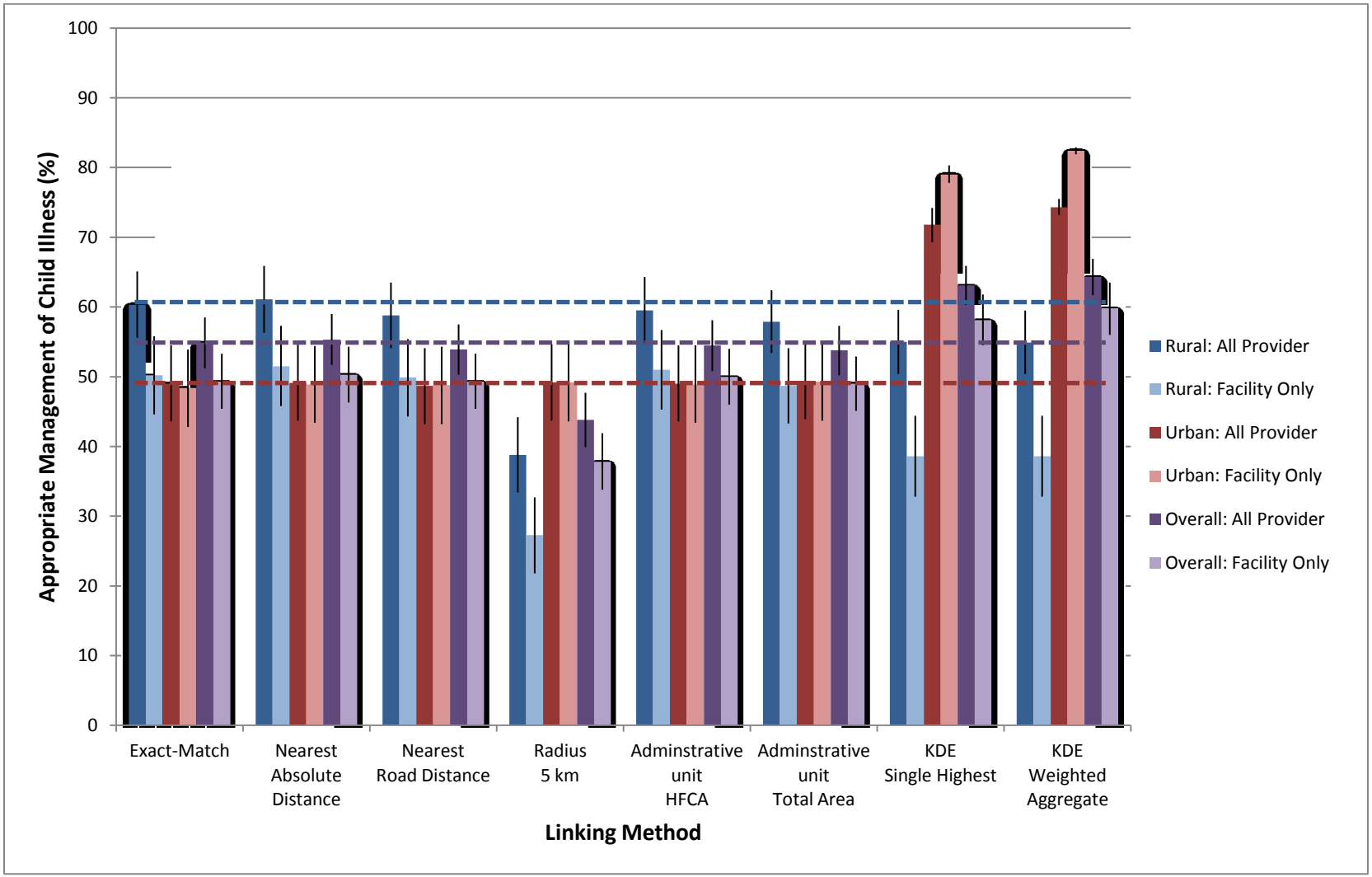


Table 15. Difference in estimated coverage by ecological and facility-only data linking versus exact-match all provider estimates, by strata

	Rural			Urban			Overall		
	Difference	+/-	Sign of Difference	Difference	+/-	Sign of Difference	Difference	+/-	Sign of Difference
ALL PROVIDER DATA									
Exact-Match	REF			REF			REF		
Single Match									
Nearest - Absolute Distance *	0.8	+	ns	0.1	+	ns	0.4	+	ns
Nearest - Travel distance *	-1.5	-	ns	-0.3	-	ns	-1	-	ns
Aggregate Match									
Radius - 5 km *	-21.5	-	***	0.2	+	ns	-11.1	-	***
Administrative unit - HFCA *	-0.8	-	ns	0	~	ns	-0.4	-	ns
Administrative unit - Total Area *	-2.4	-	ns	0.4	+	ns	-1.1	-	ns
KDE									
Single Highest	-5.3	-	*	22.8	+	***	8.2	+	***
Weighted Aggregate	-5.4	-	*	25.3	+	***	9.4	+	***
FACILITY-ONLY DATA									
Exact-Match	-10.1	-	***	-0.6	-	ns	-5.6	-	**
Single Match									
Nearest - Absolute Distance *	-8.8	-	**	-0.1	-	ns	-4.6	-	*
Nearest - Travel distance *	-10.4	-	***	-0.2	-	ns	-5.6	-	**
Aggregate Match									
Radius - 5 km *	-33	-	***	0.2	+	ns	-17.1	-	***
Administrative unit - HFCA *	-9.3	-	**	-0.1	-	ns	-4.9	-	*
Administrative unit - Total Area *	-11.6	-	***	0.3	+	ns	-5.9	-	**
KDE									
Single Highest	-21.7	-	***	30	+	***	3.2	+	ns
Weighted Aggregate	-21.7	-	***	33.4	+	***	4.9	+	*

ns=p>0.05; * p<0.05; ** p<0.01; *** p<0.001

Sup Table 1. Mean, minimum, and maximum distance from household to original source of care in kilometers by provider type

Provider		# Linked	Mean Distance	SD of Mean Distance	Minimum Distance	Maximum Distance
Hospital		5	2.80	0.31	2.36	3.21
Govt health center	Urban	113	1.63	2.42	0.10	19.05*
	Rural	120	5.41	3.81	0.32	16.13
Govt CBA	Urban					
	Rural	36	2.04	1.34	0.01	5.37
Pvt clinic		1	4.39	-	4.39	4.39
Pharmacy		2	1.84	0.25	1.67	2.02
Shop	Urban	1	1.93	-	1.93	1.93
	Rural	2	10.46	1.55	9.36	11.55
Traditional or Faith Healer	Urban	0				
	Rural	4	3.05	3.48	0.03	6.07

*Two children in rural area sought care from an urban health center

Discussion

1. Summary of findings

This study assessed the validity of maternal report of care-seeking for child illness and methods for linking household care-seeking data with provider assessments to generate better estimates of coverage of appropriate management of child illness. Children were given cards with unique barcodes. Health care providers tracked sick children brought for care by scanning barcodes and distributing tokens. Provider preparedness to manage child illness was assessed using a tool based on the SARA. A household survey on care-seeking for child illness in the preceding 2 weeks was conducted 4-6 weeks after households were enrolled.

Validity of maternal report was assessed by comparing maternal-reported and provider-documented care-seeking events. Household data on source of care was linked to provider preparedness data to estimate coverage using exact source of care and measures of geographic proximity, with data on all providers and only health facilities.

Data were collected on 385 children with at least one DHS illness in the 2 weeks preceding the survey. The study found high rates of care-seeking for child illness, including 70% of sick children seeking care from skilled providers. Despite the availability of a number of private sector providers in the urban area, public sector providers accounted for over 90% of care-seeking events. Readiness data were collected on 83 health care providers, and 75 providers participated in care-seeking event tracking.

1.1. Paper 1: Validity of Maternal Report

This study found high sensitivity and reasonable specificity of maternal report of care-seeking for child illness. Maternal report of any care-seeking event and report of seeking care from a skilled provider performed slightly better than maternal report of type of provider. There have been no other studies of the validity of maternal report of care-seeking for child illness in sub-Saharan Africa.

Care-seeking from traditional practitioners was underreported, potentially due to concern over negative perceptions of treatment by a traditional practitioners (1,2) or mothers may not consider treatment by traditional practitioners to be seeking care. Seeking care from public sector providers was over-reported potentially due to social desirability bias (3). Some sources of care were misclassified. Some mothers reported seeking care at a hospital or mission facility when the true source of care was a government health center. However, mothers overall were able to accurately report on any care seeking and care-seeking by category.

This study suggests that maternal report as captured through household surveys is a valid measure of source of care for child illness in settings where utilization of public sector providers is high.

1.2. Paper 2: Exact-match linking

The exact-match linking methodology was effective at this small scale. Both consultation with local leaders and asking participating mothers about common sources of care generated comprehensive listings of providers managing sick children in the study area. Some minor sources of care, primarily informal shops, were not identified but had very low potential for appropriate management of child illness.

Development of an accurate measure of provider likelihood of appropriate management (LAM) of a sick child was challenging due to the range of potential definitions. Although multiple scores were evaluated, all generated similar estimates of provider preparedness. A score including provider knowledge and only those SARA indicators deemed essential for correct management of a child illness was selected as the primary LAM measure because it performed as well as the SARA score but was more concise and interpretable.

Coverage of appropriate management of child illness, calculated using the primary LAM score, was 55% overall. The 15-point gap in coverage between seeking skilled care and appropriate management was attributable to health care providers' less than adequate preparedness to manage child illness. This study suggests that exact-match linking may be a feasible method for producing more informative estimates of coverage of appropriate management of child illness.

1.3. Paper 3: Ecological and Facility-only Linking

Exact-match linking on the specific source of care using information on all health care providers produced the most precise linked coverage estimates. However, most ecological linking methods produced similar coverage estimates. Maintenance of the category of source of care was important due to variation in preparedness between categories of providers.

In this study area where the majority of sick children were taken to the closest government health center for care, nearest provider linking methods (absolute and travel distance) effectively reproduced this behavior. Aggregate linking methods (HFCA and total area) produced similar estimates because of low variation in LAM scores within a

category of source of care. Methods that capped maximum link distance (5 km radius) produced lower coverage estimates in the low provider density rural area. KDE methods overestimated care-seeking behavior and coverage of appropriate management in the urban area because of the high density of skilled providers.

Estimates generated using facility-only service assessment data were significantly lower in the rural area where CBAs were a common source of skilled care. Use of facility-only data, like that available through SPA and SARA surveys, can significantly underestimate coverage of appropriate management in areas where community-based or non-health facility providers offer effective care and are a substantial source of care for sick children.

This study suggests ecological linking with provider preparedness data on at least a sample of all skilled providers may be as effective as exact-match linking in areas with low variation in preparedness within a provider category or minimal provider bypassing.

2. Limitations and strengths

Both the care-seeking validation and linking analyses were limited by the low diversity in care-seeking practices for child illness in the study area. The majority of care-seeking events occurred in the public sector, with most in government health centers and a smaller number with government CBAs in the rural study area. Very few care-seeking events were reported with private sector providers, despite the availability of a number of private clinics and pharmacies in the urban area. The public sector is the primary source of care for child illness in many sub-Saharan African countries (4). However, this provider landscape may not be representative in urban areas or in other regions,

especially those with extensive private sector care-seeking or more diverse sectors, limiting the generalizability of these findings.

The care-seeking validation was further limited by imperfect care-seeking event tracking. All shops were excluded from tracking events because they did not meet the study inclusion criteria. Shops accounted for 7% of care-seeking events in the urban area. Pharmacists faced difficulty in identifying and documenting when drugs were purchased for children. Provider documentation of care-seeking events through barcode scans and distribution of tokens was imperfect due to issues with keeping the phone charged and accessible, caregivers failing to present the barcode card to providers, providers forgetting to distribute ribbons, and caregiver refusal or loss of ribbons.

However, the study was strengthened through use of multiple methods for tracking care-seeking events and strong provider engagement. Barcode scanning was a high-tech means of tracking events, which appealed to high volume facilities, urban, and private sector providers that were more familiar with smart phones. Distribution of tokens was a low-tech method that accounted for providers with lower tech-literacy, and an additional means of capturing care-seeking events in the case of technical glitches or failure of caregivers to present the barcode card when seeking care. Review of routine provider register data provided an independent source of data on treatment of children, further strengthening the completeness of event-tracking data.

The linking analyses benefited from evaluation of the provider preparedness scores against a measure of correct management of child illness. However, the measure of correct management was based on provider-reported care, which is subject to self-reporting bias, and falls short of the gold standard quality of care measure of case

observation with reassessment (5). Additionally, this measure was only available for a subset of providers. As a result, the overall LAM score was assessed using a subsample that may not have been reflective of all providers.

The linking analysis was based on the expectation that care should be sought for children whose mother's reported they had fever, diarrhea, and/or symptoms of ARI. However, correct treatment of diarrhea without dehydration (increased fluids with continued feeding) does not require treatment outside of the home (6). Recommended home fluids (RHF) may also be prepared in the home. Therefore, estimates of coverage of appropriate management based on interaction with the health system may not accurately reflect appropriate home management of diarrhea. Additionally, studies in Pakistan and Bangladesh have shown the current survey indicator for symptoms of ARI does not accurately identify cases of pneumonia (7). Therefore, maternal reported symptoms may not accurately gauge the level of care a child requires.

The small geographic scale of the study limited the linking analyses. The small scale limited our ability to assess variation in preparedness across a wider sample of providers, the potential effect of provider bypassing on ecological linking estimates, and the effect of using aggregate administrative unit linking at a district or provincial level. However, the small scale made it possible to collect readiness data on almost all sources of care, giving a complete picture of the provider landscape to assess the contribution of non-facility providers. Additionally, collection of information on the specific source of care enabled us to assess the bias introduced by ecological linking versus exact-match linking. This type of analysis has not been performed before due to lack of data on exact source of care.

3. Public Health Significance

Governments and other organizations implementing health programs are dependent on coverage data for designing and implementing more effective health programs and policies. Accurate data on coverage of essential health interventions is required for continued improvements in health in LMICs.

Seeking care from an appropriate health care provider is a necessary step in accessing correct diagnosis and treatment of fever and pneumonia, and cases of diarrhea with dehydration. Accurate information on the rates and patterns of care-seeking for child illness is essential for the development and direction of health programs to ensure correct management of key child illnesses.

Information on seeking care for child illness is commonly collected through population-based surveys that rely on maternal-report of care-seeking behaviors. This study suggests that maternal report as captured through household surveys is a valid measure of source of care for child illness in settings where utilization of public sector providers is high. This finding is broadly applicable to other settings where the public sector is the primary source of care, including much of rural sub-Saharan Africa (4). As a valid measure, this indicator can be used to better understand care-seeking behaviors and utilization of health care providers. Additionally, it can be used in conjunction with health care provider service assessments to generate better estimates of coverage of appropriate management of child illness.

Two limitations in the existing care-seeking indicator were identified. First, mothers occasionally misclassified the source of care. Misclassification is an issue because it distorts our picture of care-seeking practices. In this setting, misclassification

occurred primarily between skilled-provider categories (e.g. health center misreported as hospital) and therefore did not negatively affect the accuracy of the skilled-care indicator. However, incorrect classification of source of care could impact on estimates generated through linking analyses in settings where provider preparedness varies widely between categories of skilled providers. Inclusion of an additional question on the name of the provider, or additional unrecorded prompting to verify the category of health provider, could reduce misclassification error in household surveys but may not be feasible at scale.

Second, mothers over-reported seeking care from public sector providers and under-reported seeking care from traditional practitioners. Social desirability bias may have caused mothers to intentionally misreport care-seeking events. Alternatively, mothers may not consider treatment by traditional practitioners to be seeking care, a point that could be clarified in the survey question administration. Where under and over-reporting cannot be corrected, and are consistently present, data on under and over-reporting could be used to adjust estimates of care-seeking for child illness.

While the care-seeking indicator was found to be valid, other studies of indicator validity have demonstrated that household surveys may inaccurately estimate coverage of key child health interventions, including treatment of malaria, pneumonia, and diarrhea (7–9). Other indicators do not reflect receipt of appropriate management due to unclear etiologies of disease, complex treatment, and limited information captured through the survey. Where household surveys are found to be inaccurate, new methods are needed for generating more reliable child health coverage estimates. Linking information on the source of care collected through household surveys with health care provider assessments

of the quality and extent of services has been proposed as a means of generating more informative population-level estimates of the coverage of key health interventions (10).

This study found that exact-match linking on the specific source of care was effective at this small scale. Commonly utilized health care providers could be identified and surveyed in advance of the household survey. Information on the specific source of care could be effectively captured through the household survey using pre-coded provider names. Mothers could not identify some shops that had very low potential for appropriate management of child illness suggesting exclusion of these providers from the provider assessment may be justified.

Construction of a valid measure of provider preparedness is challenging and may be context dependent. It is important for measures of provider preparedness to accurately predict the likelihood a sick child will be appropriately managed for linked coverage estimates to be valid. Calibration of a provider preparedness score requires a measure of correct management, ideally collected through direct observation and re-examination of sick children among providers contributing readiness data.

Exact-matching linking with all provider data generated the most precise estimates of coverage of appropriate management, however, collection of information on the specific source of care and assessment of all providers may not be feasible in many contexts. This study suggests ecological linking with provider preparedness data on at least a sample of all skilled providers maybe as effective as exact-match linking in areas with low variation in preparedness within a provider category or minimal provider bypassing. Based on the study results and existing evidence (11), effective ecological linking is dependent on:

- Collection of household and provider data in the same geographic area and within a similar timeframe to ensure a valid picture of the service environment at the time children received treatment.
- Maintenance of information on category of source of care. This study found low variation in provider preparedness within a category of care, but high variation between types of providers. Linking children to the closest provider, without consideration for the reported level of care sought, may distort estimates of the quality of care received. The KDE methods demonstrated that modeling care-seeking behavior, rather than using reported source of care from the household survey, linked children to the incorrect source of care and produced inaccurate estimates of coverage. This was particularly true in the urban area due to a high density of skilled providers resulting in an overestimation of the proportion of children taken to a skilled provider for care.
- Selection of appropriate ecological linking method. In areas with low provider bypassing, measures that link children to the nearest provider are effective linking measures. Use of measures that assign children an aggregate score of provider preparedness in a bounded area may be valid in areas with low variation in preparedness scores within a provider category. In areas with low provider density, linking methods that cap the maximum distance between a provider and source of care may underestimate care-seeking. Ideally, measures of geographic proximity would reflect true care-seeking behaviors in the study area (e.g. average or maximum distance to a provider), however these data may not be readily

available from external sources and cannot be accurately estimated without information on the specific source of care.

- Use of at least a sample of skilled providers. Use of facility-only service assessment data, like that available through SPA and SARA surveys, can significantly underestimate coverage of appropriate management in areas where community-based or non-health facility providers offer skilled care to a substantial proportion of sick children. However, if variability in provider preparedness is low, aggregate linking methods may produce accurate coverage estimates with assessment data on only a sample of skilled providers.

Given the potential to produce valid coverage estimates using ecological linking methods, this methodology is promising because it utilizes existing data collection mechanisms to generate a more complete picture of the management of child illness. Adaptation could be made to the design and conduct of existing household surveys and provider assessments to make them more suitable for linking analyses. Beyond child health, this methodology is applicable to calculation of a range of coverage indicators across the RMNCH continuum.

Overall, generation of more accurate and informative data on care-seeking and coverage of key interventions should inform the design and implementation of public health programs. Ultimately, this study aimed to improve research methods to generate more robust data to increase equitable access to quality health services in LMICs.

4. Recommendations for Future Research

This study suggests the standard indicator of care-seeking for child illness is valid in settings where utilization of public sector providers is high. There have been no other studies of the validity of maternal report of care-seeking for child illness in sub-Saharan Africa or Asia. There is a need for additional research to assess the accuracy of maternal report of care-seeking for childhood illness in other contexts, particularly to understand recall related to care-seeking in the private formal and informal sectors. Results from a similar study in Pune, India, are forthcoming and should better reflect the performance of the indicator in a more urban private care setting.

Mothers' misclassification and exclusion of some providers was an issue for assessing care-seeking behavior and could have consequences for linking analyses. Inclusion of an additional question on specific source of care, probing on category of care, and clarification on what constitutes "seeking care" may improve the validity of this indicator. Additional work is needed to pilot these additional questions and probes to assess their feasibility and performance for use in existing population-based surveys.

This study found exact-match and certain ecological linking methods were feasible and effective methods for estimating coverage of appropriate management of child illness in this setting. This study was conducted on a small scale in an area with high rates of care-seeking for child illness from public sector providers. More studies are needed at a larger scale and in areas with a more diverse health care provider landscape to further evaluate the feasibility of the linking methodology and performance of ecological linking methods. Additionally, linking analyses could be used to assess coverage for other RMNCH interventions. The methodology should be evaluated for use in measuring

coverage beyond child curative services. A study is ongoing in the northern-most Savanes district of Côte d'Ivoire to assess the feasibility of exact-match linking at a regional scale through a standard household survey. Information on specific source of care for maternal, newborn, and child health care was collected in conjunction with standard MICS data collection. The health provider assessment was conducted independently, at approximately the same time as the household survey, and includes data on all public and private formal sector providers, including CBAs. This additional research will further support the development of guidelines for conducting linking assessments and integrating this methodology into existing data collection mechanisms.

Additional research is needed to generate a standard set of indicators for measuring provider preparedness. Currently, the SARA and SPA represent global best practice in assessing provider readiness. However, the tool is extensive, difficult to administer, and not all components may correspond directly to appropriate management of child illness in every context. There is a need to systematically assess the performance of various readiness indicators against a gold-standard measure of correct management of child illness in multiple contexts to generate a tool that strongly and consistently predicts correct management of child illness.

Continued work in this field will advance coverage measurement through the improvement of existing data collection mechanisms and development of new methods for generating more informative estimates of access and coverage of interventions. Together, this work will inform the design and implementation of public health programs to improve health in LMICs.

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Appendices

Appendix 1. Household Enrollment Questionnaire

Validation of Respondent-Reported Care-seeking Location

Form 3.4: Baseline Household Questionnaire

A. Section 1: Household Identification and Screening Questions

Household ID Interviewer-District-SD-EA-HH [___|___]-[___|___|___]-[___|___]-[___|___|___|___|___]-[___|___|___]		
1.1. Today's date DD-MM-YYYY: [__|__]-[__|__]-[_2_|_0_|_1_|_2_]		
1.2. Interviewer's name [_____]	Interviewer ID	1.2a. Interviewer code [__|__]
1.3. HFCA [_____]	HFCA	1.3a. HFCA code [__|__]
1.4. Household Listing ID [__|__|__]	Household (HH)	1.4a. Household ID [__|__|__]
1.5. Full name of head of household [_____]	Head of Household	1.5a. Head of HH ID ***(enter '99' for ineligible households)*** [__|__]
1.6. Latitude reading: South [_S_] -[__|__|__].[__|__|__|__|__]	1.7. Longitude reading: East [_E_]-[__|__|__].[__|__|__|__|__]	
1.8. Is there a woman in this household between the ages of 15 – 49 who is the mother of a child under the age of 57 months? 1 = Yes **Go to question 2.1** 0 = No **End interview. Go to Question 1.9 and record result of visit.**		

1.9 Visit Details	**Visit 1**	**Visit 2**	**Visit 3**
Date	[__|__]-[__|__]-[_1_|_5_]	[__|__]-[__|__]-[_1_|_5_]	[__|__]-[__|__]-[_1_|_5_]
Result 1 = Completed interview 2 = No eligible caregiver 3 = Interview interrupted 4 = Eligible respondent not available 5 = Entire household absent 6 = Dwelling abandoned 7 = Refused ***(Go to 1.10)*** 96 = Other *(specify)* [_____]	[____]	[____]	[____]
Time started ***(use 24hr clock N/A = 00:00)*** Time completed	[___|___:___|___] [___|___:___|___]	[___|___:___|___] [___|___:___|___]	[___|___:___|___] [___|___:___|___]
1.10. Comments ***(If the caregiver refuses to participate, provide reason for refusal.)***			

Section 2: Household Roster

COMPLETE THIS SECTION BY INTERVIEWING THE HEAD OF HOUSEHOLD OR HOUSEHOLD REPRESENTATIVE. VERIFY INFORMATION WITH MOTHERS OR CAREGIVERS. COMPARE AGAINST HOUSEHOLD INFORMATION FROM EXISTING ROSTER.

NTERVIEWER TO SAY: "I am now going to ask you some questions about the members of your household"

2.1 ID	2.2 NAMES OF HH MEMBERS	2.3 SEX	2.4 AGE	2.5 CAREGIVER'S ID Only enter mother's ID for anyone less than 5 years	*Do not ask, review 2.4* 2.6 IS THIS CHILD ELIGIBLE FOR TRACKING? Eligible if child is 56 months or younger	*Do not ask, review 2.5* 2.7 IS THIS WOMAN ELIGIBLE FOR INTERVIEW? Eligible if mother of child <=56 months and between the age of 15 - 49
		1=Male 0=Female	For children less than 5 year of age, enter number of years and months. Enter '99' if don't know. If age 5+, SKIP → Next HH Member	Enter '99' if mother is <u>not</u> a household member.	1 = Eligible, assign barcode 0 = Non-eligible	1 = Eligible, interview woman 0 = Non-eligible
01	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
02	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
03	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
04	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
05	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
06	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
07	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
08	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
09	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
10	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
11	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]
12	[_____]	[___]	Y [___|___] M [___|___]	[___|___]	[___]	[___]

Section 3: Demographic Characteristics

COMPLETE THIS SECTION ONLY ONCE FOR EACH HOUSEHOLD – ADMINISTER TO PERSON COMPLETING HOUSEHOLD ROSTER

INTERVIEWER TO SAY: "I am now going to ask you some questions about your household"

No.	Questions and Filters	Coding Categories		Skip
HH1	What is the highest level of education achieved by the head of household? **(*Prompted. Circle <u>one</u> response.)***	No education Primary incomplete Primary complete Secondary incomplete Secondary complete and above Don't know	1 2 3 4 5 98	
HH2	What is the <u>main</u> occupation of the head of household?	Works for pay Receives income from spouse / other household member Unpaid in family business Unpaid worker on family farm Unemployed (not working) Not working due to disability Self-employed or runs family business Retired Other (*specify*) [_____]	1 2 3 4 5 6 7 8 96	
H1	What is the main source of drinking water for members of your household? RECORD ONE RESPONSE.	**Piped water** Piped into dwelling Piped to yard/plot Public tap/standpipe Tube well or borehole **Dug well** Protected well Unprotected well **Water from spring** Protected spring Unprotected spring Rainwater Tanker truck Cart with small tank Surface water (River/dam/ lake/pond/ stream/canal/irrigation channel) Bottled water Other, specify: [_____]	 11 12 13 21 31 32 41 42 51 61 71 81 91 96	 H4 H4 H4
H2	Where is the source of water located?	In own dwelling In over yard/plot Elsewhere	1 2 3	H4 H4
H3	How long does it take to go there, get water, and come back?	Minutes Don't Know	[__|__|__] 998	
H4	Do you do anything to the water to make it safer to drink?	Yes No	1 2	 H6
H5	What do you usually do to make the water safer to drink? Anything else? RECORD ALL MENTIONED.	BOIL ADD BLEACH/ CHLORINE/ CLORIN STRAIN THROUGH A CLOTH USE WATER FILTER (CERAMIC/ SAND/ COMPOSITE/ ETC.) SOLAR DISINFECTION LET IT STAND AND SETTLE OTHER, specify: [_____] DON'T KNOW	A B C D E F X Z	

No.	Questions and Filters	Coding Categories			Skip
H6	How do you store your drinking water?	Closed container/Jerry can Open container/ Bucket Does not store water Other, specify: [_____]		1 2 3 96	
H7	What kind of a toilet facility do members of your household usually use? RECORD ONE RESPONSE.	**Flush or pour toilet** Flush to piped sewer system Flush to septic tank Flush to pit latrine Flush to somewhere else Flush, don't know where **Pit latrine** Ventilated improved pit latrine (VIP) Pit latrine with slab Pit latrine without slab/open pit Compositing toilet Bucket toilet Hanging toilet/Hanging latrine No facility/bush/field Other, specify: [_____]		 11 12 13 14 15 21 22 23 31 41 51 61 96	
H8	Do you share this toilet with other households?	Yes No		1 2	
H9	How many households use this toilet facility?	No. of households if less than 10 10 or more households Don't know		[0|__] 95 98	
H10	Does your household have:		Y	N	
	electricity?	Electricity	1	2	
	a radio?	Radio	1	2	
	a television?	Television	1	2	
	a mobile telephone?	Mobile Telephone	1	2	
	a non-mobile telephone?	Non-Mobile Telephone	1	2	
	a refrigerator?	Refrigerator	1	2	
	a bed?	Bed	1	2	
	a chair?	Chair	1	2	
	a table?	Table	1	2	
	a cupboard?	Cupboard	1	2	
	a sofa?	Sofa	1	2	
	a clock?	Clock	1	2	
	a fan?	Fan	1	2	
	a sewing machine?	Sewing Machine	1	2	
	a cassette player?	Cassette Player	1	2	
	a plough?	Plough	1	2	
	a grain grinder?	Grain Grinder	1	2	
	a vcr/dvd?	VCR/DVD	1	2	
	a tractor?	Tractor	1	2	
	a hammer mill?	Hammer Mill	1	2	
	a computer?	Computer	1	2	
	internet?	Internet	1	2	
	a microwave?	Microwave	1	2	
H11	What type of fuel does your household mainly use for cooking? RECORD ONE RESPONSE.	Electricity Solar Power Liquid Propane Gas (LPG) Natural gas Biogas Kerosene Coal/lignite Charcoal Wood Straw/shrubs/grass Agricultural crop Animal dung No food cooked in household Other, specify: [_____]		1 2 3 4 5 6 7 8 9 10 11 12 95 96	 H15
H12	Is the cooking usually done in the house, in a separate building, or outdoors?	In the house In a separate building		1 2	 H15

No.	Questions and Filters	Coding Categories		Skip
		Outdoors	3	H15
		Other, specify: [_____]	96	H15
H13	Do you have a separate room that is used as a kitchen?	Yes	1	
		No	2	
H14	MAIN MATERIAL OF THE FLOOR RECORD OBSERVATION. RECORD ONE RESPONSE.	**Natural floor**		
		Earth/sand	11	
		Dung	12	
		Rudimentary floors		
		Wood planks	21	
		Palm/bamboo/reeds	22	
		Finished floor		
		Parquet or polished wood	31	
		Vinyl (pvc) or asphalt strips	32	
		Ceramic/terrazzo tiles	33	
		Concrete cement	34	
		Carpet	35	
		Other, specify: [_____]	96	
H15	MAIN MATERIAL OF THE ROOF RECORD OBSERVATION. RECORD ONE RESPONSE.	**Natural roofing**		
		No roof	11	
		Thatch/palm leaf/reed/grass	12	
		Rudimentary roofing		
		Rustic mat	21	
		Palm/bamboo	22	
		Wood planks	23	
		Cardboard	24	
		Finished roofing		
		Metal/Iron sheets	31	
		Wood	32	
		Calamine/cement fiber (asbestos)	33	
		Ceramic tiles/Harvey tiles	34	
		Cement	35	
		Roofing shingles	36	
		Mud Tiles	37	
		Other, specify: [_____]	96	
H16	MAIN MATERIAL OF THE EXTERIOR WALLS RECORD OBSERVATION. RECORD ONE RESPONSE ONLY.	**Natural walls**		
		No walls	11	
		Cane/palm/trunks	12	
		Mud	13	
		Rudimentary walls		
		Bamboo/pole with mud	21	
		Stone with mud	22	
		Plywood	23	
		Cardboard	24	
		Reused wood	25	
		Finished walls		
		Cement	31	
		Stone with lime/cement	32	
		Bricks	33	
		Cement blocks	34	
		Wood planks	35	
		Other, specify: [_____]	96	
H17	How many rooms in this household are used for sleeping?	Rooms	[__|__]	

No.	Questions and Filters	Coding Categories			Skip
H18	Does any member of this household own: A watch? A bicycle? A motorcycle or motor scooter? An animal-drawn cart? A car or truck? A boat with a motor? A banana boat?		Y	N	
		Watch	1	2	
		Bicycle	1	2	
		Motorcycle Or Motor Scooter	1	2	
		Animal-Drawn Cart	1	2	
		Car Or Truck	1	2	
		Boat With A Motor	1	2	
		Banana Boat	1	2	
H19	Does any member of this household own any agricultural land?	Yes		1	
		No		2	H21
H20	How much lima, acres, or hectares of agricultural land do members of this household own?	Lima	1 [__|__]. [__]		
		Acres	2 [__|__]. [__]		
		Hectares	3 [__|__]. [__]		
		95 or more hectares		95	
		Don't know		98	
H21	Does this household own any livestock, herds, other farm animals, or poultry?	Yes		1	
		No		2	H23
H22	How many of the following animals does this household own? IF NONE, ENTER '00'. IF MORE THAN 95, ENTER '95'. IF UNKNOWN, ENTER '98'. Traditional cattle? Dairy cattle? Beef cattle? Horses, donkeys, or mules? Goats? Sheep? Pigs? Chickens? Rabbits/Other Poultry? Other Livestock?				
		Traditional cattle	[__|__]		
		Dairy cattle	[__|__]		
		Beef cattle	[__|__]		
		Horses, donkeys, or mules	[__|__]		
		Goats	[__|__]		
		Sheep	[__|__]		
		Pigs	[__|__]		
		Chickens	[__|__]		
		Rabbits/Other Poultry	[__|__]		
		Other Livestock	[__|__]		
H23	Does any usual member of this household have a bank account?	Yes		1	
		No		2	
		Don't know		8	

Section 4: Caregiver Questionnaire

COMPLETE THIS SECTION FOR EACH MOTHER OF CHILD <57 MONTHS IDENTIFIED IN HOUSEHOLD ROSTER
FOR EACH MOTHER, COMPLETE THE CONSENT PROCESS

INTERVIEWER TO SAY: "I am now going to ask you some questions about your background"

No.	Questions and Filters	Coding Categories	SKIP
C1	In what month and year were you born?	Month [__|__] Don't Know Month 98 Year [__|__|__|__] Don't Know Year 98	
C2	How old were you at your last birthday?	Age in completed years [__|__]	
C3	Have you ever attended school?	Yes 1 No 2	C11
C4	What was the highest level of school you attended: primary, secondary, or higher?	Primary 1 Secondary 2 Higher 3	
C5	What is the highest grade you completed at that level?	Grade [__|__]	
	Check C4: If Secondary or Higher Skip →		C7
C6	Now I would like you to read this sentence to me. SHOW CARD TO RESPONDENT IF RESPONDENT CANNOT READ WHOLE SENTENCE, PROBE: "Can you read any part of the sentence to me?	Cannot read at all 1 Able to read only parts of sentence 2 Able to read whole sentence 3 No card with required language 4 Blind/visually impaired 5	
	Check C6: If Code '1' or '5' Skip →		C8
C7	Do you read a newspaper or magazine almost every day, at least once a week, less than once a week or not at all?	Almost every day 1 At least once a week 2 Less than once a week 3 Not at all 4	
C8	Do you listen to the radio almost every day, at least once a week, less than once a week or not at all?	Almost every day 1 At least once a week 2 Less than once a week 3 Not at all 4	
C9	Do you watch television almost every day, at least once a week, less than once a week or not at all?	Almost every day 1 At least once a week 2 Less than once a week 3 Not at all 4	
C10	What is your religion?	Catholic 1 Protestant 2 Muslim 3 Other, specify: 96 [_____]	
C11	What tribe do you belong to?	[_____]	
C12	How long have you been living continuously in (name of Current Place of Residence)? IF LESS THAN ONE YEAR, RECORD '00' YEARS.	Years [__|__] Always 95 Visitor 96	
C13	Just before you moved here, did you live in Lusaka, another city, in a town, or in a village?	Lusaka 1 Other City 2 Town 3 Village 4	
C14	In the last 12 months, on how many separate occasions have you travelled away from your home community and slept away?	Number of Trips [__|__] None 0	
C15	In the last 12 months, have you been away from your home community for more than one month at a time?	Yes 1 No 2	

No.	Questions and Filters	Coding Categories	Skip	No.
C16	What is your marital status?	Currently married Widowed Divorced Separated Deserted Never married	1 2 3 4 5 6	
C17	What is your <u>main</u> occupation?	Works for pay Receives income from spouse / other household member Unpaid in family business Unpaid worker on family farm Unemployed (not working) Not working due to disability Self-employed or runs family business Retired Other (*specify*) [_____]	1 2 3 4 5 6 7 8 96	
C18 A	How many children to whom you have given birth are living?	Living children	[__|__]	
C18 B	How many children to whom you have given birth have died?	Dead children	[__|__]	
C18 C	Are you pregnant now?	Yes No Unsure / don't know	1 2 98	 C20 C20
C19	How many months pregnant are you?	Completed months	[__|__]	
C20	When a child in your household gets sick, where do you generally take him/her for treatment?	_____ (Name of provider) _____ (Name of facility/place) _____ (Name of village)		
C21	When a child in your household has a <u>serious illness</u>, where do you generally take him/her for treatment?	_____ (Name of provider) _____ (Name of facility/place) _____ (Name of village)		
C22	Aside from the places that you have just mentioned, where else might you seek treatment or advice? Anywhere else? RECORD ALL FACILITIES AND PLACES MENTIONED. IF RESPONDENT MENTIONS NO OTHER PLACES, RECORD "NONE".	_____ (Provider) _____ (Facility/place) _____ (Village)	_____ (Provider) _____ (Facility/place) _____ (Village)	_____ (Provider) _____ (Facility/place) _____ (Village)	

Of the providers you mentioned above, which of these sources has/is:

Circle all that apply	Provider 1 _____	Provider 2 _____	Provider 3 _____	Provider 4 _____	Provider 5 _____	Other _____	Other _____	All sources equal
C23. Lowest cost for transport to the source	1	2	3	4	5	6	7	8
C24. Lowest cost of care at the source	1	2	3	4	5	6	7	8
C25. Most easy to reach	1	2	3	4	5	6	7	8
C26. Providers that are the most friendly	1	2	3	4	5	6	7	8
C27. Lowest wait time for service	1	2	3	4	5	6	7	8
Fever								
C28. Source you usually seek care for most fevers	1	2	3	4	5	6	7	8
C29. Providers that are the most knowledgeable about fever	1	2	3	4	5	6	7	8
C30. Most effective treatment for fever	1	2	3	4	5	6	7	8
C31. Treatment for fever always available	1	2	3	4	5	6	7	8
C32. Malaria blood testing always available	1	2	3	4	5	6	7	8
Pneumonia								
C33. Source you usually seek care for most respiratory illness	1	2	3	4	5	6	7	8
C34. Providers that are the most knowledgeable about respiratory illness	1	2	3	4	5	6	7	8
C35. Most effective treatment for respiratory illness	1	2	3	4	5	6	7	8
C36. Treatment for respiratory illness always available	1	2	3	4	5	6	7	8
Diarrhea								
C37. Source you usually seek care for most diarrhea	1	2	3	4	5	6	7	8
C38. Providers that are the most knowledgeable about diarrhea	1	2	3	4	5	6	7	8
C39. Most effective treatment for diarrhea	1	2	3	4	5	6	7	8
C40. Treatment for diarrhea always available	1	2	3	4	5	6	7	8

INTERVIEWER TO SAY: "I am now going to assign each of your children under the age of 57 months a bracelet or card with a unique barcode"

APPLICATION WILL PROMPT INTERVIEWER TO SCAN BARCODE FOR EACH CHILD UNDER 57 MONTHS LISTED FOR THE CAREGIVER IN THE HOUSEHOLD ROSTER.

Ask caregiver: "Is this child [Name of Child from Roster]?"

Give bracelet or card to specified child

Record barcode number of card when prompted: [__|__|__|__|__]

Appendix 2. Care-seeking Questionnaire

Validation of Respondent-Reported Care-seeking Location

Form 3.5: Follow-Up Caregiver Questionnaire

B. Household Identification and Screening Questions

Household ID Interviewer-District-SD-EA-HH [___|___]-[___|___|___]-[___|___]-[___|___|___|___|___]-[___|___|___]		
1.1. Today's date DD-MM-YYYY: [__|__]-[__|__]-[_2_|_0_|_1_|_2_]		
1.2. Interviewer's name [_____]	Interviewer ID	1.2a. Interviewer code [__|__]
1.3. HFCA [_____]	HFCA	1.3a. HFCA code [__|__]
1.4. Household Listing ID [__|__|__]	Household (HH)	1.4a. Household ID [__|__|__]
1.5. Full name of head of household [_____]	Head of Household	1.5a. Head of HH ID ***(enter '99' for ineligible households)*** [__|__]
1.6. Latitude reading: South [_S_] -[__|__|__].[__|__|__|__|__]	1.7. Longitude reading: East [_E_]-[__|__|__].[__|__|__|__|__]	

1.8 Visit Details	**Visit 1**	**Visit 2**	**Visit 3**
Date	[__|__]-[__|__]-[_1_|_5_]	[__|__]-[__|__]-[_1_|_5_]	[__|__]-[__|__]-[_1_|_5_]
Result 1 = Completed interview 2 = Enrolled household moved 3 = Interview interrupted 4 = Eligible respondent not available 5 = Entire household absent 6 = Dwelling abandoned 7 = Refused ***(Go to 1.10)*** 96 = Other *(specify)* [_____]	[____]	[____]	[____]
Time started ***(use 24hr clock N/A = 00:00)*** Time completed	[___|___:___|___] [___|___:___|___]	[___|___:___|___] [___|___:___|___]	[___|___:___|___] [___|___:___|___]
1.10. Comments ***(If the caregiver refuses to participate, provide reason for refusal.)***			

SECTION 1: DHS QUESTIONNAIRE

ADMINISTER QUESTIONNAIRE FOR EACH ENROLLED CHILD
SELECT APPROPRIATE CAREGIVER AND CHILD FROM MENU

No.	Questions and Filters	Coding Categories		SKIP
F1	Has (NAME) had diarrhoea in the last 2 weeks?	YES NO DON'T KNOW	1 2 8	 →14 →14
F2	Was there any blood in the stools?	YES NO DON'T KNOW	1 2 8	
F3	Now I would like to know how much (NAME) was given to drink during the diarrhoea (including breastmilk). Was he/she given less than usual to drink, about the same amount, or more than usual to drink? IF LESS, PROBE: Was he/she given much less than usual to drink or somewhat less?	MUCH LESS SOMEWHAT LESS ABOUT THE SAME MORE NOTHING TO DRINK DON'T KNOW	1 2 3 4 5 8	
F4	When (NAME) had diarrhoea, was he/she given less than usual to eat, about the same amount, more than usual, or nothing to eat? IF LESS, PROBE: Was he/she given much less than usual to eat or somewhat less?	MUCH LESS SOMEWHAT LESS ABOUT THE SAME MORE STOPPED FOOD NEVER GAVE FOOD DON'T KNOW	1 2 3 4 5 6 8	
F5	Did you seek advice or treatment for the diarrhoea from any source?	YES NO	1 2	 →10
F6	Where did you seek advice or treatment? Anywhere else? PROBE TO IDENTIFY EACH TYPE OF SOURCE. IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, WRITE THE NAME OF THE PLACE. (NAME OF PLACE)	**PUBLIC SECTOR** GOVT. HOSPITAL GOVT HEALTH CENTER/POST MOBILE HOSPITAL/CLINIC COMMUNITY BASED AGENT/FIELDWORKER OTHER PUBLIC SECTOR, SPECIFY _____ **PRIVATE MEDICAL SECTOR** PVT. HOSPITAL/CLINIC MISSION HOSPITAL/CLINIC PHARMACY PVT. DOCTOR MOBILE HOSPITAL/CLINIC COMMUNITY BASED AGENT/FIELDWORKER OTHER PRIVATE SECTOR, SPECIFY _____ **OTHER SOURCE** SHOP TRADITIONAL PRACTIONER MARKET OTHER _____ (SPECIFY)	 A B C D F G H I J K L M N O P X	
F7	CHECK 6: TWO OR MORE CODES SELECTED ONLY ONE CODE SELECTED			 →8 →9
F8	Where did you first seek advice or treatment? USE LETTER CODE FROM F6	FIRST PLACE	__	
F9	How many days after the diarrhoea began did you first seek advice or treatment for (NAME)? IF THE SAME DAY, RECORD '00'.	DAYS	_ _	

F10	Does (NAME) still have diarrhoea?	YES 1 NO 2 DON'T KNOW 8	
F11	Was (he/she) given any of the following to drink at any time since (he/she) started having the diarrhoea: a) A fluid made from a special packet called ORS packet? b) Homemade fluid?	Y N DK FLUID FROM ORS PKT 1 2 8 HOMEMADE FLUID 1 2 8	
F12	Was anything (else) given to treat the diarrhoea?	YES 1 NO 2 DON'T KNOW 8	 →14 →14
F13	What (else) was given to treat the diarrhoea? Anything else? RECORD ALL TREATMENTS GIVEN.	**PILL OR ANTIBIOTIC** ANTIBIOTIC A ANTIMOTILITY B OTHER (NON ANTIBIOTIC, ANTIMOTILITY) C UKNOWN PILL OR SYRUP D **INJECTION** ANTIBIOTIC E NON-ANTIBIOTIC F UNKNOWN INJECTION G INTRAVENOUS (IV) H HOME REMEDY/HERBAL MEDICINE I OTHER _____ X (SPECIFY)	
F14	Has (NAME) been ill with a fever at any time in the last 2 weeks?	YES 1 NO 2 DON'T KNOW 8	 →16 →16
F15	At any time during illness, did (NAME) have blood taken from (his/her) finger or heel for testing?	YES 1 NO 2 DON'T KNOW 8	
F16	Has (NAME) had an illness with a cough at any time in the last 2 weeks?	YES 1 NO 2 DON'T KNOW 8	 →19 →19
F17	When (NAME) had an illness with a cough, did (he/she) breathe faster than usual with short, rapid breaths or have difficult breathing?	YES 1 NO 2 DON'T KNOW 8	 →20 →20
F18	Was the fast or difficult breathing due to a problem in the chest or to a blocked or runny nose?	CHEST ONLY 1 NOSE ONLY 2 BOTH 3 OTHER _____ 6 (SPECIFY) DON'T KNOW 8	→20 →20 →20 →20 →20
F19	CHECK 14: HAD FEVER YES NO OR DON'T KNOW		 →20 →33
F20	Now I would like to know how much (NAME) was given to drink (including breastmilk) during the illness with a (fever/cough). Was he/she given less than usual to drink, about the same amount, or more than usual to drink? IF LESS, PROBE: Was he/she given much less than usual to drink or somewhat less?	MUCH LESS 1 SOMEWHAT LESS 2 ABOUT THE SAME 3 MORE 4 NOTHING TO DRINK 5 DON'T KNOW 8	
F21	When (NAME) had a (fever/cough), was he/she given less than usual to eat, about the same amount, more than usual, or nothing to eat? IF LESS, PROBE: Was he/she given much less than usual to eat or somewhat less?	MUCH LESS 1 SOMEWHAT LESS 2 ABOUT THE SAME 3 MORE 4 STOPPED FOOD 5 NEVER GAVE FOOD 6 DON'T KNOW 8	

F22	Did you seek advice or treatment for the illness from any source?	YES 1 NO 2	 →27
F23	Where did you seek advice or treatment? Anywhere else? PROBE TO IDENTIFY EACH TYPE OF SOURCE. IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, WRITE THE NAME OF THE PLACE. (NAME OF PLACE)	**PUBLIC SECTOR** GOVT. HOSPITAL A GOVT HEALTH CENTER/POST B MOBILE HOSPITAL/CLINIC C COMMUNITY BASED AGENT/FIELDWORKER D OTHER PUBLIC SECTOR, SPECIFY F _____ **PRIVATE MEDICAL SECTOR** PVT. HOSPITAL/CLINIC G MISSION HOSPITAL/CLINIC H PHARMACY I PVT. DOCTOR J MOBILE HOSPITAL/CLINIC K COMMUNITY BASED AGENT/FIELDWORKER L OTHER PRIVATE SECTOR, SPECIFY M _____ **OTHER SOURCE** SHOP N TRADITIONAL PRACTIONER O MARKET P OTHER _____ X (SPECIFY)	
F24	CHECK 23: TWO OR MORE CODES SELECTED ONLY ONE CODE SELECTED		 →25 →26
F25	Where did you first seek advice or treatment? USE LETTER CODE FROM 23.	FIRST PLACE [__]	
F26	How many days after the illness began did you first seek advice or treatment for (NAME)? IF THE SAME DAY, RECORD '00'.	DAYS [__|__]	
F27	Is (NAME) still sick with a (fever/ cough)?	FEVER A COUGH B NO, NEITHER C DON'T KNOW Z	
F28	At any time during the illness, did (NAME) take any drugs for the illness?	YES 1 NO 2 DON'T KNOW 8	 →32 →32
F29	What drugs did (NAME) take? Any other drugs? RECORD ALL TREATMENTS GIVEN	**ANTIMALARIAL DRUGS** SP/FANSIDAR A CHLOROQUINE B AMODIAQUINE C QUININE D COARTEM/ACT E ARTEMETHER F ASUNATE/ARTESUNATE G ARTETHER H OTHER ANTI-MALARIAL I _____ (SPECIFY) **ANTIBIOTIC DRUGS** PILL/SYRUP J INJECTION K **OTHER DRUGS** ASPIRIN L PARACETAMOL (PANADOL) M ACETAMINOPHIN N	

		IBUPROFEN O OTHER _____ X (SPECIFY) DON'T KNOW Z	
F30	CHECK 29: ANY CODE 'A-K' CIRCLED? YES NO		→31 →32
F31	Did you already have (NAME OF DRUG FROM 538) at home when the child became ill? ASK SEPARATELY FOR EACH OF THE DRUGS 'A' THROUGH 'K' THAT THE CHILD IS RECORDED AS HAVING TAKEN IN F29. IF YES FOR ANY DRUG, CIRCLE CODE FOR THAT DRUG. IF NO FOR ALL DRUGS, CIRCLE 'Y'.	**ANTIMALARIAL DRUGS** SP/FANSIDAR A CHLOROQUINE B AMODIAQUINE C QUININE D COARTEM/ACT E ARTEMETHER F ASUNATE/ARTESUNATE G ARTETHER H OTHER ANTI-MALARIAL I _____ (SPECIFY) **ANTIBIOTIC DRUGS** PILL/SYRUP J INJECTION K NO DRUGS AT HOME Y DON'T KNOW Z	
F32	CHECK 29: ANY CODE 'A-I' CIRCLED? YES NO		→33 →Sect 2
F33	How long after the fever started, did (NAME) first take (DRUG(S) FROM 29 A-G)?	SAME DAY 1 NEXT DAY 2 TWO DAYS AFTER FEVER 3 THREE OR MORE DAYS AFTER FEVER 4 DON'T KNOW 8	
F34	For how many days did (NAME) take the (DRUG)? IF 7 DAYS OR MORE, RECORD 7.	DAYS [__] DON'T KNOW 8	

SECTION 2: SYMPTOMS

No.	Questions and Filters	Coding Categories				SKIP
S1	In the previous two weeks, was [NAME] ill with [SYMPTOM]? PROMPT WITH EACH SYMPTOM		Y	N	DN	
		A Diarrhea	1	2	8	
		B Blood in stools	1	2	8	
		C Fever	1	2	8	
		D Cough	1	2	8	
		E Fast breathing	1	2	8	
		F Unable to eat	1	2	8	
		G Vomited everything	1	2	8	
		H Convulsions	1	2	8	
		I Unusually sleepy or unconscious	1	2	8	
		J Lower chest indrawing	1	2	8	
		K Nasal discharge	1	2	8	
		L Other, specify [_____]	1	2	8	
S2	FOR EACH SYMPTOM = 1, How long ago did [SYMPTOM] begin?	Days			[__|__]	
S3	FOR EACH SYMPTOM = 1: How many days ago did [SYMPTOM] end?	Days Still sick with symptom			[__|__] 99	
S4	IF 1I = 1: How many times did convulsions occur as part of this illness?	Occurrences			[__|__]	
S5	Were all of these symptoms part of the same illness episode? PROMPT: DID [NAME] RECOVER FROM ONE ILLNESS AND GET SICK AGAIN, OR WERE ALL SYMPTOMS PART OF THE SAME ILLNESS?	Yes No Don't know			1 2 8	Sect 3 Sect 3
S6	How many days ago did [NAME] become sick with the most recent illness?	Days			[__|__]	
S7	How many days ago did [NAME] recover from the most recent illness?	Days Still sick			[__|__] 99	
S8	How many days ago did [NAME] become sick with the previous illness?	Days			[__|__]	
S9	How many days ago did [NAME] recover from the previous illness?	Days			[__|__]	

SECTION 3: SEQUENCE OF CARE

CHECK SECTION 2, QUESTION S5:
IF S5 = 1 OR 8, COMPLETE ONE SECTION 3
IF S5 = 2, COMPLETE SECTION 3 FOR EACH ILLNESS SEPARATELY

No.	Questions and Filters	Coding Categories		SKIP
C1	What is the FIRST thing that you did to treat the illness? PROMPT: THIS INCLUDES GIVING MODERN MEDICINES, HERBAL/HOME REMEDIES, PRAYERS, ETC	Treated at home Sought Treatment Outside of Home Did not treat illness	1 2 3	Sect 3A Sect 3B C3
C2	What is the [SECOND/THIRD/FOURTH] thing that you did to treat the illness? PROMPT: THIS INCLUDES GIVING MODERN MEDICINES, HERBAL/HOME REMEDIES, PRAYERS, ETC	Treated at home Sought Treatment Outside of Home Did not seek additional treatment for illness	1 2 3	Sect 3A Sect 3B
C3	Do you have any other tokens you haven't shown me already?	Yes [SCAN TOKEN] No	1 2	
C4	Why was the illness not treated? DO NOT READ RESPONSES. CIRCLE ALL THAT APPLY	Illness was not serious Illness went away / Child got better No money for treatment No transportation The place where treatment could be obtained was too far away No one in the household had time to obtain treatment Did not know where to go to get treatment Medicines / drugs not available at outlet Still ill, waiting for fever to get worse before seeking treatment Other (specify) [_____] Don't know	1 2 3 4 5 6 7 8 9 96 98	End Interview

SECTION 3A: HOME MANAGEMENT

No.	Questions and Filters	Coding Categories		SKIP
H1	How many days ago did you treat at home?	Days	[__|__]	
H2	When you decided to treat the illness at home, how serious was the illness? ***Read the question and each of the responses. Circle <u>one</u> response***	Not at all serious Mild/not very serious Somewhat serious Very serious Extremely serious/Life threatening	1 2 3 4 5	
H3	Did [NAME] have an RDT performed or a drop of blood taken from his/her finger or heel while at home? CHECK THAT THE RDT HAD BEEN PURCHASED AND STORED AT HOME BEFORE THE ILLNESS	Yes No Don't Know	1 2 8	
H4	What was the result of the test?	Positive Negative Don't Know	1 2 8	
H5	What types of treatment were given to [NAME] at this time? ***(Read all responses. Circle <u>all</u> the responses that apply.)***	Modern medicines stored at home ORS/ORT Traditional medicines or practices (including herbs and prayers) Changed diet Hot or cold compress/bath Other home-made remedies Other *(specify)*	1 2 3 4 5 6 96	

	CHECK: If H5 '1' is circled If H5 '1' is not circled		H6 C3
H6	What type of medicine was given to [CHILD] at this time? PROMPT: ANYTHING ELSE? CIRCLE ALL THAT APPLY RECORD BRAND NAME IF TYPE OF MEDICINE IS UNKNOWN	**ANTIMALARIAL DRUGS** SP/FANSIDAR A CHLOROQUINE B AMODIAQUINE C QUININE D COARTEM/ACT E ARTEMETHER F ASUNATE/ARTESUNATE G ARTETHER H OTHER ANTI-MALARIAL I _____ (SPECIFY) **ANTIBIOTIC DRUGS** PILL/SYRUP J INJECTION K **OTHER DRUGS** ASPIRIN L PARACETAMOL (PANADOL) M ACETAMINOPHIN N IBUPROFEN O OTHER _____ X (SPECIFY) DON'T KNOW Z	
H7	How many days did you give [NAME] the [MEDICINE]? COMPLETE FOR EACH MEDICINE LISTED IN H6	Days [__|__]	
H8	Was the medicine that you had at home a treatment that you had bought in advance, or a medicine left over from a previous illness episode?	Bought in advance 1 Leftover from previous illness episode 2	C2 C2

SECTION 3B: OUTSIDE MANAGEMENT

No.	Questions and Filters	Coding Categories	SKIP
P1	Where did you seek advice or treatment? PROBE TO IDENTIFY TYPE OF SOURCE.	**Public Sector** Govt. Hospital A Govt Health Center/Post B Mobile Hospital/Clinic C Community Based Agent/Fieldworker D Other Public Sector, Specify F _____ **Private Medical Sector** Pvt. Hospital/Clinic G Mission Hospital/Clinic H Pharmacy I Pvt. Doctor J Mobile Hospital/Clinic K Community Based Agent/Fieldworker L Other Private Sector, Specify M _____ **Other Source** Shop N Traditional Practitioner O Market P Other _____ X (Specify)	
P2	What is the name of the facility or provider that you visited?	[_____]	

P3	How many days ago did you seek care at [PROVIDER]?	Days [__|__]	
P4	Did [name] stay overnight at the [PROVIDER]?	Yes 1 No 2	
P5	When you decided to treat the illness at [PROVIDER], how serious was the illness? ***Read the question and each of the responses. Circle <u>one</u> response***	Not at all serious 1 Mild/not very serious 2 Somewhat serious 3 Very serious 4 Extremely serious/Life threatening 5	
P6	What mode of transport did you take to get to this place? ***(Circle <u>all</u> responses that apply)***	Walk 1 Car 2 Bicycle 3 Public Transportation 4 Other *(specify)* [_____] 96	
P7	How long did it take you to travel there?	Minutes [__|__|__]	
P8	How much did it cost you to travel <u>to and from</u> this place?	ZMW [__|__|__|__]	
P9	Did [NAME] have an RDT performed or a drop of blood taken from his/her finger or heel while at home?	Yes 1 No 2 Don't Know 8	 P11 P11
P10	What was the result of the test?	Positive 1 Negative 2 Don't Know 8	
P11	What types of treatment were given to [NAME] at this time? ***(Read all responses. Circle <u>all</u> the responses that apply.)***	Modern medicines 1 ORS/ORT 2 Traditional medicines or practices (including herbs and prayers) 3 Recommend changed diet 4 Hot or cold compress/bath 5 Other home-made remedies 6 Other *(specify)* 96 [_____]	
	CHECK: If P11 '1' is circled If P11 '1' is not circled		 P12 P14
P12	What type of medicine was given to [CHILD] at this time? PROMPT: ANYTHING ELSE? CIRCLE ALL THAT APPLY RECORD BRAND NAME IF TYPE OF MEDICINE IS UNKNOWN	**Antimalarial Drugs** Sp/Fansidar A Chloroquine B Amodiaquine C Quinine D Coartem/Act E Artemether F Asunate/Artesunate G Artether H Other Anti-Malarial I _____ (Specify) **Antibiotic Drugs** Pill/Syrup J Injection K **Other Drugs** Aspirin L Paracetamol (Panadol) M Acetaminophin N Ibuprofen O Other _____ X (Specify) Don't Know Z	
P13	How many days did you give [NAME] the [MEDICINE]? COMPLETE FOR EACH MEDICINE LISTED IN P8	Days [__|__]	
P14	How much money did you pay at this place?	ZMW [__|__|__|__]	

P15	Who sought treatment from this source?	Respondent (Caregiver) Spouse Child Caregiver's Mother/ Mother-in-law Other *(specify)* [_____]	1 2 3 4 96	P16
P15A	Is [PERSON WHO TOOK CHILD TO PROVIDER] currently available?	Yes: FIND AND ADMINSTER P16-P26 No	1 2	 C2
P16	Was the cost of treatment at this source:	Very cheap Somewhat cheap Somewhat expensive Very expensive	1 2 3 4	
P17	Were the providers at this source:	Very friendly Somewhat friendly Not very friendly Not at all friendly	1 2 3 4	
P18	Was getting to this source:	Very easy Somewhat easy Somewhat difficult Very difficult	1 2 3 4	
P19	Was the wait for service at this source:	No time – immediate A short time A long time A very long time	1 2 3 4	
P20	To handle illness in children under 5, were the provider(s) at this source:	Very knowledgeable Somewhat knowledgeable Not very knowledgeable Not at all knowledgeable	1 2 3 4	
P21	How often do you seek care for other child illnesses at this source of treatment:	Usually Sometimes Rarely Never	1 2 3 4	
P22	Overall, how satisfied were you with the care you received at this source:	Very satisfied Somewhat satisfied Somewhat dissatisfied Very dissatisfied	1 2 3 4	
P23	Did you carry [NAME]'s barcode bracelet/card carried when you sought care from [PROVIDER]?	Yes No Don't Know	1 2 98	
P24	Did [PROVIDER] scan the barcode?	Yes No Don't Know	1 2 98	
P25	Did [PROVIDER] give you a token?	Yes No	1 2	
P26	Can you show me the token?	Yes: SCAN THE BARCODE ON TOKEN No, token was lost No, token is not stored here	1 2 3	

Appendix 3. Provider Assessment

Validation of Respondent-Reported Care-seeking Location

Form 3.1: Provider Screening and Readiness Assessment

SECTION 1: PROVIDER DETAILS

No.	Questions and Filters	Coding Categories	Skip
PD1	Provider/facility name	_____	
PD2	GPS Coordinates:	Latitude: S ___ ___ . ____ ____ ____ ____ ____ Latitude: E ___ ___ . ____ ____ ____ ____ ____	
PD3	Health Facility Catchment Area	-- 1 -- 2	
PD4	Managing authority	Government/public 1 NGO/Not-for-profit 2 Mission/Faith-based 3 Private for profit 4	
PD5	Type of provider (Menu limited by response to preceding question)	**Government/public:** Health Post 1 Rural Health Centre 2 Hospital Affiliated Health Center 3 Urban Health Center 4 First Level Hospital 5 Second Level Hospital 6 Third Level Hospital 7 CHW 8 **NGO/Not-for-profit:** NGO Hospital 9 NGO Health Center/Clinic 10 CHW 11 **Mission/Faith-based:** Mission Hospital 12 Mission Health Center/Clinic 13 CHW 14 **Private for profit:** Private hospital 15 Private Health Center/Clinic 16 Pharmacy/chemist 17 Drug store 18 Grocery store/Supermarket 19 Market stand/Kantemba/Kiosk 20 Mobile provider 21 Traditional/Spiritual healer 22	
PD6	Does the outlet currently offer any of the following services:	YES NO A. Treat sick children <5 years 1 2 B. Immunization 1 2 C. Growth Monitoring 1 2 D. Routine health check-ups 1 2 E. Sell/provide medicines 1 2 F. Treat sick adults or children over 5 years of age 1 2 G. Disease prevention 1 2 H. VCT 1 2 I. HIV Treatment 1 2 J. Family planning, including spacing methods 1 2 K. Antenatal care 1 2 L. Delivery care 1 2 M. Cesarean section 1 2 N. Postnatal care 1 2	
	CHECK PD6: IF 'A' or 'E' = 1 IF BOTH 'A' or 'E' = 0	Administer Consent and Precede to PD7 END	

No.	Questions and Filters	Coding Categories			Skip
PD7	Does provider charge for any services offered at the outlet?	Yes No	1 2		 PD10
PD8	Do you accept payment in installments for any of these services?	Yes No	1 2		
PD9	Does provider charge for child curative services?	Yes No	1 2		
PD10	What days of the week is the outlet open?		YES	NO	
		A. Monday	1	2	
		B. Tuesday	1	2	
		C. Wednesday	1	2	
		D. Thursday	1	2	
		E. Friday	1	2	
		F. Saturday	1	2	
		G. Sunday	1	2	
PD11	Is the outlet open the same number of hours each day?	Yes No	1 2		
PD12	On average, how many hours per day is this facility open?	4 HOURS OR LESS 5 TO 8 HOURS 9 TO 16 HOURS 17 TO 23 HOURS 24 HOURS	1 2 3 4 5		
PD13	Does this outlet have at least one clinical staff member that stays in the same village as the facility where s/he provides care? PROMPT: CLINICAL STAFF MEMBER REFERS TO EMPLOY WHO CAN ASSESS AND TREAT ILLNESSES	Yes No	1 2		
PD14	How much time does a provider typically take to attend to an emergency?	<30 minutes 30 minutes to an hour 1-3 hours More than 3 hours	1 2 3 4		

SECTION 2A: INPATIENT SERVICES

	CHECK PD5: IF PROVIDER IS A FACILITY (1-7, 9-10,12-13, OR 15-16 SELECTED) IF PROVIDER IS NOT A FACILITY			IS1 Sect 2B
IS1	Does facility offer inpatient services?	Yes No	1 2	 Sect 2B
IS2	Excluding any delivery beds, how many overnight/inpatient beds in total does this facility have, both for adults and children?	[__|__|__|__]		

SECTION 2B: STAFFING

THIS SECTION SHOULD BE ADMINISTERED TO HIGHEST-RANKING STAFF MEMBER

No.	Questions and Filters	Coding Categories		Skip
ST1	How many staff with each of the following qualifications are currently assigned to, employed by, or seconded to this outlet?	1 = Medical doctor 2 = Clinical officer 3 = Nurse 4 = Midwife 5 = Lab technician 6 = Pharmacist 7 = CHW 96 = Other clinically trained staff, specify: [_____] [_____]	[___|___] [___|___] [___|___] [___|___] [___|___] [___|___] [___|___] [___|___] [___|___]	

SECTION 2C: INFRASTRUCTURE

THIS SECTION SHOULD BE ADMINISTERED TO STAFF MEMBERS AS NEEDED

3.01 Communications					3.02
CM1	Does this outlet have any of the following communication devices in functioning condition?		YES	NO	
		A. Land line telephone that is available to call outside at all times client services are offered?	1	2	
		B. Cellular telephone or a private cellular phone that is supported by this outlet?	1	2	
		C. Short-wave radio	1	2	
		D. Computer	1	2	
		E. Email or internet connection (currently available)	1	2	

3.03 Ambulance/Emergency Transport				3.04
	CHECK PD5: IF PROVIDER IS A FACILITY (1-7, 9-10,12-13, OR 15-16 SELECTED) IF PROVIDER IS NOT A FACILITY			ET1 PS1
ET1	Does this facility have a ***functional ambulance*** or other vehicle for emergency transportation for clients that is stationed at this outlet or operates from this outlet?	Yes No	1 2	 ET3
ET2	Is fuel for the ambulance or other emergency vehicle available today?	Yes No Don't Know	1 2 98	
ET3	Does this facility have access to an ambulance or other vehicle for emergency transport for clients that is stationed at another facility or that operates from another facility in near proximity?	Yes No	1 2	

3.05 Power Supply				3.06
PS1	Does your facility have electricity from any source (e.g. electricity grid, generator, solar, or other) including for stand-alone devices (EPI cold chain)?	Yes No	1 2	 BA1
PS2	During the past 7 days, was electricity available at all times from the main or any backup source when the facility was open for services?	ALWAYS AVAILABLE (NO INTERRUPTIONS) OFTEN AVAILABLE (INTERRUPTIONS OF LESS THAN 2 HOURS PER DAY) SOMETIMES AVAILABLE (FREQUENT OR PROLONGED INTERRUPTIONS OF MORE THAN 2 HOURS PER DAY)	1 2 3	

3.07 Basic Client Amenities				3.08
BA1	What is the ***most commonly used*** source of water for the facility ***at this time***?	PIPED INTO FACILITY	1	BA3
		PIPED ONTO FACILITY GROUNDS	2	BA3
		PUBLIC TAP/STANDPIPE	3	
		TUBEWELL/BOREHOLE	4	
		PROTECTED DUG WELL	5	
		UNPROTECTED DUG WELL	6	
		PROTECTED SPRING	7	
		UNPROTECTED SPRING	8	
		RAINWATER COLLECTION	9	
		BOTTLED WATER	10	BA3
		CART W/SMALL TANK/DRUM	11	BA3
		TANKER TRUCK	12	BA3
		SURFACE WATER	13	
		OTHER, Specify	96	

		[_____] DON'T KNOW 98 NO WATER SOURCE 00	 BA3 BA3
BA2	Is a water outlet from this source available within 500 meters of the facility?	Yes 1 No 2	
BA3	Is there a room with auditory and visual privacy available for patient consultations?	AUDITORY PRIVACY ONLY 1 VISUAL PRIVACY ONLY 2 BOTH AUDITORY AND VISUAL PRIVACY 3 NO PRIVACY 4	
BA4	Is there a toilet (latrine) in ***functioning condition*** that is available for general outpatient client use?	Yes 1 No 2	
BA5	IF YES: What type of toilet? **IF MULTIPLE TOILETS ARE AVAILABLE, CONSIDER THE MOST MODERN TYPE**	FLUSH TOILET 1 VENTILATED IMPROVED PIT LATRINE (VIP) 2 PIT LATRINE WITH SLAB 3 PIT LATRINE WITHOUT SLAB/OPEN PIT 4 COMPOSTING TOILET 5 BUCKET 6 HANGING TOILET/ HANGING LATRINE 7	

3.09 Infection Control

IC 1	Does this facility have any guidelines on standard precautions for infection prevention? **IF YES, ASK TO SEE THE DOCUMENT**	YES, OBSERVED 1 YES, REPORTED NOT SEEN 2 NO 3		
IC 2	Please tell me if the following resources/supplies used for infection control are available in the general outpatient area of this facility today. **ASK TO SEE THE ITEMS**	OBSERVED	REPORTED NOT SEEN	NOT AVAILABLE
	A. Clean running water (piped, bucker with tap, or pour pitcher)	1	2	3
	B. Hand-washing soap/liquid soap	1	2	3
	C. Alcohol based hand rub	1	2	3
	D. Disposable latex gloves	1	2	3
	E. Waste receptacle (pedal bin) with lid and plastic bin liner	1	2	3
	F. Sharps container (“safety box”)	1	2	3
	G. Environmental disinfectant (eg chlorine, alcohol)	1	2	3
	H. Disposable syringes with disposable needles	1	2	3
	I. Auto-disposable needles	1	2	3

3.10 Supervision				**3.11**
SS1	When was the last time this outlet received a supervision visit from the higher level (DHMT or other)?	THIS MONTH 1 IN THE LAST 3 MONTHS 2 MORE THAN 3 MONTHS 3 DON’T KNOW 98 NO HIGHER LEVEL/SUPERVISORY BODY 00		 BE1 BE1 BE1
SS2	During the supervision visit, did the supervisor assess the following?:		YES NO	
		Pharmacy (eg Drug stock out, expiry, records, etc)	1 2	
		Staffing (eg staff available and training)	1 2	
		Data (eg completeness, quality, and timely reporting)	1 2	
		Conduct case observation	1 2	

SECTION 2D: EQUIPMENT AND SUPPLIES

THIS SECTION SHOULD BE ADMINISTERED TO STAFF MEMBER AS NEEDED

3.12 Basic Equipment

		A) AVAILABLE			B) FUNCTIONING		
BE1	Please tell me if the following basic equipment and supplies used in the provision of client services are available and functional in this facility today. **ASK TO SEE THE ITEMS**	Observed	Reported Not Seen	Not Available	Yes	No	Don't Know
	A. Adult weight scale	1 → B	2 → B	3 → Next Item	1	2	8
	B. Child weighing scale – 250 gram gradation	1 → B	2 → B	3 → Next Item	1	2	8
	C. Infant weighing scale – 100 gram gradation	1 → B	2 → B	3 → Next Item	1	2	8
	D. Measuring tape – height board /stadiometre	1 → B	2 → B	3 → Next Item	1	2	8
	E. Growth charts	1 → Next Item	2 → Next Item	3 → Next Item			
	F. Thermometer	1 → B	2 → B	3 → Next Item	1	2	8
	G. Stethoscope	1 → B	2 → B	3 → Next Item	1	2	8
	H. Respiratory timer/watch	1 → B	2 → B	3 → Next Item	1	2	8
	I. Blood pressure apparatus (may be digital or manual sphygmomanometer with stethoscope)	1 → B	2 → B	3 → Next Item	1	2	8
	J. Light source (flashlight acceptable)	1 → B	2 → B	3 → Next Item	1	2	8
	K. X-ray machine	1 → B	2 → B	3 → Next Item	1	2	8
	L. Intravenous infusion kits	1 → Next Question	2 → Next Question	3 → Next Item			
	M. Oxygen concentrators	1 → B	2 → B	3 → Next Item	1	2	8
	N. Oxygen cylinders	1 → B	2 → B	3 → Next Item	1	2	8
	O. Central oxygen supply	1 → B	2 → B	3 → Next Item	1	2	8
	P. Flowmeter for oxygen therapy (with humidification)	1 → B	2 → B	3 → Next Item	1	2	8
	Q. Oxygen delivery apparatus (key connecting tubes and mask/nasal prongs)	1 → B	2 → B	3 → Next Question	1	2	8
	R. At any time during the past 3 months has oxygen been unavailable for any reason?	Yes No			1 2		

3.13 Child Preventative and Curative Services				
CS1	Please tell me if this facility provides the following services: **READ ALL**		YES	NO
		A. Diagnose and/or treat child malnutrition	1	2
		B. Provide vitamin A supplementation	1	2
		C. Provide iron supplementation	1	2
		D. Provide ORS to children with diarrhoea	1	2
		E. Provide zinc supplementation to children with diarrhoea	1	2
		F. Child growth monitoring	1	2
		G. Treatment of pneumonia	1	2
		H. Administration of amoxicillin for the treatment of pneumonia in children	1	2
		I. Treatment of malaria in children	1	2
		J. Referral for severe or complicated illness	1	2
	CHECK CS1: IF OFFER REFERRAL SERVICES (J = '1') IF NO REFERRAL SERVICES		CS2 CS3	
CS2	What sort of referral services do you offer?	Facilitated referral with ambulance or other form of transport	1	
		Recommendation of other local provider	2	
CS2A	What provider do you refer children with severe or complicated illness to?	[_____]		
CS3	Please tell me if the following documents are available in the facility today: **IF AVAILABLE, ASK TO SEE THE DOCUMENT**	OBSERVED	REPORTED NOT SEEN	NOT AVAILABLE
	A. IMCI guidelines for the diagnosis and management of childhood illnesses	1	2	3
	B. Any check-lists and/or job-aids for IMCI	1	2	3
CS4	Have you or any provider(s) of curative care services for sick children received any training in the Integrated Management of Childhood Illnesses (IMCI) in the last two years?	Yes No	1 2	

3.14 Diagnostics					3.15
	ASK TO BE SHOWN THE LOCATION IN THE FACILITY WHERE MALARIA SERVICES ARE PROVIDED. FIND THE PERSON MOST KNOWLEDGEABLE ABOUT MALARIA SERVICES IN THE FACILITY. INTRODUCE YOURSELF, EXPLAIN THE PURPOSE OF THE SURVEY AND ASK THE FOLLOWING QUESTIONS.				
DX1	Do providers in this outlet diagnose malaria?	Yes No		1 2	
DX2	Which of the following methods are used at this facility for diagnosing malaria? **READ ALL**		YES	NO	
		A. Clinical symptoms	1	2	
		B. Rapid diagnostic testing (RDT)	1	2	
		C. Microscopy	1	2	
	CHECK DX2: IF OUTLET CONDUCTS MALARIA RDTS ('B' CIRCLED) IF OUTLET DOES NOT CONDUCT MALARIA RDTS				DX3 DX6
DX3	Does this facility have malaria rapid diagnostic test kits (with valid expiration date) in stock in this service site today? **CHECK TO SEE IF VALID (NOT EXPIRED)**	YES, OBSERVED YES, REPORTED NOT SEEN NO		1 2 3	
DX4	Has there been a stock-out of malaria RDT kits in the past 4 weeks?	YES NO		1 2	 DX6
DX5	How many days of stock-out?	LESS THAN 7 DAYS 7 TO 14 DAYS MORE THAN 14 DAYS		1 2 3	

	CHECK DS2: IF OUTLET CONDUCTS MALARIA MICROSCOPY ('C' CIRCLED) IF OUTLET DOES NOT CONDUCT MALARIA MICROSCOPY						DS6 DS8
DX6	I would like to know if the following general equipment items are available and functional today. **ASK TO SEE THE ITEMS**	A) AVAILABLE			B) FUNCTIONING		
		Observed	Reported Not Seen	Observed	Yes	No	Don't Know
	A. Light microscope	1 → B	2 → B	3 → Next Question	1	2	8
	B. Glass slides and cover slips	1 → B	2 → B	3 → Next Question	1	2	8
	C. Wright-Giemsa stain or other acceptable malaria parasite stain (e.g. Field Stain A and B)	1 → B	2 → B	3 → Next Question	1	2	8
DX7	Does this outlet have an accredited/certified microscopist?	YES NO				1 2	
DX8	Do you have the national guidelines for the diagnosis and treatment of malaria available in this outlet today? **IF AVAILABLE, ASK TO SEE THE DOCUMENT**	YES, OBSERVED YES, REPORTED NOT SEEN NO				1 2 3	
DX9	Have you or any provider(s) of malaria services received any training in malaria diagnosis with RDTs in the last two years?	YES NO				1 2	
DX10	Have you or any provider(s) of malaria services received any training in malaria treatment in the last two years?	YES NO				1 2	

3.16 DRUGS

	CHECK PD6: IF DISTRIBUTE MEDICINES ('E' SELECTED) IF DO NOT DISTRIBUTE MEDICINES					DS1 END INTERVIEW	
	ASK TO BE SHOWN THE MAIN LOCATION IN THE FACILITY WHERE MEDICINES AND OTHER SUPPLIES ARE STORED. FIND THE PERSON MOST KNOWLEDGEABLE ABOUT STORAGE AND MANAGEMENT OF MEDICINES AND SUPPLIES IN THE FACILITY. INTRODUCE YOURSELF, EXPLAIN THE PURPOSE OF THE SURVEY AND ASK THE FOLLOWING QUESTIONS.						
DS1	Are any of the following medicines available in the outlet today? **CHECK TO SEE IF AT LEAST ONE OF EACH MEDICINE IS VALID (NOT EXPIRED)**	NOT OBSERVED				OBSERVED AVAILABLE	
		Never Available	Reported Available But Not Seen	Out Of Stock <=7 Days	Out Of Stock >7 Days	At Least One Valid	Available Non Valid
	C. Fluconazole cap/tab	1	2	3	4	5	6
	D. Albendazole or Mebendazole cap/tab	1	2	3	4	5	6
	E. Metronidazole cap/tab	1	2	3	4	5	6
	F. Amoxicillin cap/tab	1	2	3	4	5	6
	G. Ceftriaxone injection	1	2	3	4	5	6
	H. Ciprofloxacin cap/tab	1	2	3	4	5	6
	I. Co-trimoxazole cap/tab (Oral antibiotic)	1	2	3	4	5	6
	J. Procaine benzylpenicillin injection	1	2	3	4	5	6
	K. Oral Rehydration Salts (ORS)	1	2	3	4	5	6
	L. Zinc sulphate tablets	1	2	3	4	5	6
	M. Zinc sulphate syrup or dispersible tablets	1	2	3	4	5	6
	N. Vitamin A (retinol) capsules	1	2	3	4	5	6
	O. Antibiotic eye ointment	1	2	3	4	5	6
	P. Co-trimoxazole syrup/suspension	1	2	3	4	5	6
	Q. Paracetamol	1	2	3	4	5	6
	R. Amoxicillin 250 mg or 500 mg dispersible tablet or syrup/suspension	1	2	3	4	5	6

	S. Artemisinin combination therapy (ACT)	1	2	3	4	5	6
	T. Artesunate rectal or injection dosage	1	2	3	4	5	6
	U. Quinine injection	1	2	3	4	5	6
	V. Gentian violet						
	W. Gentamycin injection						
	X. Normal saline IV solution	1	2	3	4	5	6
	Y. Ringers lactate IV solution	1	2	3	4	5	6
	Z. 5% dextrose IV solution	1	2	3	4	5	6
	AA. Skin disinfectant	1	2	3	4	5	6

DS2	Has there been a stock-out of the below drug in the past 3 months?	Stock- Out In The Past 3 Months	No Stock- Out In Past 3 Months	Don't Know
	A. Amoxicillin 250mg or 500mg dispersible tablet or syrup/suspension	1	2	98
	B. Oral rehydration salts (ORS)	1	2	98
	C. Zinc sulphate tablets	1	2	98
	D. Zinc sulphate syrup or dispersible tablets	1	2	98
	E. ACT	1	2	98

Appendix 4. Case Management Scenario

Validation of Respondent-Reported Care-seeking Location

Form 3.2: Quality of Care Assessment

No.	Questions and Filters	Coding Categories	
QA1	Outlet name	_____	
QA2	Staff member's qualification	Medical doctor	1
		Clinical officer	2
		Nurse	3
		Midwife	4
		Pharmacist	5
		CHW	6
		Other, specify: [_____]	96

Case scenario 1

A little girl aged 25 months and weighing 10.5 kg is brought to the facility because she has been asleep since the morning and very difficult to wake up. She hasn't eaten or drank since yesterday. When asked, the mother said that her daughter did not vomit and did not have any convulsions, but had diarrhoea for about six days. She also had fever for three days and a runny nose. The health worker assessed the child and confirmed that the child was lethargic. The health worker also performed a skin pinch that came back very slowly. No other clinical signs were found. The family lives in a low malaria risk area and has not travel recently.

After reading the case scenario with the health worker, ask him/her to tell you all actions and/or prescriptions he/she would take to provide this child with the most appropriate treatment, assuming that all their drugs are in stock and that there is a referral facility available 20 minutes away. Do not prompt.

Circle "yes" for each of the following actions mentioned by the health worker.

1.01 Recommends urgent referral to an hospital	(1) YES	(2) NO
1.02 Administer Ringer Lactate or Normal saline IV solution	(1) YES	(2) NO
1.03 Administer liquid by naso-gastric tube	(1) YES	(2) NO
1.04 Inject one dose of an injectable antibiotic	(1) YES	(2) NO
1.05 Inject one dose of a second antibiotic	(1) YES	(2) NO
1.06 Prescribe injectable antibiotic for five days	(1) YES	(2) NO
1.07 Give one dose of an oral antibiotic	(1) YES	(2) NO
1.08 Prescribe oral antibiotics for five days	(1) YES	(2) NO
1.09 Inject one dose of quinine	(1) YES	(2) NO
1.10 Give one dose of oral antimalarial	(1) YES	(2) NO
1.11 Prescribe quinine for five days	(1) YES	(2) NO
1.12 Prescribe oral antimalarials for 3 days	(1) YES	(2) NO
1.13 Administer ORS at the facility	(1) YES	(2) NO
1.14 Advise on giving ORS on the way to hospital	(1) YES	(2) NO
1.15 Prescribe ORS for home treatment	(1) YES	(2) NO
1.16 Give one dose of paracetamol	(1) YES	(2) NO
1.17 Prescribe paracetamol for home treatment	(1) YES	(2) NO
1.18 Give one dose of vitamin A	(1) YES	(2) NO
1.19 Treat to prevent low blood sugar	(1) YES	(2) NO
1.20 Recommends to continue breastfeeding	(1) YES	(2) NO
1.21 Recommends to give food and fluids other than breastmilk	(1) YES	(2) NO
1.22 Advise mother to keep infant warm	(1) YES	(2) NO

As for the previous case scenario, read this case scenario with the health worker and ask him/her to tell you all actions and/or prescriptions he/she would take to provide this child with the most appropriate treatment, assuming that all their drugs are in stock and that there is a referral facility available 20 minutes away. Do not prompt.

Case scenario 2

A father brought his 29 month old son to your facility because he has had a fever for more than three days and has an ear discharge since last week. The child does not have other symptoms and lives in a low malaria risk area. The health worker found that the child had a temperature of 38.2°C and saw an ear discharge. The health worker found the child's neck to be stiff. The child has a normal weight and received all vaccinations for his age. There are no other clinical signs.

Circle "yes" for each of the following actions mentioned by the health worker.

2.01 Recommends urgent referral to an hospital	(1) YES	(2) NO
2.02 Administer Ringer Lactate or Normal saline IV solution	(1) YES	(2) NO
2.03 Administer liquid by naso-gastric tube	(1) YES	(2) NO
2.04 Inject one dose of an injectable antibiotic	(1) YES	(2) NO
2.05 Inject one dose of a second antibiotic	(1) YES	(2) NO
2.06 Prescribe injectable antibiotic for five days	(1) YES	(2) NO
2.07 Give one dose of an oral antibiotic	(1) YES	(2) NO
2.08 Prescribe oral antibiotics for five days	(1) YES	(2) NO
2.09 Inject one dose of quinine	(1) YES	(2) NO
2.10 Give one dose of oral antimalarial	(1) YES	(2) NO
2.11 Prescribe quinine for five days	(1) YES	(2) NO
2.12 Prescribe oral antimalarials for 3 days	(1) YES	(2) NO
2.13 Administer ORS at the facility	(1) YES	(2) NO
2.14 Advise on giving ORS on the way to hospital	(1) YES	(2) NO
2.15 Prescribe ORS for home treatment	(1) YES	(2) NO
2.16 Give one dose of paracetamol	(1) YES	(2) NO
2.17 Prescribe paracetamol for home treatment	(1) YES	(2) NO
2.18 Give one dose of vitamin A	(1) YES	(2) NO
2.19 Treat to prevent low blood sugar	(1) YES	(2) NO
2.20 Recommends to continue breastfeeding	(1) YES	(2) NO
2.21 Recommends to give food and fluids other than breastmilk	(1) YES	(2) NO
2.22 Advise mother to keep infant warm	(1) YES	(2) NO

As for the previous case scenario, read this case scenario with the health worker and ask him/her to tell you all actions and/or prescriptions he/she would take to provide this child with the most appropriate treatment, assuming that all their drugs are in stock and that there is a referral facility available 20 minutes away. Do not prompt.

Case scenario 3

A teenager came to the facility with her small sister aged 13 months. She said that her sister was coughing for five days and has had temperature since yesterday night. She remembers that her sister had a generalized rash about one month ago and that neighbours in the village said that it was measles. Her mother continues to breastfeed her sister. There is no malaria in the place where they live. The health worker weighed the child (8.5 kg) and checked temperature (38.8°C). The health worker counted 48 breaths per minute and noticed chest indrawing. No other clinical signs were found. The vaccination card shows that the child received all vaccinations as well as a dose of vitamin A four months ago.

Circle "yes" for each of the following actions mentioned by the health worker.

3.17 Recommends urgent referral to an hospital	(1) YES	(2) NO
3.18 Administer Ringer Lactate or Normal saline IV solution	(1) YES	(2) NO
3.19 Administer liquid by naso-gastric tube	(1) YES	(2) NO
3.20 Inject one dose of an injectable antibiotic	(1) YES	(2) NO
3.21 Inject one dose of a second antibiotic	(1) YES	(2) NO
3.22 Prescribe injectable antibiotic for five days	(1) YES	(2) NO
3.23 Give one dose of an oral antibiotic	(1) YES	(2) NO
3.24 Prescribe oral antibiotics for five days	(1) YES	(2) NO
3.25 Inject one dose of quinine	(1) YES	(2) NO
3.26 Give one dose of oral antimalarial	(1) YES	(2) NO
3.27 Prescribe quinine for five days	(1) YES	(2) NO
3.28 Prescribe oral antimalarials for 3 days	(1) YES	(2) NO
3.29 Administer ORS at the facility	(1) YES	(2) NO
3.30 Advise on giving ORS on the way to hospital	(1) YES	(2) NO
3.31 Prescribe ORS for home treatment	(1) YES	(2) NO
3.32 Give one dose of paracetamol	(1) YES	(2) NO
3.33 Prescribe paracetamol for home treatment	(1) YES	(2) NO
3.34 Give one dose of vitamin A	(1) YES	(2) NO
3.35 Treat to prevent low blood sugar	(1) YES	(2) NO
3.36 Recommends to continue breastfeeding	(1) YES	(2) NO
3.37 Recommends to give food and fluids other than breastmilk	(1) YES	(2) NO
3.38 Advise mother to keep infant warm	(1) YES	(2) NO

As for the previous case scenario, read this case scenario with the health worker and ask him/her to tell you all actions and/or prescriptions he/she would take to provide this child with the most appropriate treatment, assuming that all their drugs are in stock and that there is a referral facility available 20 minutes away. Do not prompt.

Case scenario 4

A 10-day old baby is brought to the facility by her mother because she thinks her daughter is sick and feels hot. After careful examination, the health worker found that the baby has a temperature of 38°C and a bulging fontanelle. The mother breastfeeds day and night, about 10 times/24 hours and does not report feeding problems. The child's weight is normal.

Circle "yes" for each of the following actions mentioned by the health worker.

4.01 Recommends urgent referral to an hospital	(1) YES	(2) NO
4.02 Administer Ringer Lactate or Normal saline IV solution	(1) YES	(2) NO
4.03 Administer liquid by naso-gastric tube	(1) YES	(2) NO
4.04 Inject one dose of an injectable antibiotic	(1) YES	(2) NO
4.05 Inject one dose of a second antibiotic	(1) YES	(2) NO
4.06 Prescribe injectable antibiotic for five days	(1) YES	(2) NO
4.07 Give one dose of an oral antibiotic	(1) YES	(2) NO
4.08 Prescribe oral antibiotics for five days	(1) YES	(2) NO
4.09 Inject one dose of quinine	(1) YES	(2) NO
4.10 Give one dose of oral antimalarial	(1) YES	(2) NO
4.11 Prescribe quinine for five days	(1) YES	(2) NO
4.12 Prescribe oral antimalarials for 3 days	(1) YES	(2) NO
4.13 Administer ORS at the facility	(1) YES	(2) NO
4.14 Advise on giving ORS on the way to hospital	(1) YES	(2) NO
4.15 Prescribe ORS for home treatment	(1) YES	(2) NO
4.16 Give one dose of paracetamol	(1) YES	(2) NO
4.17 Prescribe paracetamol for home treatment	(1) YES	(2) NO
4.18 Give one dose of vitamin A	(1) YES	(2) NO
4.19 Treat to prevent low blood sugar	(1) YES	(2) NO
4.20 Recommends to continue breastfeeding	(1) YES	(2) NO
4.21 Recommends to give food and fluids other than breastmilk	(1) YES	(2) NO
4.22 Advise mother to keep infant warm	(1) YES	(2) NO

As for the previous case scenario, read this case scenario with the health worker and ask him/her to tell you all actions and/or prescriptions he/she would take to provide this child with the most appropriate treatment, assuming that all their drugs are in stock and that there is a referral facility available 20 minutes away. Do not prompt.

Case scenario 5

A mother brought her three-week old little boy to the facility because he does not gain weight and does not want to eat. The child receives breastmilk and since last week some milk and weak tea because he seemed not to like breastmilk. The health worker finds that the child weights 2.3 kg, does not have an abnormal temperature, and has 62 breaths per minute. The health worker repeated the count and found 65 breaths per minute. There are no other clinical signs. The health worker asked the mother whether he could observe her while she breastfeeds her child. During the observation, the health worker noticed that there was no attachment of the child to the breast at all and that the child was not suckling.

Circle "yes" for each of the following actions mentioned by the health worker.

5.01 Recommends urgent referral to an hospital	(1) YES	(2) NO
5.02 Administer Ringer Lactate or Normal saline IV solution	(1) YES	(2) NO
5.03 Administer liquid by naso-gastric tube	(1) YES	(2) NO
5.04 Inject one dose of an injectable antibiotic	(1) YES	(2) NO
5.05 Inject one dose of a second antibiotic	(1) YES	(2) NO
5.06 Prescribe injectable antibiotic for five days	(1) YES	(2) NO
5.07 Give one dose of an oral antibiotic	(1) YES	(2) NO
5.08 Prescribe oral antibiotics for five days	(1) YES	(2) NO
5.09 Inject one dose of quinine	(1) YES	(2) NO
5.10 Give one dose of oral antimalarial	(1) YES	(2) NO
5.11 Prescribe quinine for five days	(1) YES	(2) NO
5.12 Prescribe oral antimalarials for 3 days	(1) YES	(2) NO
5.13 Administer ORS at the facility	(1) YES	(2) NO
5.14 Advise on giving ORS on the way to hospital	(1) YES	(2) NO
5.15 Prescribe ORS for home treatment	(1) YES	(2) NO
5.16 Give one dose of paracetamol	(1) YES	(2) NO
5.17 Prescribe paracetamol for home treatment	(1) YES	(2) NO
5.18 Give one dose of vitamin A	(1) YES	(2) NO
5.19 Treat to prevent low blood sugar	(1) YES	(2) NO
5.20 Recommends to continue breastfeeding	(1) YES	(2) NO
5.21 Recommends to give food and fluids other than breastmilk	(1) YES	(2) NO
5.22 Advise mother to keep infant warm	(1) YES	(2) NO

Appendix 5. Care-seeking Event Tracking Form

Validation of Respondent-Reported Care-seeking Location

Form 3.3: Provider Event Tracking

No.	Questions and Filters	Coding Categories			SKIP
P1	SCAN BARCODE				
P2	What is the name of the person who brought this child for care?	[_____]			
P3	What symptoms does the child have? CHECK ALL THAT APPLY	**General Symptoms** Fever Acute cough Chronic cough Rapid breathing Chest indrawing Stridor Runny nose Acute diarrhea Persistent diarrhea Bloody diarrhea Ear pain Rash Vomiting Red eyes Pus in eyes Mouth ulcers **Danger Signs** Vomits everything Unable to drink or breastfeed Convulsions Lethargic/unconscious Palmor pallor (pale skin) Oedema (swelling in feet) Sunken eyes Restless/irritable Stiff neck Other symptom, specify [_____]	 A B C D E F G H I J K L M N O P Q R S T U V W X XX Y		
P4	What diagnostic tests did you perform?		Y	N	
		A. Took temperature	1	2	P6
		B. RDT	1	2	
		C. Microscope smear for malaria	1	2	
		D. X-ray	1	2	P6
		E. Counted breaths	1	2	P6
		F. Listened to respiratory sounds	1	2	P6
		G. Stool sample	1	2	P6
		H. Skin pinch	1	2	P6
		Y. Other test, specify [_____]			P6
P5	What was the result of the malaria diagnostic test?	Positive Negative Don't know	1 2 98		
P6	Did you weigh the child?	Yes No	1 2		
P6A	Did you check the child's weight against the growth chart?	Yes No	1 2		
P7	Did you check the child's vaccination history?	Yes No	1 2		
P8	What diagnosis(es) did you give?	Pneumonia Cough/Cold/Flu Dehydration	A B C		

		Diarrhea	D	
		Dysentery	E	
		Severe febrile illness	F	
		Malaria	G	
		Non-malarial fever	H	
		Measles	I	
		Mastoiditis	J	
		Acute ear infection	K	
		Chronic ear infection	L	
		Malnutrition	M	
		Anemia	N	
		Low weight	O	
		Undiagnosed severe illness	P	
		Undiagnosed illness	Q	
		Other, specify: [_____]	Y	
P9	Is the illness severe? RECORD FOR EACH DIAGNOSIS	Yes	1	
		No	2	
P10A	Were there any drugs you wanted to prescribe but were unable to because they are not in stock?	Yes, specify: [_____]	1	
		No	2	
P10B	What treatment have you prescribed? RECORD ALL TREATMENTS PRESCRIBED	Referred to another provider	A	
		ANTIBIOTIC		
		Cotrimoxazole	B	P12
		Amoxicillin	C	P12
		Other antibiotic: [_____]	D	P15
		ANTIMALARIAL		
		SP/Fansidar	E	P15
		Chloroquine	F	P15
		Amodiaquine	G	P15
		Quinine	H	P12
		Artemether-lumefantrine (Coartem)	I	P12
		Dihydrosrtemisinin-piperaquine (DHA-PPQ)	J	P12
			K	P12
		Artemether	L	P12
		Asunate/Artesunate	M	P12
		Artether	N	P15
		Other antimalarial: [_____]		
		OTHER	O	P14
		ORS	P	P12
		Zinc	Q	P15
		IV fluid	R	P15
		Aspirin	S	P15
		Paracetamol (panadol)	T	P15
		Acetaminophin	U	P15
		Ibuprofen	V	P15
		Tetracycline eye ointment	W	P15
		Herbal medicine	X	P15
		Traditional medicine/prayer	Y	P15
		Other, specify: [_____]	Z	
		No treatment		
P11	What is the name of the provider you referred the child to?	[_____]		END
P12	What was the formulation of the [DRUG] prescribed? RECORD FOR EACH PRESCRIPTION	Tablet	1	
		Dispersible tablet	2	
		Syrup/Suspension	3	P15
		Injection	4	P15
	CHECK P10 & P12: If B, C or H-J Selected in P10 and 1 or 2 selected in P12 If Not Selected			P13 P15

P13	What was the dosage of the active ingredients in the [DRUG] you prescribed? RECORD FOR EACH PRESCRIPTION	**Cotrimoxazole** Sulfamethoxazole Trimethoprim **Amoxicillin** **AL/Coartem** Artemether Lumefantrine **DHA-PPQ** Dihydroartemisinin Piperaquine **Quinine** **Zinc**	 [__|__|__].[__|__] mg [__|__|__].[__|__] mg [__|__|__].[__|__] mg [__|__|__].[__|__] mg [__|__|__].[__|__] mg [__|__|__].[__|__] mg [__|__|__].[__|__] mg [__|__|__].[__|__] mg [__|__|__].[__|__] mg	
P14	How many tablets/sachets of [DRUG] did you prescribe for the child? RECORD FOR EACH PRESCRIPTION		[___|___]	
P15	Did you counsel the caregiver on management of the illness at home?	Yes No	1 2	END END

Appendix 6A. Key Informant Recruitment Script

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

RECRUITMENT SCRIPT

FORM 1.1: Key Informant Recruitment

Study Title: Validation of Respondent-Reported Care-seeking & New Methods for Estimating Coverage of Appropriate Management of Childhood Illness
Principal Investigator: Melinda Munos
IRB No.: IRB00006579
PI Version Date: V2/6 August 2015

Hello, my name is _____. I work for Chainama College of Health Sciences. We are conducting a study to develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The results will be used to improve maternal and child health programs.

We would like for you to participate in this study because community members have mentioned you are familiar with health services for children in the study area. As part of the study, we would like to ask you to answer a few questions about health services in the area.

We will not share individual information about you or other participants with anyone beyond our research team. Participation in this study is voluntary. You are free to decide if you want to take part or not. If you do agree, you can change your mind at any time. You can refuse to answer any specific questions, or stop participation at any time. If you choose to participate, you will receive a small payment for your participation.

Appendix 6B. Household Recruitment Script

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

RECRUITMENT SCRIPT

Form 1.2. Household Recruitment

Study Title: Validation of Respondent-Reported Care-seeking & New Methods for Estimating Coverage of Appropriate Management of Childhood Illness
Principal Investigator: Melinda Munos
IRB No.: IRB00006579
PI Version Date: V2/6 August 2015

Hello, my name is _____. I work for Chainama College of Health Sciences. We are conducting a study to develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The results will be used to improve maternal and child health programs.

We would like for you to participate in this study because we believe you have a mother of a child under the age of 57 months in your household.

Is there a woman in your household between the ages of 15 – 49 years?

[INTERVIEWER INSTRUCTIONS: IF YES, CONTINUE WITH SCRIPT. IF NO WOMAN FITTING AGE REQUIREMENTS, END SCRIPT AND THANK INDIVIDUAL FOR THEIR TIME]

Does this woman have a child under the age of 57 months?

[INTERVIEWER INSTRUCTIONS: IF YES, CONTINUE WITH SCRIPT. IF NO CHILD UNDER 5, END SCRIPT AND THANK INDIVIDUAL FOR THEIR TIME]

If you choose to participate, we will ask you some questions about your household. We will give your child a card or bracelet with a barcode. If your child becomes sick in the next 6 weeks, this barcode will be used to create a record of where the child was taken for care. We will return later to ask you about what was done to treat your child if they became sick.

We will not share individual information about you or other participants with anyone beyond our research team. Participation in this study is voluntary. You are free to decide if you want to take part or not. If you do agree, you can change your mind at any time. You can refuse to answer any specific questions, or stop participation at any time. If you choose to participate, you will receive a small payment for your participation.

Appendix 6C. Provider Recruitment Script

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

RECRUITMENT SCRIPT

1.3. Provider Recruitment

Study Title: Validation of Respondent-Reported Care-seeking & New Methods for Estimating Coverage of Appropriate Management of Childhood Illness
Principal Investigator: Melinda Munos
IRB No.: IRB00006579
PI Version Date: V1/27 July 2015

Hello, my name is _____. I work for Chainama College of Health Sciences. We are conducting a study to develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The results will be used to improve maternal and child health programs.

We would like for you to participate because you offer treatment for sick children. Participation may include completion of a survey on the availability of supplies and services offered at this outlet and/or tracking of children that seek treatment at this outlet.

We are not here to inspect your business and no information about this specific outlet will be passed on to the regulatory authorities. We will not share individual information about you or other participants with anyone beyond our research team. Participation in this study is voluntary. You are free to decide if you want to take part or not. If you do agree, you can change your mind at any time. You can refuse to answer any specific questions, or stop the interview at any time. If you choose to participate in the event tracking, you will receive a small payment for your participation.

Appendix 7A. Key Informant Consent Form

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

INFORMED CONSENT DOCUMENT

2.1. Key Informant Consent

Study Title: Validation of Respondent-Reported Care-seeking & New Methods for Estimating Coverage of Appropriate Management of Childhood Illness
Principal Investigator: Melinda Munos
IRB No.: IRB00006579
PI Version Date: V1/27 July 2015

What you should know about this study

- You are being asked to join a research study.
- This consent form explains the research study and your part in the study.
- Please read it carefully and take as much time as you need.
- You are a volunteer. You can choose not to take part and if you join, you may quit at any time. There will be no penalty if you decide to quit the study.
- During the study, we will tell you if we learn any new information that might affect whether you wish to continue to be in the study.

Purpose of research project

The purpose of this study is develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The study is designed to assess where children are taken for care, the treatment they receive, and how best to measure both things.

Why you are being asked to participate

You are being asked to participate because you are familiar with health services for children in the study area.

Procedures

If you agree to participate, you will be asked to answer questions about where sick children are taken for care in the area. We will also ask you for your opinions on a tracking method we are developing for a study on care-seeking for child illness.

Risks/discomforts

If you agree to participate, the interview will take approximately 45 minutes of your time. This research project has no physical risks to you and will not cost you anything. There is a risk that the information you share with us may accidentally be shared with others. We will not ask any sensitive questions and will take steps to keep your responses secret.

Benefits

There is no direct benefit to you from being in the study.

Your participation in this research project will help us to understand care-seeking for child illnesses. This research project will collect information that will improve the quality of household surveys here and in other countries. It could also help the Ministry of Health and other organizations to improve maternal and child health programs.

Payment

You will receive 100 ZMW for participating.

Protecting data confidentiality

All research projects carry some risk that information about you may become known to people outside of a study. We believe that your privacy is important. We will take several steps to make sure that your information is kept confidential. We will store all of your information in a safe place that can only be accessed by members of this study team. We will also make sure that your information is stored in a way that does not identify you. This means that no one will be able to look at the information we keep and know who it came from you. Finally, we will not share any of your information with anyone outside of this study team.

Protecting subject privacy during data collection

Where possible, we will ask you questions in a private location to protect the privacy of your responses.

Cost of participation in the study

There is no cost to participate in the study.

What happens if you leave the study early?

You may choose to not answer specific questions or leave the study at any time. You will not be penalized for leaving the study.

Who do I call if I have questions or problems?

If you have any questions, complaints and concerns about any aspect of the study:

- Call the investigator at Chainama College of Health Sciences, Micky Ndhlovu, at +260955890203 if you have questions, complaints, or get sick or injured as a result of being in this study.

- Call or contact the ERES Converge IRB Office if you have questions about your rights as a study participant. Contact the IRB if you feel you have not been treated fairly or if you have other concerns. The IRB contact information is:

Contact: ERES Converge Institutional Review Board
Address: 33 Joseph Mwilwa Road, Rhodes Park
Lusaka, Zambia
Telephone: +260 955 155 633
+260 955 155 634
E-mail: eresconverge@yahoo.co.uk

Is it okay to proceed with the survey?

☐ Check if respondent agrees to participate

_____	_____	_____
Print name of Person Obtaining Consent	Signature of Person Obtaining Consent	Date

Give one copy to the participant and keep one copy in study records

Appendix 7B. Head of Household Consent Form

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

INFORMED CONSENT DOCUMENT

2.2. Head of Household Consent

Study Title: Validation of Respondent-Reported Care-seeking & New Methods for Estimating Coverage of Appropriate Management of Childhood Illness
Principal Investigator: Melinda Munos
IRB No.: IRB00006579
PI Version Date: V2/6 August 2015

What you should know about this study

- You are being asked to join a research study.
- This consent form explains the research study and your part in the study.
- Please read it carefully and take as much time as you need.
- You are a volunteer. You can choose not to take part and if you join, you may quit at any time. There will be no penalty if you decide to quit the study.
- During the study, we will tell you if we learn any new information that might affect whether you wish to continue to be in the study.

Purpose of research project

The purpose of this study is develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The study is designed to assess where children are taken for care, the treatment they receive, and how best to measure both things.

Why you are being asked to participate

You are being asked to participate because you are the head of a household with at least one woman between the ages of 15-49 who is the mother of child under the age of 57 months.

Procedures

If you join this study, we will ask you to answer a short questionnaire about your household.

Will we collect any additional data about you?

We will also ask for permission to have providers record the care given to your child and review your child's medical records and at health providers. We will use these records to better understand the care your child received. Your decision will not change whether or not you can participate in the study.

Risks/discomforts

If you agree to participate, this visit will take approximately 15 minutes of your time. This research project has no physical risks to you and will not cost you anything. There is a risk that information you share with us may accidentally be shared with others. We will not ask any sensitive questions and will take steps to keep your responses secret.

Benefits

There is no direct benefit to you from being in the study.

Your participation in this research project will help us to understand care-seeking for child illnesses. This research project will collect information that will improve the quality of household surveys here and in other countries. It could also help the Ministry of Health and other organizations to improve maternal and child health programs.

Payment

You will not receive payment for participation in this survey.

Protecting data confidentiality

All research projects carry some risk that information about you may become known to people outside of a study. We believe that your privacy is important. We will take several steps to make sure that your information is kept confidential. We will store all of your information in a safe place that can only be accessed by members of this study team. We will also make sure that your information is stored in a way that does not identify you. This means that no one will be able to look at the information we keep and know who it came from you. Finally, we will not share any of your information with anyone outside of this study team.

Protecting subject privacy during data collection

Where possible, we will ask you questions in a private location to protect the privacy of your responses.

Cost of participation in the study

There is no cost to participate in the study. We will not pay for any medical care that you seek during the study period.

What happens if you leave the study early?

You may choose to not answer specific questions or leave the study at any time. You will not be penalized for leaving the study.

Who do I call if I have questions or problems?

If you have any questions, complaints and concerns about any aspect of the study:

- Call the investigator at Chainama College of Health Sciences, Micky Ndhlovu, at +260955890203 if you have questions, complaints, or get sick or injured as a result of being in this study.

- Call or contact the ERES Converge IRB Office if you have questions about your rights as a study participant. Contact the IRB if you feel you have not been treated fairly or if you have other concerns. The IRB contact information is:

Contact: ERES Converge Institutional Review Board
Address: 33 Joseph Mwilwa Road, Rhodes Park
Lusaka, Zambia
Telephone: +260 955 155 633
+260 955 155 634
E-mail: eresconverge@yahoo.co.uk

What does your signature (or thumbprint/mark) on this consent form mean?

Your signature on this form means:

- You have been informed about this study's purpose, procedures, possible benefits and risks.
- You have been given the chance to ask questions before you sign.
- You have voluntarily agreed to be in this study.

☐ Check if respondent agrees to above

Print name of Adult Participant	Signature of Adult Participant	Date

☐

Ask the participant to mark a "left thumb impression" in this box if the participant (or participant's parent) is unable to provide a signature above.

Print name of Person Obtaining Consent	Signature of Person Obtaining Consent	Date

Give one copy to the participant and keep one copy in study records

Appendix 7C. Caregiver Consent Form

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

INFORMED CONSENT DOCUMENT

2.3. Caregiver Consent

Study Title: Validation of Respondent-Reported Care-seeking & New Methods for Estimating Coverage of Appropriate Management of Childhood Illness
Principal Investigator: Melinda Munos
IRB No.: IRB00006579
PI Version Date: V3/31 August 2015

What you should know about this study

- You are being asked to join a research study.
- This consent form explains the research study and your part in the study.
- Please read it carefully and take as much time as you need.
- You are a volunteer. You can choose not to take part and if you join, you may quit at any time. There will be no penalty if you decide to quit the study.
- During the study, we will tell you if we learn any new information that might affect whether you wish to continue to be in the study.

Purpose of research project

The purpose of this study is develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The study is designed to assess where children are taken for care, the treatment they receive, and how best to measure both things.

Why you are being asked to participate

You are being asked to participate because you are between the ages of 15 and 49 and are the mother of a child under the age of 57 months.

Procedures

If you join this study, your child or children under the age of 57 months will be given a card or bracelet with a barcode. This barcode is unique to the child. If the child becomes sick, you should take the card or bracelet with you when you seek care or treatment for the child. You should present the card or bracelet to the person giving care to the child. This includes traditional healers, pharmacists, community health workers, providers at public health facilities or any other individual providing care. The person giving care to the child will scan the barcode with a phone. This will create a record that the child was taken for care.

We will ask all caregivers to answer a short questionnaire about your household at the beginning of the study.

One to two months later, we will visit you again to ask you a set of questions about any care sought for your child recently.

Will we collect any additional data about you?

We will also ask for permission to have providers record the care given to your child and review your child's medical records at health providers. We will use these records to better understand the care your child received. Your decision will not change whether or not you can participate in the study.

Risks/discomforts

If you agree to participate, this visit will take approximately 30 minutes of your time. We will visit you one more time in approximately 6 weeks. The second visit should take about 45 minutes of your time. This research project has no physical risks to you and will not cost you anything. There is a risk that the information you share with us may accidentally be shared with others. We will not ask any sensitive questions and will take steps to keep your responses secret.

Benefits

There is no direct benefit to you from being in the study.

Your participation in this research project will help us to understand care-seeking for child illnesses. This research project will collect information that will improve the quality of household surveys here and in other countries. It could also help the Ministry of Health and other organizations to improve maternal and child health programs.

Payment

You will receive 40 ZMW for enrolling in the study. You will receive an additional 40 ZMW during the second visit if you still have the barcode bracelet/card and answer the questions about care sought for your child recently.

Protecting data confidentiality

All research projects carry some risk that information about you may become known to people outside of a study. We believe that your privacy is important. We will take several steps to make sure that your information is kept confidential. We will store all of your information in a safe place that can only be accessed by members of this study team. We will also make sure that your information is stored in a way that does not identify you. This means that no one will be able to look at the information we keep and know who it came from you. Finally, we will not share any of your information with anyone outside of this study team.

Protecting subject privacy during data collection

Where possible, we will ask you questions in a private location to protect the privacy of your responses.

Cost of participation in the study

There is no cost to participate in the study. We will not pay for any medical care that you seek during the study period.

What happens if you leave the study early?

You may choose to leave the study at any time. You will not be penalized for leaving the study. You will not receive the second payment of 40 ZMW if you leave the study early.

Who do I call if I have questions or problems?

If you have any questions, complaints and concerns about any aspect of the study:

- Call the investigator at Chainama College of Health Sciences, Micky Ndhlovu, at +260955890203 if you have questions, complaints, or get sick or injured as a result of being in this study.

- Call or contact the ERES Converge IRB Office if you have questions about your rights as a study participant. Contact the IRB if you feel you have not been treated fairly or if you have other concerns. The IRB contact information is:

Contact: ERES Converge Institutional Review Board
Address: 33 Joseph Mwilwa Road, Rhodes Park
Lusaka, Zambia
Telephone: +260 955 155 633
+260 955 155 634
E-mail: eresconverge@yahoo.co.uk

What does your signature (or thumbprint/mark) on this consent form mean?

Your signature on this form means:

- You have been informed about this study's purpose, procedures, possible benefits and risks.
- You have been given the chance to ask questions before you sign.
- You have voluntarily agreed to be in this study.

☐ Check if respondent agrees to above

☐ Check if respondent also agrees to provide the study team access to medical records

_____	_____	_____
Print name of Adult Participant	Signature of Adult Participant	Date

☐

Ask the participant to mark a "left thumb impression" in this box if the participant (or participant's parent) is unable to provide a signature above.

_____	_____	_____
Print name of Person Obtaining Consent	Signature of Person Obtaining Consent	Date

Give one copy to the participant and keep one copy in study records

Appendix 7D. Provider Consent Form

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

INFORMED CONSENT DOCUMENT

2.4. Provider Consent

Study Title: Validation of Respondent-Reported Care-seeking & New Methods for Estimating Coverage of Appropriate Management of Childhood Illness
Principal Investigator: Melinda Munos
IRB No.: IRB00006579
PI Version Date: V2/30 August 2015

What you should know about this study

- You are being asked to join a research study.
- This consent form explains the research study and your part in the study.
- Please read it carefully and take as much time as you need.
- You are a volunteer. You can choose not to take part and if you join, you may quit at any time. There will be no penalty if you decide to quit the study.
- During the study, we will tell you if we learn any new information that might affect whether you wish to continue to be in the study.

Purpose of research project

The purpose of this study is develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The study is designed to assess where children are taken for care, the treatment they receive, and how best to measure both things.

Why you are being asked to participate

You are being asked to participate because you offer curative health services to children under the age of 5 in the study area.

Procedures

If you agree to participate, we will ask you to participate in one or both of the following activities: care-seeking event tracking, a readiness/QOC assessment, and a record review. You may agree to participate in only one or all activities.

Care-Seeking Event Tracking:
If you agree to participate in the Care-Seeking Event Tracking, you will be asked to document children under the age of five that are brought to you for treatment of a childhood illness. We will give you a mobile phone with an application for reading barcodes. Some children in your community have been given bracelets or cards with barcodes. You will be asked to scan the barcode with the phone. This will record the identity of the child brought to you for care. The application will also ask you to enter some basic information about the child's illness and what you did to manage the illness.

We will also give you tokens with a barcode. You will be asked to give a token to every caregiver that brings a child under the age of 5 to you for treatment of an illness. You will need to scan the barcode before you give the token to a caregiver. This will record the day you gave out the token. You should also instruct the caregiver to save the token at home for up to 2 months.

Readiness and QOC assessment:
If you agree to participate in the Readiness/QOC assessment, you will be asked to complete a series of questions about the availability of different equipment, staff, and services at this outlet. We will also ask that

you respond to a set of case scenarios about the management of hypothetical sick child. If you have more than one staff member at this outlet that treats sick children, we will also ask to complete the QOC assessment with some of those staff members.

Record Review:
If you keep records of people treated at this outlet, including client names, we will ask to review those records. We will look to see if any of the children enrolled in our study were brought to this outlet for care. This record review will take about 15 minutes of your time and will only require that you provide us with the necessary documents to review.

Risks/discomforts

If you agree to participate, the Readiness/QOC assessment will take approximately 1 hour of your time.

We anticipate the Care-seeking Event Tracking will add approximately 1 minute of additional time to each visit for every child you treat and approximately 2 minutes of additional time for each child with a barcode bracelet. It will take approximately 10 minutes for us to train you to use the event tracking application. Additionally, we will visit in 2 weeks to check how the event tracking is going. That visit should take around 15 minutes.

This research project has no physical risks to you and will not cost you anything. There is a risk that the information you share with us may accidentally be shared with others. We will not ask any sensitive questions and will take steps to keep your responses secret.

Benefits

There is no direct benefit to you from being in the study.

Your participation in this research project will help us to understand care-seeking for child illnesses. This research project will collect information that will improve the quality of household surveys here and in other countries. It could also help the Ministry of Health and other organizations to improve maternal and child health programs.

Payment

You will receive 150 ZMW for each month that you participate in the event tracking. You will also be allowed to keep the phone used for tracking care-seeking events.

Protecting data confidentiality

All research projects carry some risk that information about you may become known to people outside of a study. We believe that your privacy is important. We will take several steps to make sure that your information is kept confidential. We will store all of your information in a safe place that can only be accessed by members of this study team. We will also make sure that your information is stored in a way that does not identify you. This means that no one will be able to look at the information we keep and know who it came from you. Finally, we will not share any of your information with anyone outside of this study team.

Protecting subject privacy during data collection

Where possible, we will ask you questions in a private location to protect the privacy of your responses.

Cost of participation in the study

There is no cost to participate in the study.

What happens if you leave the study early?

You may choose to leave the study at any time. You will not be penalized for leaving the study. You will not receive payment for months in which you do not track care-seeking events.

Who do I call if I have questions or problems?

If you have any questions, complaints and concerns about any aspect of the study:

- Call the investigator at Chainama College of Health Sciences, Micky Ndhlovu, at +260955890203 if you have questions, complaints, or get sick or injured as a result of being in this study.

- Call or contact the ERES Converge IRB Office if you have questions about your rights as a study participant. Contact the IRB if you feel you have not been treated fairly or if you have other concerns. The IRB contact information is:

Contact: ERES Converge Institutional Review Board
Address: 33 Joseph Mwilwa Road, Rhodes Park
Lusaka, Zambia
Telephone: +260 955 155 633
+260 955 155 634
E-mail: eresconverge@yahoo.co.uk

What does your signature (or thumbprint/mark) on this consent form mean?

Your signature on this form means:

- You have been informed about this study's purpose, procedures, possible benefits and risks.
- You have been given the chance to ask questions before you sign.
- You have voluntarily agreed to be in this study.

☐ Check if respondent agrees to participate in the Readiness/QOC assessment

☐ Check if respondent agrees to participate in the Care-Seeking Event Tracking

☐ Check if respondent agrees to provide the study team access to medical records

_____	_____	_____
Print name of Provider Representative	Signature of Provider	Date

☐

Ask the participant to mark a "left thumb impression" in this box if the participant is unable to provide a signature above.

_____	_____	_____
Print name of Person Obtaining Consent	Signature of Person Obtaining Consent	Date

Give one copy to the participant and keep one copy in study records

Appendix 7E. Case Scenario Consent Form

JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

INFORMED CONSENT DOCUMENT

2.5. Provider Consent – QOC Assessment

Study Title: Validation of Respondent-Reported Care-seeking & New Methods for Estimating Coverage of Appropriate Management of Childhood Illness
Principal Investigator: Melinda Munos
IRB No.: IRB00006579
PI Version Date: V1/27 July 2015

What you should know about this study

- You are being asked to join a research study.
- This consent form explains the research study and your part in the study.
- Please read it carefully and take as much time as you need.
- You are a volunteer. You can choose not to take part and if you join, you may quit at any time. There will be no penalty if you decide to quit the study.
- During the study, we will tell you if we learn any new information that might affect whether you wish to continue to be in the study.

Purpose of research project

The purpose of this study is develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The study is designed to assess where children are taken for care, the treatment they receive, and how best to measure both things.

Why you are being asked to participate

You are being asked to participate because you offer curative health services to children under the age of 5 in the study area.

Procedures

If you agree to participate, we will ask you to complete a quality of care (QOC) assessment. We will describe a series of sick children with common symptoms of childhood illnesses. We will ask you respond about the way you would manage each hypothetical sick child.

Risks/discomforts

If you agree to participate, the QOC assessment will take approximately 10 minutes of your time. This research project has no physical risks to you and will not cost you anything. There is a risk that the information you share with us may accidentally be shared with others. We will not ask any sensitive questions and will take steps to keep your responses secret.

Benefits

There is no direct benefit to you from being in the study.

Your participation in this research project will help us to understand care-seeking for child illnesses. This research project will collect information that will improve the quality of household surveys here and in other countries. It could also help the Ministry of Health and other organizations to improve maternal and child health programs.

Payment

You will not be paid for participating.

Protecting data confidentiality

All research projects carry some risk that information about you may become known to people outside of a study. We believe that your privacy is important. We will take several steps to make sure that your information is kept confidential. We will store all of your information in a safe place that can only be accessed by members of this study team. We will not record your name and will make sure that your information is stored in a way that does not identify you. This means that no one will be able to look at the information we keep and know who it came from you. Finally, we will not share any of your information with anyone outside of this study team.

Protecting subject privacy during data collection

Where possible, we will ask you questions in a private location to protect the privacy of your responses.

Cost of participation in the study

There is no cost to participate in the study.

What happens if you leave the study early?

You may choose to not answer specific questions or leave the study at any time. You will not be penalized for leaving the study.

Who do I call if I have questions or problems?

If you have any questions, complaints and concerns about any aspect of the study:

- Call the investigator at Chainama College of Health Sciences, Micky Ndhlovu, at +260955890203 if you have questions, complaints, or get sick or injured as a result of being in this study.

- Call or contact the ERES Converge IRB Office if you have questions about your rights as a study participant. Contact the IRB if you feel you have not been treated fairly or if you have other concerns. The IRB contact information is:

Contact: ERES Converge Institutional Review Board
Address: 33 Joseph Mwilwa Road, Rhodes Park
Lusaka, Zambia
Telephone: +260 955 155 633
+260 955 155 634
E-mail: eresconverge@yahoo.co.uk

Is it okay to proceed with the survey?

☐ Check if respondent agrees to participate

_____	_____	_____
Print name of Person Obtaining Consent	Signature of Person Obtaining Consent	Date

Give one copy to the participant and keep one copy in study records

Appendix 8. Data Collection Manual

ZAMBIA MANAGEMENT OF CHILDHOOD ILLNESS STUDY

FIELD MANUAL FOR DATA COLLECTORS

Chainama College of Health Sciences
- and -
Johns Hopkins School of Public Health

January 11, 2016

STUDY OVERVIEW

Purpose:

The purpose of this study is develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The study is designed to assess where children are taken for care, the treatment they receive, and how best to measure both things.

Participants:

- Randomly selected mothers with at least one child under the age of 59 months
- All potential sources of care for a child under 5, including: health center, private clinics, pharmacies, traditional or faith healers, shops and kiosks that sell drugs

Location:

The study will take place in Choma District. The study site include 3 rural HFCAs: Simakutu, Sikalongo, and Mochipapa. It also includes 2 urban HFCAs: the urban catchment of Shampande and Railways Surgery.

Method Overview:

This is a prospective cohort study with three primary components: 1) an assessment of provider readiness and QOC, 2) tracking of care-seeking events for child illness through an mHealth and low-tech approach, and 3) a household survey on care-seeking for child illness

All health providers will be mapped and data will be collected on available services. Those reporting provision of child curative services will be administered a provider assessment tool around the availability of essential services and quality of care. The study will track enrolled child care-seeking interactions with health care providers using an mHealth application and a low-tech tracking method.

Mothers will be enrolled into the study and administered a Baseline Household Survey to collect basic demographic information. Eligible children <59 months will be given a card with a unique barcode. Their mother will be instructed that if the child becomes sick they should take this card with them wherever they seek treatment.

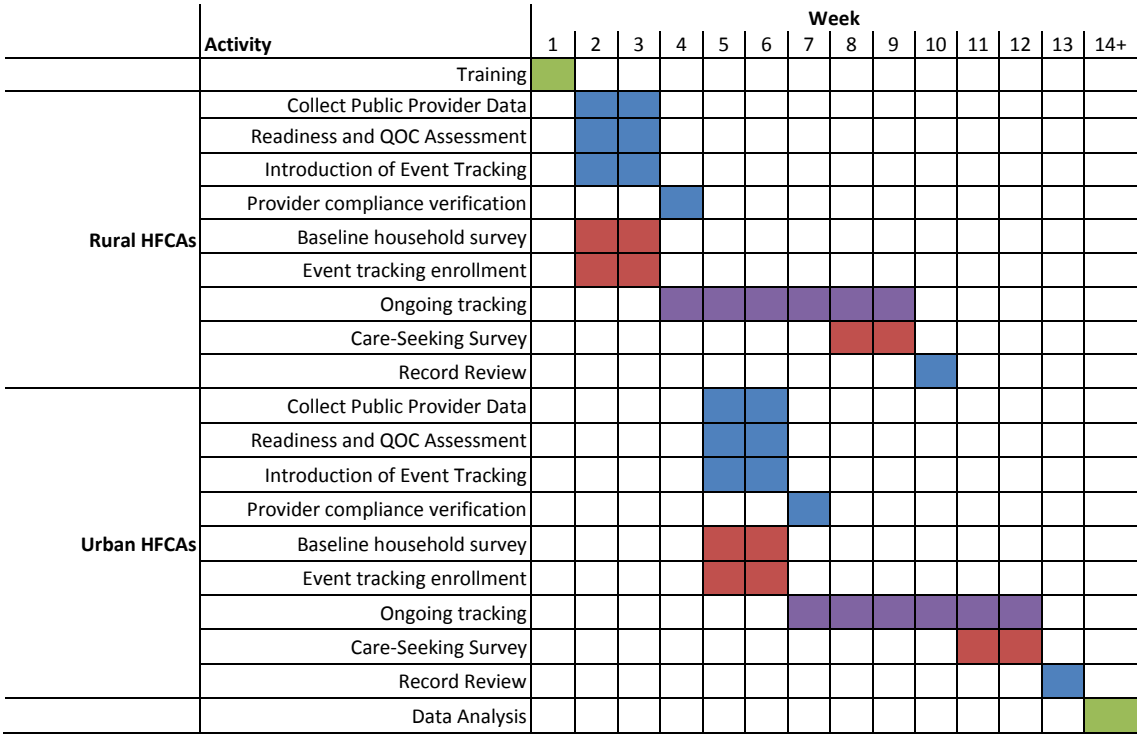
Participating providers will be given a smartphone with a preloaded application for reading barcodes. Providers will scan the barcode and record basic information about the child's diagnosis and treatment. This creates a record of the care-seeking event and the treatment received. Additionally, providers will be given provider-specific tokens. Providers will be instructed to give caregivers these provider-specific tokens when care is sought for a child illness, regardless of whether a child is enrolled in the study. These tokens will used to verify the point of care during the household survey.

Approximately 6 weeks of enrollment, mothers will be administered an Endline Care-seeking Survey modeled off the care-seeking questions contained in the Zambia Demographic and Health Survey (ZDHS). The survey will be conducted using an electronic data capture system on Android mobile phones.

Timeline:
The study will begin in the 3 rural HFCAs. All providers will be surveyed and enrolled. At the same time, the randomly selected households will be screened for eligibility. Eligible household will be enrolled in the event-tracking and a baseline household survey will be conducted.

After completing the baseline survey for all households in the rural HFCAs, we will move to the urban HFCAs. There we will repeat the process of enrolling providers and conducting the baseline household survey.

After completing the baseline survey for all households in the urban HFCAs, we will return to the rural HFCAs. At this time, approximately 4 – 6 weeks after the baseline survey, we will conduct the endline care-seeking survey in all enrolled households. When the endline surveys are completed in the rural HFCAs, we will return to the urban HFCAs to conduct the endline care-seeking survey with enrolled households.


Week
Activity
1
2
3
4
5
6
7
8
9
10
11
12
13
14+
Training
Rural HFCAs
Collect Public Provider Data
Readiness and QOC Assessment
Introduction of Event Tracking
Provider compliance verification
Baseline household survey
Event tracking enrollment
Ongoing tracking
Care-Seeking Survey
Record Review
Urban HFCAs
Collect Public Provider Data
Readiness and QOC Assessment
Introduction of Event Tracking
Provider compliance verification
Baseline household survey
Event tracking enrollment
Ongoing tracking
Care-Seeking Survey
Record Review
Data Analysis

BASELINE HOUSEHOLD SURVEY: OVERVIEW OF THE QUESTIONNAIRE

THE BASELINE SURVEY IS USED TO IDENTIFY AND ENROLL ELIGIBLE CHILDREN IN THE HOUSEHOLD. IT ALSO CAPTURES DEMOGRAPHIC INFORMATION ON THE HOUSEHOLD AND INFORMATION ON MOTHER'S CARE-SEEKING BEHAVIORS AND BELIEFS.

SECTION	WHO IS THE RESPONDENT?
SECTION 1: HOUSEHOLD LOCATION AND SCREENING This section contains information related to the geographical location of the household. The interviewer must complete this information even if the household is not eligible for the study. This section also determines if this is an eligible household. Two screening questions determines eligibility for participation in this survey: 1. Is there a woman in your household between the ages of 15 – 49 years? 2. Does this woman have a child under the age of 5 years? If the household is eligible, you must then complete the Household Consent (Form 2.2).	**Head of Household or Representative** **Administer screening questions in EVERY sampled household**
SECTION 2: HOUSEHOLD MEMBER INFORMATION This section provides an overview of the members residing in the household and will help to identify all members who need to be interviewed. This section also identifies eligible children and prompts you to assign barcodes to eligible children.	**Head of Household or Representative** **Administered in Eligible Households**
SECTION 3: HOUSEHOLD DEMOGRAPHIC INFORMATION This section captures information on the background characteristics of the household head, including questions used to determine the socio-economic status of the household of all members residing in the household.	**Head of Household or Representative** **Administered in Eligible Households**
SECTION 4: MOTHER QUESTIONNAIRE This section is captures basic information about each eligible mother in the household. It also captures information about where she typically takes her child for care and her perceptions about different sources of care in her community. A copy of Section 4 must be completed for all eligible mothers in the household. This section is required for all eligible members. A call back must be made if the woman is not at home at the time of visit.	**All Eligible Mothers**

SECTION 1: IDENTIFYING SELECTED HOUSEHOLDS

SELECTED HOUSEHOLDS ARE IDENTIFIED THROUGH QUESTIONS 1.1 TO 1.3 OF SECTION 1 OF THE BASELINE HOUSEHOLD SURVEY. THIS SECTION MUST BE COMPLETED FOR ALL HOUSEHOLDS. THESE QUESTIONS CAN BE COMPLETED IN ADVANCE BY THE INTERVIEWER.

Households in both the rural and urban areas have been randomly selected to participate in this study.

You will be given the location, GPS coordinates, and the name of the head of household for each selected household.

When you arrive at a selected household, you should first start a new blank "Baseline Questionnaire" on your phone. Before approaching the head of household, you should record the HFCA in which the household is located and the GPS location of the household. The Baseline Questionnaire will prompt you to record both pieces of information, followed by the name of the head of household.

1.1 In what HFCA is the household located?

Select the correct HFCA from the list of HFCAs

1.2 What is the name of the head of household?

Ask for the name of the head of the household. Check that this name matches the name given for the dwelling in that location. If name does not match, asked the head of household or their representative if:

A. The household has moved from that dwelling
B. The household is located nearby and you are at the wrong dwelling

If the household has moved (A) please continue with the recruitment script. If you are at the wrong dwelling (B), please locate the correct dwelling and repeat question 1.2 with the correct household.

1.3 Record the GPS coordinates of this household

Record the GPS coordinates before entering the house. Anything blocking your view of the sky can prevent the phone from taking the GPS reading. It is best to record the GPS location in the yard outside in front of the house. It may take up to 1 minute to get an accurate GPS reading, depending on cloud cover.

ONCE YOU HAVE ESTABLISHED THAT YOU ARE AT THE CORRECT HOUSEHOLD AND HAVE RECORDED THE LOCATION OF THE HOUSEHOLD, YOU SHOULD PROCEED TO INTRODUCE THE STUDY BY ADMINISTERING THE HOUSEHOLD RECRUITMENT SCRIPT (FORM 1.2).

INTRODUCING THE STUDY

WHEN YOU FIRST VISIT A HOUSEHOLD, IT IS IMPORTANT THAT YOU CORRECTLY INTRODUCE THE STUDY AND ASSESS HOUSEHOLD ELIGIBILITY. YOU WILL INTRODUCE THE STUDY USING THE HOUSEHOLD RECRUITMENT SCRIPT (FORM 1.2) EXPLAINED HERE.

First, you should introduce yourself. Say:

"Hello, my name is _____. I work for Chainama College of Health Sciences."

Then explain the purpose of the study. Say:

"We are conducting a study to develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The study is designed to assess where children are taken for care, the treatment they receive, and how best to measure both things. The results will be used to improve maternal and child health programs."

Explain why you are approaching this household. Say:

"We would like for you to participate in this study because we believe you may have a mother of a child under the age of 5 years in your household."

Then you will administer 2 screening questions. The responses to these screening questions will be recorded in Section 1 of the Baseline Household Questionnaire.

"1. Is there a woman in your household between the ages of 15 – 49 years?"

INTERVIEWER INSTRUCTIONS: IF YES, CONTINUE WITH SCRIPT. IF NO WOMAN FITTING AGE REQUIREMENTS, END SCRIPT AND THANK INDIVIDUAL FOR THEIR TIME

"2. Does this woman have a child under the age of 5 years?"

INTERVIEWER INSTRUCTIONS: IF YES, CONTINUE WITH SCRIPT. IF NO CHILD UNDER 5, END SCRIPT AND THANK INDIVIDUAL FOR THEIR TIME

If the household is eligible, you should then briefly explain more about what the study involves. Most households should be aware of the study because of the sensitization activities that have been happening in the community. Say:

"Your household is eligible to participate in this study. If you choose to participate, your child or children under the age of 5 will be given a card with a barcode. This barcode is unique to the child. If the child becomes sick, you should take the card with you when you seek care or treatment for the child. You should present the card to the person giving care to the child. The person giving care to the child will scan the barcode with a phone. This will create a record that the child was taken for care.

We will ask all caregivers to answer a short questionnaire about your household at the beginning of the study.

One to two months later, we will visit you again to ask you a set of questions about any care sought for your child recently."

Help the household feel comfortable with the study. Explain that their information will be kept secret and that participation is completely voluntary. Say:

"We will not share individual information about you or other participants with anyone beyond our research team. Participation in this study is voluntary. You are free to decide if you want to take part or not. If you do agree, you can change your mind at any time. You can refuse to answer any specific questions, or stop participation at any time. If you choose to participate, you will receive a small payment for your participation."

YOU HAVE REACHED THE END OF THE RECRUITMENT SCRIPT. IF THE HOUSEHOLD IS WILLING TO PARTICIPATE, ADMINISTER THE HOUSEHOLD CONSENT (FORM 2.2) AND THEN PROCEED TO COMPLETE THE REST OF THE BASELINE HOUSEHOLD SURVEY.

SECTION 1: SCREENING QUESTIONS

QUESTIONS 1.4 TO 1.6 OF SECTION 1 ARE RELATED TO THE ELIGIBLITY OF THE HOUSEHOLD. THIS SECTION MUST BE COMPLETED FOR ALL HOUSEHOLDS.

WHO TO INTERVIEW: Any adult member of the household who is capable of providing information needed to fill in Sections 1 - 3 can serve as the respondent. If an adult is not available, do **not** interview a young child. Instead, go on to the next household, and call back at the first household later.

Generally you will ask a single individual in the household for the information you will need to complete Sections 1 - 3. However, as appropriate, you may need to consult other members of the household for specific information.

INSTRUCTIONS TO INTERVIEWER: Administer the Household Recruitment Script (Form 2.2). Record the responses to the screening questions on the following screens.

Record the answers to the two screening questions when prompted by the application:

1.4 Is there a woman in your household between the ages of 15 – 49 years?

If yes, you will proceed to the next screen question. If no, the household is not eligible and you will end the interview.

1.5 Does this woman have a child under the age of 5 years?

If yes, the household is eligible and you will be prompted to administer the Household Consent (Form 2.2). If no, the household is not eligible and you will end the interview.

INSTRUCTIONS TO INTERVIEWER: Administer Household Consent (Form 2.2) to the Head of Household or their representative.

1.6 Does the head of household or representative consent to participate?

If yes, you will be prompted to begin Section 2: Household Roster. If the household does not consent to participate you will end the interview.

SECTION 2: HOUSEHOLD ROSTER

THERE ARE TWO SECTIONS WHEN COMPLETING THE HOUSEHOLD ROSTER. FIRST, RECORD INFORMATION ABOUT ALL THE ADULTS AND CHILDREN OVER THE AGE OF 10. SECIOND, RECORD INFORMATION ABOUT ALL THE CHILDREN AGE 10 AND YOUNGER. IT IS VERY IMPORTANT TO RECORD THE ADULTS AND OLDER CHILDREN FIRST.

INTERVIEWER TO SAY: "I am now going to ask you some questions about the members of your household. I would like to ask you about people in your household over the age of 10."

You will then be prompted to record information on each household member including:

2.1 Record household member's name

You should only record the person's first name. If more than one person has the same name in the household then record their unique name or an age identifier.

2.2 Is [NAME] male or female?

2.3 Does name usually live here?

Record if this is the person's primary residence. If they are a visitor, or typically sleep at another residence record 'No'

Examples of people who do not live in a household:
- Someone who has not lived in the household for the past 6 months;
- A child who is a boarding student at school and returns on holidays;
- A groundskeeper/guard/housekeeper/nanny who returns to their own home in the evenings

2.4 How old is [NAME]?

Record person's age in years. You should record each person's age in completed years, that is, the age at the time of the last birthday.

The age of a mother is an important eligibility criterion. If an adult woman is said to be somewhere between the ages of 12 – 55, verify her age by asking the woman.

If the woman **knows** her age, write it in the space provided. If the woman **does not know** her age, you will need to use one of the following methods to estimate her age.

(a) If the **year of birth is known**, compute the woman's age as follows:

- Already celebrated birthday in the current year. If the woman has had her birthday in the current year, subtract the year of birth from the current year [2016].
- Not yet celebrated birthday in the current year. If the woman has not yet had her birthday in the current year, subtract the year of birth from last year [2015].
- Does not know when her birthday is. If the woman does not keep track of the time within a year when her birthday falls, it is sufficient to subtract year of birth from the current year [2016].

(b) If the woman **does not know** her age, and **year of birth is not known**, you will have to probe to try to estimate her age. There are several ways to probe for age:

1) Ask the respondent how old she was when she got married or had her first child, and then try to estimate how long ago she got married or had her first child.

Example: If she says she was 19 years old when she had her first child and that the child is now 12 years old, she is probably 31 years old.

2) Relate her age to that of someone else in the household whose age is more reliably known.

3) Try to determine how old she was at the time of an important event such as war, flood, earthquake, change in political regime, etc. and add her age at that time to the number of years that have passed since the event.

(c) The woman **does not know** her age and probing did not help.

If probing does not help in determining the respondent's age or date of birth, you will have to estimate her age. Remember, this is a last resort to be used only when all your efforts at probing have failed.

2.5 Is there another person >10 years in this household?

You will repeat questions 2.1 – 2.5 for every adult or older child in the household.

2.6 Are you sure there are no other people >10 years in this household?

If 'Yes' no other people > 10 years, you will proceed to the section on children ≤10 years. If 'No' and there is another individual over the age of 10, you will be prompted to go back to the previous screen. Click the Back button to return to the previous screen and enter information on the remaining individual.

It is very important to record information on all of the household members > 10 years before proceeding to the section on children.

INTERVIEWER TO SAY: "I am now going to ask you some questions about the members of your household age 10 years and younger"

2.7 Record child's name
2.8 Is [NAME] male or female?
2.9 Does name usually live here?
2.10 How old is [NAME]?

Record child's age in completed years

2.11 What was (NAME)'s date of birth?

If the child is ≤5 years of age, you will be prompted to record their date of birth. If the head of household cannot recall the child's date of birth, ask the child's mother. If no one can recall the exact date of birth, record the best approximation. For example, the mother can recall the month and year of birth but not exact day of birth. Ask if birth occurred close to a specific holiday or event. Or ask if the birth happened at the beginning (record date 1), middle (record date 15), or end of month (record date 30/31).

2.12 Is (NAME)'s natural mother alive?

If the child is age ≤58 months, you will ask a series of questions about the child's natural mother.

This question is referring to the child's biological mother. By "natural" we mean the biological mother, that is, the woman who gave birth to the child. Someone may consider other people's children whom they are raising their own, especially children of their husband or sisters. So you should be certain that the respondent understands that you are asking about the child's biological mother.

2.13 Does (NAME)'s natural mother usually live in this household?

Record 'Yes' if the child's mother resides in the household and was previously recorded in the adult household roster.

2.14 What is her name?

Select the name of the child's mother from the list. Do not select a blank space. If the mother's name is not listed but she is a member of the household, return to the section on adult household members and record the mother's information.

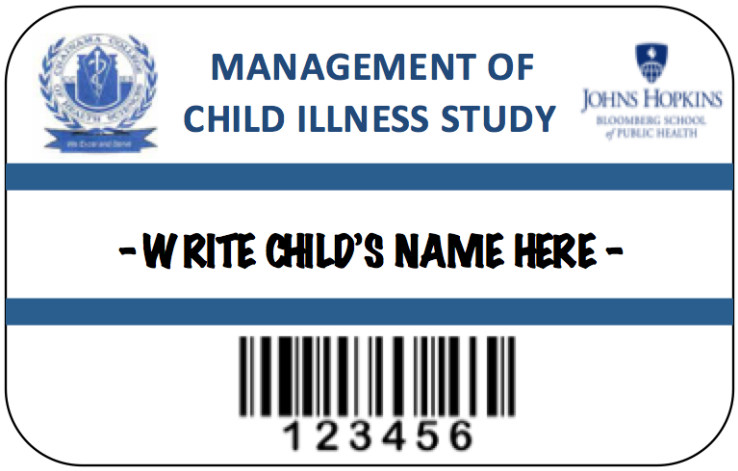
The application will then automatically assess whether or not the child is eligible to participate in the study. A child is eligible if:

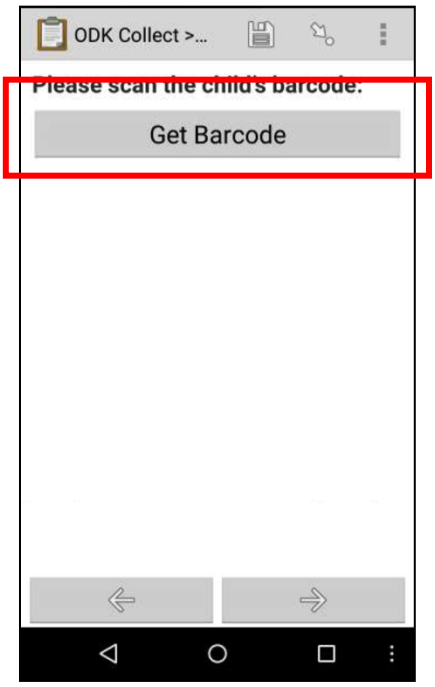
- Child is ≤58 months of age
- Child's natural mother is living and resides in household
- Child's natural mother is between the ages of 15 - 49

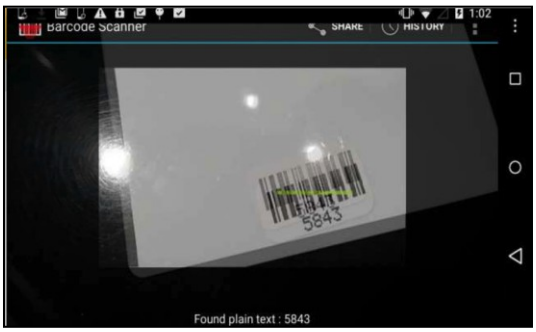
If the child is eligible, you will see the message **"CHILD IS ELIGIBLE"** (Q 2.15)

You will then be prompted to **"Get mother's consent to assign child a barcode"** (Q 2.16). Approach the child's mother and administer Caregiver Consent (Form 2.4).

If mother agrees to participate, you will assign the child a card with a barcode. Write the child's name in the blank on the card. On the next screen, you will be prompted to scan the barcode. Make sure when scanning the code that the recorded barcode number matches the number displayed on the card.







2. Hold Camera over Barcode

2.17 Does any other child live in this household?

You will repeat questions 2.7 – 2.17 for every child ≤ 10 years in the household.

2.18 Just to make sure that I have a complete listing. Are there any other persons such as small children or infants that we have not listed?

If 'No,' no other children, you will proceed to Q 2.19. If 'Yes' and there is another child, you will be prompted to go back to the previous screen. Hit the Back button right to return to the previous screen and enter information on the remaining individual.

It is very important to record information on all of the children in the household before proceeding.

At this point, the application will assess whether the household is eligible again. If no eligible children were identified in the household roster, the application will tell you the household is not eligible and end the interview.

If at least one child was eligible, you will be asked to assign the household a barcode.

2.19 SCAN BARCODE ASSIGNED TO HOUSEHOLD

Place a barcode sticker on an interior doorframe or another place where the sticker will be visible but secure. Scan the barcode assigned to the household. THIS IS A VERY IMPORTANT STEP! WE WILL USE THIS BARCODE TO IMPORT INFORMATION FOR THE ENDLINE SURVEY.

2.20 ENTER BARCODE NUMBER

You will also be asked to record the barcode number. This is the 4-digit number underneath the barcode. You will use this number if the barcode is no longer available at the time of the endline survey.

You will also write this number on a paper listing the households to be visited in the area. Your team supervisor will use this information to track which sampled households have been approached and the outcome of the interview.

After assigning the barcode, you will proceed to Section 3: Household Demographic Information.

SECTION 3: HOUSEHOLD DEMOGRAPHIC INFORMATION

THIS SECTION COLLECTS INFORMATION ON THE HOUSEHOLD, INCLUDING HOUSEHOLD ASSETS. THIS SECTION SHOULD BE ADMINISTERED TO THE HEAD OF HOUSEHOLD OR THEIR REPRESENTATIVE.

INTERVIEWER TO SAY: "I am now going to ask you some questions about your household"

3.1 What is the highest level of education achieved by the head of household?

3.2 What is the main occupation of the head of household?

SELECT ONLY ONE RESPONSE – if more than one occupation, record their primary occupation.

3.3 What is the main source of drinking water for members of your household?

The purpose of this question is to assess the cleanliness of the household drinking water by asking about the household's main source of water. If drinking water is obtained from several sources, probe to determine the source from which the household obtains the majority of its drinking water. If the source varies by season, record the main source used at the time of interview. SELECT ONLY ONE RESPONSE.

Definitions of Water Source Codes	
Response Categories	*Definition*
Piped into dwelling	Pipe connected with in-house plumbing to one or more taps, e.g. in the kitchen and bathroom. Sometimes called a house connection.
Piped to yard/plot	Pipe connected to a tap outside the house in the yard or plot. Sometimes called a yard connection.
Public tap or standpipe	Public water point from which community members may collect water. A standpipe may also be known as a public fountain or public tap. Public standpipes can have one or more taps and are typically made of brickwork, masonry or concrete.
Tube well or borehole	A deep hole that has been driven, bored or drilled with the purpose of reaching ground water supplies. Water is delivered from a tubewell or borehole through a pump which may be human, animal, wind, electric, diesel or solar-powered.
Protected dug well	A dug well that is (1) protected from runoff water through a well lining or casing that is raised above ground level and a platform that diverts spilled water away from the well and (2) covered so that bird droppings and animals cannot fall down the hole. Both conditions must be observed for a dug well to be considered as protected.
Unprotected dug well	A dug well which is (1) unprotected from runoff water; (2) unprotected from bird droppings and animals; or (3) both.
Protected spring	A spring protected from runoff, bird droppings, and animals by a "spring box" which is typically constructed of brick, masonry, or concrete and is built around the spring so that water flows directly out of the box into a pipe without being exposed to outside pollution.
Unprotected spring	A spring that is subject to runoff and/or bird droppings or animals. Unprotected springs typically do not have a "spring box".
Rainwater	Rain that is collected or harvested from surfaces by roof or ground catchment and stored in a container, tank or cistern.
Tanker truck	Water is obtained from a provider who uses a truck to transport water into the community. Typically the provider sells the water to households.
Cart with small tank	Water is obtained from a provider who transports water into a community using a cart and then sells the water. The means for pulling the cart may be motorized or non-motorized (e.g., a donkey).
Surface water	Water located above ground and includes rivers, dams, lakes, ponds, streams, canals, and irrigation channels.
Bottled water	Water that is bottled and sold to the household in bottles.

3.4 Where is the source of water located?

IN OWN DWELLING and IN OWN YARD/PLOT means the water is located in the dwelling or in the yard (such as a well that is in the yard). If the household gets their water from a TANKER TRUCK or CART WITH A SMALL, you would record ELSEWHERE in Q 3.4 because the truck or cart does not reside in the dwelling or yard.

3.5 How long does it take to go there, get water, and come back?

This question is not asked if the source of drinking water is located within the dwelling or yard/plot or if the household relies on rainwater.

Include the time it takes to get to the source, wait to get water, and get back to the house. Record the time it takes to get water by whatever means of transportation the person generally uses, whether the person walks or rides a bicycle or motor vehicle. If the respondent tells you that the water is delivered to their dwelling (a situation that could arise if the water comes from a tanker truck or a small cart with a tank and the truck or cart delivers right to the dwelling), record '0'.

Convert answers given in hours to minutes. For example, "one hour and a half hours" would be '90'.

3.6 Do you do anything to the water to make it safer to drink?

3.7 What do you usually do to make the water safer to drink? Anything else?

The purpose this question is to know whether the household drinking water is treated within the household and if so, what type of treatment is used. The type of treatment used at the household level provides an indication of the quality of the drinking water used in the household. SELECT ALL THAT APPLY.

Definitions of Water Treatment Codes	
Response Categories	*Definition*
Boil	Boiling or heating of water with fuel.
Add bleach/chlorine	Use of free chlorine to treat drinking water. Free chlorine may be in the form of liquid sodium hypochlorite, solid calcium hypochlorite, or bleaching powder.
Strain it through a cloth	Pouring water through a cloth that acts as a filter for collecting particulates from the water.
Use water filter (ceramic/sand/composite/etc.)	The water flows through media to remove particles and at least some microbes from water. Media used in filtering systems usually include ceramic, sand and composite.
Solar disinfection	Exposing water, which is stored in buckets, containers, or vessels, to sunlight.
Let it stand and settle	Holding or storing water undisturbed and without mixing long enough for larger particles to settle out or sediment by gravity.

3.8 How do you store your drinking water?

3.9 What kind of a toilet facility do members of your household usually use?

If the respondent answers in general terms such as "flush toilet," probe to determine where the toilet flushes to. If the respondent answers "latrine", probe to determine the type of latrine. The table below provides definitions for the terms used in Q 3.9.

If you are not able to determine the toilet type based on your conversation with the respondent, ask to observe the facility. SELECT ONLY ONE RESPONSE.

Definitions of Toilet Facility Codes	
Response Categories	*Definition*
Flush/pour flush toilet	A flush toilet uses a cistern or holding tank for flushing water and has a water seal, which is a U-shaped pipe, below the seat or squatting pan that prevents the passage of flies and odors. A pour flush toilet uses a water seal, but unlike a flush toilet, a pour flush toilet uses water poured by hand for flushing (no cistern is used).
• to piped sewer system	A system of sewer pipes (also called sewerage) that is designed to collect human excreta (feces and urine) and wastewater and remove them from the household environment. Sewerage systems consist of facilities for collection, pumping, treating and disposing of human excreta and wastewater.
• to septic tank	An excreta collection device consisting of a water-tight settling tank normally located underground, away from the house or toilet.
• to pit latrine	A system that flushes excreta to a hole in the ground.
• to somewhere else	A system in which the excreta is deposited in or nearby the household environment in a location other than a sewer, septic tank, or pit, e.g., excreta may be flushed to the street, yard/plot, drainage ditch or other location.
Pit latrine	Excreta are deposited without flushing directly into a hole in the ground.
• ventilated improved pit latrine (VIP)	A dry pit latrine ventilated by a pipe extending above the latrine roof. The open end of the vent pipe is covered with gauze mesh or fly-proof netting. If the vent pipe is not covered by a gauze mesh or fly-proof netting, the facility should be classified as a pit latrine with slab not a VIP latrine. The inside of the VIP latrine is kept dark. If the door of the VIP superstructure is missing so that it is no longer dark inside the latrine, the facility should be classified as a pit latrine with slab, not a VIP latrine.
• pit latrine with slab	A dry pit latrine whereby the pit is fully covered by a slab or platform that is fitted either with a squatting hole or seat. The slab or platform should be solid and can be made of any type of material (such as concrete, logs with earth or mud, or cement). The slab or platform should adequately cover the pit so that pit contents are not exposed other than through the squatting hole or seat.
• pit latrine without slab/open pit	A latrine without a squatting slab, platform or seat. An open pit is a rudimentary hole in the ground where excreta is collected.
Composting toilet	A dry toilet into which excreta and carbon-rich material are combined (vegetable wastes, straw, grass, sawdust, ash) and special conditions maintained to produce inoffensive compost. A composting latrine may or may not have a urine separation device.
Bucket toilet	The use of a bucket or other container for the retention of feces (and sometimes urine and anal cleaning material), which is periodically removed for treatment, disposal or use as fertilizer.
Hanging toilet/Hanging Latrine	A toilet built over the sea, a river, or other body of water allowing excreta to drop directly into the water.

3.10 Do you share this toilet with other households?

3.11 How many households use this toilet facility?

We want to find out how many households, including the respondent's household, use the same facility. For example, if the respondent's household shares the toilet with one other household, record "2". If they share it with two other households, record "3".

3.12 Does your household have any of the following items:

The answers to these questions on ownership of certain items will be used as a rough measure of the socioeconomic status of the household. Read out each item and record the answer given after each item. Do not leave any item(s) blank.

If the respondent reports that a household item such as a radio is broken, try to find out how long it has been broken and whether it will be fixed. If the item appears to be out of use only temporarily, record 'Yes'. Otherwise, record 'No'.

3.13 What type of fuel does your household mainly use for cooking?

This question asks about fuel for cooking, not fuel for heating or lighting. The category 'biogas' includes gases produced by fermenting manure in an enclosed pit.

If the household uses more than one fuel for cooking, find out the fuel used most often. If any fuel other than the listed ones is reported as being the main fuel used for cooking, select 'Other' and specify the type of fuel in the space provided. RECORD ONLY ONE RESPONSE.

3.14 Is the cooking usually done in the house, in a separate building, or outdoors?

The purpose of this question is to collect information on the location where food is prepared in the household: in the household, in a separate building, or outdoors. This information is important in providing an indicator of the air quality inside and around the dwelling.

3.15 Do you have a separate room that is used as a kitchen?

3.16 MAIN MATERIAL OF THE FLOOR. RECORD OBSERVATION. RECORD ONE RESPONSE

3.17 MAIN MATERIAL OF THE ROOF. RECORD OBSERVATION. RECORD ONE RESPONSE.

3.18 MAIN MATERIAL OF THE EXTERIOR WALLS. RECORD OBSERVATION. RECORD ONE RESPONSE ONLY.

For Q 3.16 – 3.18, observe and do not ask, if possible. If the interview is being conducted in an area where you cannot observe, then ask the respondent. If the household has more than one building (e.g. a separate structure for cooking; separate quarters for a houseboy), then enter information about the main residence only. RECORD ONLY ONE RESPONSE.

3.19 How many rooms in this household are used for sleeping?

Record the number of rooms that the household uses for sleeping even if that room also serves a second function. For example, if a dwelling unit consists of two rooms: a bedroom and a kitchen, but household members sleep in both the bedroom and the kitchen, record '2' in Q 3.19.

3.20 Does any member of this household own:

If the respondent reports that an item is broken, try to find out how long it has been broken and whether it will be fixed. If the item appears to be out of use only temporarily, record 'Yes'. Otherwise, record 'No'

3.21 Does any member of this household own any agricultural land?

Ask whether any member of the household owns any land that can be used for agriculture. Agricultural land refers to land that is used for growing crops (the crops may be food for people, food for animals, or other non-food crops), raising animals, and grazing animals. In answering this question, common land used to graze animals but not owned by the household should not be included.

3.22 How much lima, acres, or hectares of agricultural land do members of this household own?

If the answer to Q 3.21 is 'Yes', ask Q 3.22 on the number of hectares/ acres/ or lima owned altogether by the members of the household. Only record the size of the land using one type of measurement. If the household owns more than 95 hectares, enter '95.5'. If the number of hectares is unknown, enter '98.8'.

3.23 Does this household own any livestock, herds, other farm animals, or poultry?

Information on whether households own any livestock, herds, poultry or other animals and how many they own is used as an additional indicator of the socioeconomic status of the household.

3.24 How many of the following animals does this household own?

Ask about the type of animals the household owns and how many of each. Read out each item and be sure to record the number in the respective boxes for each item. Do not leave any blank. If the household doesn't own any of a type, record '00'. If a household owns more than 95 of a type of animal, record '95'. If the number of animals is unknown, record '98'.

3.25 Does any usual member of this household have a bank account?

Ask if any member in the household has an account with a bank, credit association or other similar organization in which they can deposit and withdraw funds. Record the appropriate answer. This does not include savings programs at the community level.

SECTION 4: MOTHER QUESTIONNAIRE

THIS SECTION COLLECTS INFORMATION ON EACH ELIGIBLE MOTHER. THIS SECTION CAPTURES INFORMATION ON THE MOTHER'S BACKGROUND AND CARE-SEEKING FOR CHILD ILLNESS. THIS SECTION SHOULD BE ADMINISTERED TO EACH ELIGIBLE MOTHER.

4.1 What eligible mother is being interviewed?

Select the correct respondent from the list of eligible women. All women in the list have been checked against the inclusion criteria and are eligible to be interviewed. You will complete a Section 4 for each of these women.

If you believe a woman is eligible and her name is not listed, please call your supervisor. It is very unlikely that an eligible woman will not be listed. A missing name is probably due to an error in information recorded in the household roster. If on speaking with your supervisor it is decided a missing woman is eligible, select "Other" and record her name when prompted.

INSTRUCTIONS TO INTERVIEWER: Administer Caregiver Consent (Form 2.3) to the eligible mother.

4.2 Does she consent to participate in the study?

You should administer the Caregiver Consent (Form 2.3) to the eligible mother. If she agrees to participate, select 'Yes' and continue with the interview. If she does not consent, select 'No'. You will not interview this mother. If there is another eligible mother, you will be prompted to repeat Section 4 with the next eligible mother.

INTERVIEWER TO SAY: "I am now going to ask you some questions about your background"

4.3 In what month and year were you born?

If the respondent knows her date of birth, record it using the appropriate spaces for MONTH and YEAR. You will need to convert the month into numbers. For this, January is '01', February is '02', March is '03', and so on. If she does not know her month of birth, record '98' for DON'T KNOW MONTH and ask her for the year of her birth. If she knows the year, record it in the spaces for YEAR. Try under all circumstances to obtain at least the year of birth.

If the respondent is unable to provide this information, ask whether she has any documentation such as an identification card or a birth or baptismal certificate that might give her date of birth. Circle '9998' for DON'T KNOW YEAR only if the respondent does not know and cannot provide any record showing her birth date.

4.4 How old were you at your last birthday?

Even if you already asked the respondent her age when you were completing the Household Questionnaire, you must ask again for her date of birth on the Mother Questionnaire.

4.5 Have you ever attended school?

The term "school" means formal schooling, which includes primary, secondary, and post-secondary school, and any other intermediate levels of schooling in the formal school system. It includes technical or vocational training beyond the primary-school level, such as long-term courses in mechanics or secretarial work. However, this definition of school does not include preschool, Bible school or Koranic school, or short courses like typing or sewing.

4.6 What was the highest level of school you attended: primary, secondary, or higher?

Record the highest level the respondent ever attended, regardless of whether or not the year was completed. For example, if she attended secondary school for only two weeks, record SECONDARY.

4.7 What is the highest grade you completed at that level?

For this question, record only the highest grade (form/year) that the respondent successfully completed at that level.

Example: if a woman was attending Grade 3 of secondary school and left school before completing that year, record '02'. Although Grade 3 was the highest year she attended, she completed two years of secondary school.

Note that you will record the number of years completed at the level that was recorded in Q 4.6.

Example: If a woman attended only two weeks of Grade 1 of secondary school, record '00' for completed years.

4.8 Now I would like you to read this sentence to me. SHOW CARD TO RESPONDENT. IF RESPONDENT CANNOT READ WHOLE SENTENCE, PROBE: "Can you read any part of the sentence to me?

You will be provided with cards with 4 simple sentences in Nyanja, Tonga, or English.

Based on your knowledge of the respondent, choose the card with the language in which the respondent is likely to be able to read if she is literate. Show the first sentence on the card to the respondent. Give the respondent enough time to read the sentence; do not rush her. Record whether the respondent was not able to read the sentence at all, was able to read only parts of the sentence, or was able to read the whole sentence. If the respondent asks for a sentence in another language and you were provided a card with sentences in that language, show the respondent the appropriate card. If there is no card with sentences in the language required, circle '4' and specify the language.

It is important to avoid the problem of having other respondents in the household overhear the sentence being read. Subsequent respondents in the household might be able to repeat the sentence when they are interviewed, even if they are unable to read. If there is a second eligible respondent in the household, show her the second sentence on the card. Show the third respondent the third sentence on the card, and the fourth respondent the fourth sentence. If there are more than five respondents, start again with the first sentence on the card.

4.9 What is your religion?

4.10 What tribe do you belong to?

4.11 How long have you been living continuously in (name of Current Place of Residence)?

This question asks how long the woman has been living in the village where she resides. Here, "living continuously" means without having moved away from a locality. For example, if the respondent has been away from her home only on visits, these periods should not count as having lived away. If she has moved from one dwelling to another within the same neighborhood, it also does not count.

If she has always lived in her current place of residence (that is, she has never lived in any other locality), record '95.'

If she has lived in other places, ask her to count how many years she has been living continuously in her current place of residence (how many years have passed since she moved to this locality). Record her answer in completed years.

Example: If the answer is "three and one-half years," write '03.' If the answer is less than one year, record '00.'

4.12 Just before you moved here, did you live in Lusaka, another city, in a town, or in a village?

This question asks about the place the respondent lived just before she moved to her current residence. If she has lived in more than one place before, we want to know which type of place was the last one before her current place of residence.

4.13 What is your marital status?

4.14 What is your main occupation?

4.15 How many children to whom you have given birth are living?

Q 4.15 and Q 4.16 collect information about all births that the woman has had (no matter who the father is). It is important that you understand which events to include. We want to record all of the respondent's natural births. You should record all children who were born alive (that is, who showed signs of life by crying, breathing, or moving) even if they survived only for a few minutes. We want to know about all the woman's births even if the child no longer stays in the household or if the child is no longer alive.

It is also important to understand which events should not be recorded. You must not record adopted or foster children or children of relatives who may be living in the households. You also should not include any of her husband's children to whom the respondent did not give birth herself. Finally, you must not record children who were born dead (stillbirths), miscarriages, or abortions.

4.16 How many children to whom you have given birth have died?

These questions on children who have died are extremely important and are among the most difficult on which to obtain accurate data. Some respondents may fail to mention children who died very young, so if a woman answers 'NO,' it is important to probe by asking, "Any baby who cried, who made any movement, sound, or effort to breathe, or who showed any other signs of life even if for a very short time?" Some respondents may be reluctant to talk about this subject and may become sad or upset that you are asking such questions. Be sympathetic and tactful in such situations. Say that you know the subject is painful but that the information is important.

4.17 Are you pregnant now?

4.18 How many months pregnant are you?

Record the answer in completed months. You may need to check that the woman is responding in completed months.

Example: If the woman answers that she is 'five months pregnant', ask "Are you in your fifth month of pregnancy, or have you completed your fifth month of pregnancy?" Record '04' if she responds she is in the fifth month of pregnancy and '05' if she has completed five months of pregnancy.

If the woman does not know how many months she has been pregnant, probe to get an estimate by asking, for example, about the date of her last menstrual period.

4.19 When your child is sick, how do you know when their illness is serious or severe?

This question is meant to understand how a mother perceives a child's illness is severe. Ask the mother how she knows when her child's illness is severe. For example, are there are any specific symptoms or behaviors that indicate the illness is serious. Record her response in this open-ended question.

4.20 When a child in your household gets sick, where do you generally seek treatment for him/her?

This is referring to the most often used source of care for a sick child. This question is referring to any illness in their children under the age of 5.

4.21 When a child in your household has a serious illness, where do you generally seek treatment for him/her?

4.22 Aside from the places that you have just mentioned, where else might you seek treatment or advice? Anywhere else?

For this question, we want a complete listing of all the providers where a mother might seek treatment for their sick child. This listing should include all health centers, CHWs, private providers, traditional healers, and faith healers a mother might visit when her child is sick. It should also specifically list any shops or kiosks where a mother might purchase medicines for a sick child. It is very important that we get a complete listing of all sources of care. This listing will be used to ensure these providers are included in our event-tracking portion of the study. Select all of the sources of care the mother mentions. For providers mentioned, but not listed, select 'Other' and record the name and location of the provider when prompted.

Questions 4.23 – 4.40 are designed to help us understand mothers' perceptions of different health care providers in her community. The questions ask about a mother's perception of the quality of care offered by different providers in her community. Record the respondent's opinion on each of the questions in relation to ALL sources of treatment. The interviewer should say, "I would like your opinion on the best source of treatment considering each of the following factors. Please consider: the health center, community health workers, private pharmacies & clinics, drug shops, kiosks, traditional providers and faith healers in this community. You can choose more than 1 source for each factor, or indicate that all sources are equally good. Which of these sources has_____." Remember that the respondent can choose more than one source, none, or all of the sources for each of the questions. You should ask for the name of the specific provider.

4.23 Lowest cost for transport to the source
Lowest cost for transport to reach this source of treatment. If the mother says she walks to every source, select all.

4.24 Lowest cost of care at the source
This question refers to the lowest total cost for care, including any fees for consultation, books, tests, medicines, or other services.

4.25 Most easy to reach
This question asks which providers are the most easy to reach. This includes the distance to the provider, as well as the accessibility due to road conditions, terrain, etc.

4.26 Providers that are the most respectful
This question asks which providers she believes are the most respectful to patients.

4.27 Lowest wait time for service
This question asks which providers she believes offer the lowest time to wait to be seen and treated.

Q 4.28 -4.32 ASK FOR MOTHERS PERCEPTIONS ABOUT TREATMENT OF FEVER IN A CHILD <5 YEARS

4.28 Source you usually seek care for most fevers

Where does the mother most often seek care if her child under 5 has a fever? Fever refers to a child with a high body temperature, and includes suspected malaria.

4.29 Providers that are the most knowledgeable about fever
What provider/s does the mother believe are most knowledgeable about treating fevers?

4.30 Most effective treatment for fever
What provider/s does the mother believe offer the most effective (successful) treatment for fever in a child<5?

4.31 Treatment for fever always available
What provider/s does the mother believe that correct treatment for a fever is ALWAYS available?

4.32 Malaria blood testing always available
What provider/s does the mother believe that blood testing for malaria (RDT or microscopy) is ALWAYS available?

Q 4.33 -4.35 ASK FOR MOTHERS PERCEPTIONS ABOUT TREATMENT OF RESPIRATORY ILLNESS IN A CHILD <5

4.33 Source you usually seek care for most respiratory illness
Where does the mother most often seek care if her child under 5 has a respiratory illness? Respiratory illness refers to a situation when the child has cough or difficulty breathing.

4.34 Providers that are the most knowledgeable about respiratory illness

4.35 Most effective treatment for respiratory illness

4.36 Treatment for respiratory illness always available

Q 4.28 -4.32 ASK FOR MOTHERS PERCEPTIONS ABOUT TREATMENT OF DIARRHEA IN A CHILD <5 YEARS

4.37 Source you usually seek care for most diarrhea

4.38 Providers that are the most knowledgeable about diarrhea

4.39 Most effective treatment for diarrhea

4.40 Treatment for diarrhea always available

4.41 You have completed Section 4 for (NAME)

This note will alert you to the end of Section 4 for your eligible mother. A list of all eligible mothers will then be displayed.

4.42 Is there another eligible mother in this household?

If there is another eligible mother in the household who you have not interviewed, select yes and you will complete another Section 4 for this mother. Thank the mother for their time and ask to speak to the next eligible mother. This cycle will continue until you have interviewed all eligible mothers. Once all eligible mothers have been interviewed, select 'No'. Thank the household for their time and end the interview.

END OF THE BASELINE HOUSEHOLD SURVEY. IF THERE IS ANOTHER ELIGIBLE MOTHER YOU WILL REPEAT SECTION 4.

ENDLINE CARE-SEEKING HOUSEHOLD SURVEY: OVERVIEW OF THE QUESTIONNAIRE

THE ENDLINE SURVEY IS ADMINISTERED IN THE PARTICIPATING HOUSEHOLD 4-6 WEEKS AFTER THE BASELINE SURVEY. THIS QUESTIONNAIRE IDENTIFIES IF ANY OF THE PARTICIPATING CHILDREN WERE SICK IN THE PRECEEDING 2 WEEKS. IF A CHILD WAS SICK, THE QUESTIONNAIRE CAPTURES INFORMATION ON HOW THE ILLNESS WAS MANAGED.

SECTION	WHO IS THE RESPONDENT?
SECTION 1: HOUSEHOLD IDENTIFICATION You will be prompted to scan the household barcode to import data on enrolled participants from the baseline survey.	
SECTION 2: DHS QUESTIONNAIRE This section asks basic questions about whether any of a participating mother's children <5 were sick in the preceding 2 weeks. If a child was sick, this section collects information on how the sick child was managed.	**Each enrolled mother, complete for each enrolled child**
SECTION 3: SYMPTOMS This section captures more detailed information on the symptoms the child may have experienced in the past two weeks. Administer questionnaire for each enrolled child.	**Each enrolled mother, complete for each enrolled child**
SECTION 4: SEQUENCE OF CARE This section captures detailed information on the sequence of care a sick child received. Administer questionnaire for each enrolled child with any symptoms in Section 2 or 3. It contains two sections: **Section 4A: Treatment from Home** This part of section 4 addresses treatment for an illness received at home. These questions will only be asked for an illness if the respondent indicated treating the illness at home in Q 4.1 or Q 4.2. **Section 4B: Treatment Outside of Home** This part of section 4 addresses treatment for an illness sought from outside the home. These questions will only be asked for an illness if the respondent indicated treating the illness outside the home in Q 4.1 or Q 4.2.	**Each enrolled mother, complete for each enrolled child**

SECTION 1: HOUSEHOLD IDENTIFICATION

YOU WILL RETURN TO THE SAME ELIGIBLE HOUSEHOLDS WHO CONSENTED TO PARTICIPATE AND ADMINISTER THE ENDLINE SURVEY. SECTION 1 IS USED TO INDENTIFY THE HOUSEHOLD AND IMPORT IMPORTANT FROM THE BASELINE SURVEY INTO THE APPLICATION.

INSTRUCTIONS TO INTERVIEWER: When you arrive in the household, check for barcode on doorframe.

1.1 SCAN BARCODE

If the household barcode can be located, scan the barcode as prompted.

1.2 ENTER THE HOUSEHOLD BARCODE NUMBER RECORDED ON LISTING

Question 1.1 and 1.2 will use the unique number assigned to the household to import information from the Baseline Survey for use in the Endline Survey.

The application will automatically calculate and state "**There are XX children in this household**"

The application will also import the names of the children in the household who were enrolled in the study. You will be prompted to ask mothers a series of questions about each of these children in Sections 2 – 4.

SECTION 2: DHS QUESTIONNAIRE

THESE QUESTIONS ARE MODELED AFTER THE DHS QUESTIONNAIRE AND COLLECT INFORMATION ON CHILD ILLNESS AND MANAGEMENT IN THE PRECEEDING 2 WEEKS. ADMINISTER QUESTIONNAIRE FOR EACH ENROLLED CHILD.

INTERVIEWER TO SAY: "I am now going to ask you some questions about your children enrolled in the study. If you have more than one child enrolled in the study, I will ask about each child separately"

2.1 Select the name of the child who's mother you are interviewing:

You will be given a list of all the children in the household who are under the age of 5 and participating in the study. Ask to speak to the mother of the first participating child. Select the name of the child you will be asking the mother about. If there is more than one participating mother in the household, and the first mother is unavailable, proceed to the available mother and select the name of their child you will be discussing.

2.2 Reenter the name of child

Re-enter the name of the child you will be asking the mother about.

2.3 Has (NAME) had diarrhoea in the last 2 weeks?

Did this child have diarrhea at any point in the preceding 2 weeks? If a respondent is not sure what we mean by diarrhea, tell her it means three or more loose or liquid stools per day. While reading this question, emphasize "in the last two weeks." The last two weeks includes illness that began prior to the 2 week window, but continued into the preceding 2 weeks.

For example: If a child had diarrhea that start 3 weeks ago (21 days ago), but ended 10 days ago. You would select 'Yes,' because the diarrhea was still occurring within the 2-week reference period.

If the child did not have diarrhea, you will skip to question 2.15.

2.4 Was there any blood in the stools?

2.5 Now I would like to know how much (NAME) was given to drink during the diarrhoea (including breastmilk). Was he/she given less than usual to drink, about the same amount, or more than usual to drink? IF LESS, PROBE: Was he/she given much less than usual to drink or somewhat less?

Read the entire question before accepting a response. We are interested in knowing the amount of fluids the child drank. If a respondent says that the child was given "less than usual" probe to determine more specifically if she meant the child was given "<u>much</u> less" than usual or "<u>somewhat</u> less."

2.6 When (NAME) had diarrhoea, was he/she given less than usual to eat, about the same amount, more than usual, or nothing to eat? IF LESS, PROBE: Was he/she given much less than usual to eat or somewhat less?

Note that there is an important difference between the response codes STOPPED FOOD and NEVER GAVE FOOD. The latter is reserved for children who are not yet being given food (e.g., they are only breastfed).

2.7 Did you seek advice or treatment for the diarrhoea from any source?

These questions ask whether advice was sought from someone else on how to treat this episode of diarrhea, for example, advice from a health center, a health worker, or a traditional healer. Record YES if <u>anyone</u> sought advice or treatment for the child's diarrhea (not just the mother).

2.8 Where did you seek advice or treatment? Anywhere else? PROBE TO IDENTIFY EACH TYPE OF SOURCE. IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, WRITE THE NAME OF THE PLACE.

If advice or treatment was sought, you will ask Q 2.8 and probe for all sources. Record each facility or person contacted.

If the respondent does not know whether a facility is public or private, write the name of the facility in the space provided, and inform your supervisor after you complete the interview.

2.9 Where did you first seek advice or treatment?

For women citing more than one source in Q 2.8, probe for the first place where advice or treatment for diarrhea was sought. If the woman mentions a source that is not recorded in Q 2.8, first probe to be sure that advice was sought from the source and then add that source in Q 2.8.

2.10 How many days after the diarrhoea began did you first seek advice or treatment for (NAME)?

Record the number of days after the illness began that advice or treatment was first sought. If treatment was sought the same day the illness began, record '00'.

2.11 Does (NAME) still have diarrhoea?

2.12 Was (he/she) given any of the following to drink at any time since (he/she) started having the diarrhoea:

Women are asked if they gave a child with diarrhea fluid made from a packet of oral rehydration salts (ORS), a pre-packaged ORS liquid, a government-recommended homemade fluid, and/or zinc tablets or syrup. Read out each item and record the answer given for each one. Be sure to record an answer for each item and do not leave any blanks.

2.13 Was anything (else) given to treat the diarrhoea?

These questions ask the mother whether the child received any treatment for diarrhea other than those mentioned in Q 2.12 for this episode of diarrhea. If in Q 2.12 you learned that the child was given fluid from an ORS packet, then ask Q 2.13 by saying, "Was anything <u>else</u> given to treat the diarrhea?" If nothing was given in Q 2.12, ask Q 2.13 by saying, "Was anything given to treat the diarrhea?"

2.14 What (else) was given to treat the diarrhoea? Anything else? RECORD ALL TREATMENTS GIVEN.

If you learn in Q 2.13 that the child was given something to treat the episode of diarrhea, ask Q 2.14 to identify what the mother or anyone else may have given the child. As with Q. 2.13, this question has two versions: Q 2.14a) for children who received anything in Q 2.12 and Q 2.14b) for children who did not receive anything in Q 2.12. After recording a treatment, ask the woman whether "anything else" was given, but do so without implying that something else <u>should</u> have been given.

2.15 Has (NAME) been ill with a fever at any time in the last 2 weeks?

For Q 2.15 record YES only if the fever occurred in the two weeks prior to the date of interview.

2.16 At any time during illness, did (NAME) have blood taken from (his/her) finger or heel for testing?

This question is meant to determine whether the child with fever was tested for malaria. Malaria is diagnosed by taking a few drops of blood from the patient and examining them for the presence of malaria parasites.

2.17 Has (NAME) had an illness with a cough at any time in the last 2 weeks?

Record 'YES' only if the cough occurred in the two weeks prior to the date of interview.

2.18 When (NAME) had an illness with a cough, did (he/she) breathe faster than usual with short, rapid breaths or have difficult breathing?

This question is asked only if the child had a cough in the past two weeks. Short, rapid breathing or difficulty breathing are signs of pneumonia or other acute respiratory infections, which are a principal cause of death among children.

2.19 Was the fast or difficult breathing due to a problem in the chest or to a blocked or runny nose?

The purpose of this question is to better distinguish between respiratory illness that is life threatening and an ordinary runny nose that is less serious.

Questions 2.20 – 2.31 are asked if the child had either a fever or cough. If the child did not have fever or cough, you will skip to Section 3.

2.20 Now I would like to know how much (NAME) was given to drink (including breastmilk) during the illness with a (fever/cough). Was he/she given less than usual to drink, about the same amount, or more than usual to drink?

2.21 When (NAME) had a (fever/cough), was he/she given less than usual to eat, about the same amount, more than usual, or nothing to eat?

2.22 Did you seek advice or treatment for the illness from any source?

2.23 Where did you seek advice or treatment? Anywhere else?

2.24 Where did you first seek advice or treatment?

2.25 How many days after the illness began did you first seek advice or treatment for (NAME)?

2.26 Is (NAME) still sick with a (fever/ cough)?

Question 2.20 – 2.26 should be administered in the same manner as Q 2.5 – 2.11, except in reference to fever and/or cough.

2.27 At any time during the illness, did (NAME) take any drugs for the illness?

Ask the respondent whether the child who had fever/cough in the past two weeks has taken any drugs for the fever and, if so, what drugs the child received. Note that more than one drug may have been administered to the child during the illness. If the child did not receive any drugs for the fever/cough, or if the respondent doesn't know, skip to Section 3.

2.28 What drugs did (NAME) take? Any other drugs? RECORD ALL TREATMENTS GIVEN

If the child received treatment, in Q 2.27, mark all the drugs mentioned by the woman. If available, ask the mother to show you the drugs or their package. Record DON'T KNOW only if she cannot show you the drug or you cannot determine the type of drug given to the child.

If the woman says she gave the child either Quinine or Artesunate, probe to find out the form of the drug. For quinine, record if the drug was a tablet or an injection. For artesunate, record if the drug was given as an injection or as a suppository.

2.29 Did you already have (NAME OF DRUG FROM 2.28) at home when the child became ill? ASK SEPARATELY FOR EACH OF THE DRUGS 'A' THROUGH 'K' THAT THE CHILD IS RECORDED AS HAVING TAKEN IN 2.28.

If the mother reports giving her child an antimalarial (A – G) ask the mother if the drugs had been stored at home prior to the child's illness. This means she did not purchase the drugs or get the drugs from a provider after the child became ill.

If the mother said she gave the child more than one antimalarial or antibiotic, ask this question for each drug.

2.30 How long after the fever started, did (NAME) first take (DRUG(S) FROM 29 A-G)?

This question is asked if the child was given any antimalarial for fever/cough. This question asks about the time interval between the beginning of the child's fever and when he/she took the first dose of an antimalarial treat the fever. If he/she started taking the antimalarial the same day the fever started, record '0' for SAME DAY. If the antimalarial was first given the next day (the day after the fever began), record '1' for NEXT DAY, and so on.

If the mother said she gave the child more than one antimalarial, ask this question for each antimalarial.

2.31 For how many days did (NAME) take the (DRUG)? IF 7 DAYS OR MORE, RECORD 7.

This question is asked if the child was given any antimalarial for fever/cough

This is the end of Section 2. You will proceed to Section 3.

SECTION 3: SYMPTOMS

THIS SECTION CAPTURES MORE DETAILED INFORMATION ON THE SYMPTOMS THE CHILD MAY HAVE EXPERIENCED IN THE PAST TWO WEEKS. ADMINISTER QUESTIONNAIRE FOR EACH ENROLLED CHILD.

3.1 INTERVIEWER TO SAY: You stated previously that your child experienced the following symptoms during the past 2 weeks:

The application will automatically list the symptoms that were reported in Section 2. If no symptoms were reported, nothing will be listed. If nothing is listed, do not read this prompt.

3.2 In the previous two weeks, was [NAME] ill with [SYMPTOM]? PROMPT WITH EACH SYMPTOM

For this question, we want to know if the child had any additional symptoms beyond those discussed in Section 2. Read each symptom and record whether the child had the symptom or not. If 'Fever,' 'Cough,' or 'Diarrhea' were listed in Q 3.1, do not record them under 'Other'. Do not read the possible responses; continue prompting the respondent with "Any other symptoms?" until they say no.

3.3 Were all of these symptoms part of the same illness episode? PROMPT: DID [NAME] RECOVER FROM ONE ILLNESS AND GET SICK AGAIN, OR WERE ALL SYMPTOMS PART OF THE SAME ILLNESS?

We want to know if all these symptoms occurred as part of the same illness. Alternatively, a child may have had to separate illnesses that occurred within 2 weeks. It is possible that the child had more than one illness with the same symptom/symptoms. For example the child could have had fever related to pneumonia, recovered from the pneumonia, and then had fever related to malaria within the same 2 week period. If the mother is unsure, explain:

- SEPARATE ILLNESS: If the child fully recovered from the first illness and then became sick again later
- SAME ILLNESS: If the child's symptoms occurred over a period of time but the child never fully recovered from one illness before another developed.

3.4 FOR EACH SYMPTOM = 1, How long ago did [SYMPTOM] begin?

For each symptom recorded in Section 2 or Q 3.2, we want to record when the symptom began. Determine how many days ago the symptom started by counting backwards from the day of interview. For example, if the interview is on Thursday and the symptom began on Monday, then the symptom began **4 days ago.** If the symptom began today, record '0'. If the mother has difficulty recalling when the symptom began use the calendar to help her remember the correct day and then calculate the number of days since the symptom began.

3.5 FOR EACH SYMPTOM = 1: How many days ago did [SYMPTOM] end?

3.6 IF 1I = 1: How many times did convulsions occur as part of this illness?

If the mother reported the child had convulsions as part of the illness, you will be prompted to ask how many times the child convulsed.

3.7 How many days ago did [NAME] become sick with the most recent illness?

3.8 How many days ago did [NAME] recover from the most recent illness?

BB. If the child is still sick, enter '0'

3.9 How many days ago did [NAME] become sick with the previous illness?

3.10 How many days ago did [NAME] recover from the previous illness?

SECTION 4: SEQUENCE OF CARE

THIS SECTION CAPTURES DETAILED INFORMATION ON THE SEQUENCE OF CARE A SICK CHILD RECEIVED. ADMINISTER QUESTIONNAIRE FOR EACH ENROLLED CHILD WITH ANYY SYMPTOMS IN SECTION 2 OR 3.

4.1 What is the FIRST thing that you did to treat the illness? PROMPT: THIS INCLUDES GIVING MODERN MEDICINES, HERBAL/HOME REMEDIES, PRAYERS, ETC. TREATMENT OF A CHILD IN THE HOME BY A CHW IS CONSIDERED SEEKING TREATMENT OUTSIDE OF THE HOME

'Treatment' refers to **any action** that was taken to try to relieve the child's illness and includes the following: Conventional treatment such as seeing a doctor, nurse or any other healthcare professional; self medication at home; treatments with home remedies; visiting a traditional or faith healer for herbs, worship or prayer, etc. You must make it clear to the respondent that you are not only asking about modern medicine, and that you want to know about any (relevant) action taken to treat the illness. Also, emphasize that this questions asks about SEEKING treatment. It is not until later that the respondent is asked about RECEIVING treatment.

A. Treated at home – select this option if the first thing done to treat the illness was a treatment at home. Treatment at home includes giving the child a medicine that was already stored at home when the illness began. It also includes giving the child an herbal or traditional remedy prepared by an immediate family member. For example, if the mother or grandmother collects plants to treat the child, this is considered treatment at home.

B. Sought Treatment Outside of Home - select this option if the first thing done to treat the illness was to seek care from outside the home. This includes

- visiting the health center or private clinic or doctor
- seeking treatment from a CHW
- seeking treatment from a traditional or faith healer
- going to buy drugs from a shop or kiosk

Even if the CHW or traditional/faith healer visits the home to treat the child, this is still considered treatment outside of the home.

C. Did not treat illness – only select this option if the mother reports nothing was done to treat the illness. Remember, treatment includes giving modern medicines, herbal or home remedies, prayers, etc.

After selecting the first source of treatment, you will complete a series of questions on the type of treatment received from the source. If the child was treated at home, you will complete Section 4A: Home Management. If the child was treated outside of the home, you will complete Section 4B: Outside Management. If nothing was done to treat the child's illness, you will skip to question 4.5. After completing Sections 4A or 4B, **you will return to Q 4.2 to record the next thing that was done to treat the illness.**

4.2 What is the [SECOND/THIRD/FOURTH] thing that you did to treat the illness? PROMPT: THIS INCLUDES GIVING MODERN MEDICINES, HERBAL/HOME REMEDIES, PRAYERS, ETC

4.3 Do you have any other pieces of paper you haven't shown me already?

Ask if the mother has any other tokens that she has not already shown you in Sect 4A or 4B

4.4 RECORD SERIAL NUMBER

4.5 Why was the illness not treated? DO NOT READ RESPONSES. CIRCLE ALL THAT APPLY

SECTION 4A: TREATMENT FROM HOME

THIS PART OF SECTION 4 ADDRESSES TREATMENT FOR AN ILLNESS RECEIVED AT HOME. THESE QUESTIONS WILL ONLY BE ASKED FOR AN ILLNESS IF THE RESPONDENT INDICATED TREATING THE ILLNESS AT HOME IN Q 4.1 -OR- Q 4.2.

4A.1 How many days ago did you treat at home?

This question should be asked in the same manner as the questions about the timing of symptoms. Determine what day treatment was started at home and count backwards from the day of interview. For example, if the interview is on Thursday and the symptom began on Monday, then the symptom began **4 days ago.** If the home treatment began today, record '0'. If the mother has difficulty recalling when the symptom began use the calendar to help her remember

4A.2 When you decided to treat the illness at home, how serious was the illness?

This is a scale question. We are interested in understand the severity of the child's illness at the time of treating at home, relative to treating at other locations. One mother's idea of severity may differ from another mother's idea of severity. Read the statement and each of the responses. Then record the response that the mother most agrees with.

4A.3 Did [NAME] have an RDT performed or a drop of blood taken from his/her finger or heel while at home? CHECK THAT THE RDT HAD BEEN PURCHASED AND STORED AT HOME BEFORE THE ILLNESS

If the respondent is not sure what an RDT is, assess whether a blood test was done for this case of fever by asking if the respondent or child's "finger or heel was stuck with a needle to collect blood." If the respondent says "no," you will skip to Q 4A.5. Remember this section is asking for treatment at home. It is very unlikely that an RDT was performed at home. If the mother says 'Yes,' check that the RDT had been purchased and stored at home before the illness. If the test was preformed by a CHW, this should be recorded as "Treatment outside the home" and you should not record it here.

4A.4 What was the result of the test?

Ask the mother if she remember the result of the RDT. Record whether the RDT showed the child was 'Positive' for malaria or 'Negative' for malaria. If the mother does not remember or was never told the result of the test, record 'Don't Know'.

4A.5 What types of treatment were given to [NAME] at home? READ ALL RESPONSES. RECORD <u>ALL</u> THE RESPONSES THAT APPLY.

This question is essential to ensure the correct series of questions are completed. You should record ALL the responses given. Modern medicines include any sort of manufactured drug from a store, health facility, or other source. If a "modern medicine" was used to treat this case of fever at home, you will need to complete Q 4A.6 – 4A.8 for this illness.

A. **Modern medicines stored at home**: any sort of manufactured drug from a store, health facility, or other source. Remember, to be included in this section the medicine must have been in the home before the illness began.

B. **ORS/ORT**: fluid made from a packet of oral rehydration salts (ORS), a pre-packaged ORS liquid, or a government-recommended homemade fluid

C. **Traditional/herbal/home remedies**: this includes giving the child plants or herbs, performing special prayers or blessings, changing the child's diet, giving the child hot or cold baths, or other traditional practices

D. **Other**: If a treatment does not fit any of these categories – select other and record appropriately

4A.6 What type of medicine was given to [CHILD] at this time? PROMPT: ANYTHING ELSE? CIRCLE ALL THAT APPLY. RECORD BRAND NAME IF TYPE OF MEDICINE IS UNKNOWN

If the child was giving drugs stored at home, record the type/s of the medicine. If possible, ask if the packaging for the drug/s is still available.

4A.7 How many days did you give [NAME] the [MEDICINE]? COMPLETE FOR EACH MEDICINE LISTED IN H6

For each drug recorded in 4A.6, record the number of days the child was given the medicine

4A.8 Was the medicine that you had at home a treatment that you had bought in advance, or a medicine left over from a previous illness episode?

For each drug recorded in 4A.6, ask if the medicine had been purchased in advance in case the child became sick or whether the medicine was leftover from a previous illness.

4A.9 Did you do anything else to treat the illness? PROBE:

After completing this section you will be asked if anything else was done to treat the illness. If 'Yes', something else was done, then you will return to Q 4.2 to record the next place the child was treated. If 'No', you will skip to question 4.3.

SECTION 4B: TREATMENT OUTSIDE OF HOME

THIS PART OF SECTION 4 ADDRESSES TREATMENT FOR AN ILLNESS SOUGHT FROM OUTSIDE THE HOME. THESE QUESTIONS WILL ONLY BE ASKED FOR AN ILLNESS IF THE RESPONDENT INDICATED TREATING THE ILLNESS OUTSIDE THE HOME IN Q 4.1 -OR- Q 4.2.

4B.1 Where did you seek advice or treatment? PROMPT: THIS INCLUDES HEALTH FACILITIES, CHWS, TRADITIONAL OR FAITH HEALERS, SHOPS AND KIOSKS WITH DRUGS.

Use the PROVIDER PHOTOBOOK to help the mother correctly classify the type of provider. If the mother still cannot classify whether a facility is public or private, write the name of the facility in the space provided, and inform your supervisor after you complete the interview.

4B.2 What is the name of the facility or provider that you visited?

Record the exact name of the health facility or the provider from which care was sought. For example, if the mother says she sought care from a CHW in Q 4B.1, ask for the name of the CHW. Record the CHW's name, for example "Michael Banda" in Q 4B.2.

4B.3 How many days ago did you seek care at [PROVIDER]?

This question should be asked in the same manner as Q 4A.1. Determine what day treatment was sought from the provider and count backwards from the day of interview. If the mother has difficulty recalling when the symptom began use the calendar to help her remember

4B.4 Did [name] stay overnight at the [PROVIDER]?

If the provider stated in 4B.1 is a health facility or hospital, you should ask the mother if the child stayed at the facility overnight as an inpatient.

4B.5 When you decided to treat the illness at [PROVIDER], how serious was the illness? READ THE QUESTION AND EACH OF THE RESPONSES. CIRCLE <u>ONE</u> RESPONSE.

This question should be asked in the same manner as Q 4A.2.

4B.6 What mode of transport did you take to get to this place? CIRCLE <u>ALL</u> RESPONSES THAT APPLY

Public transport can include bicycles, taxis, buses and other modes of transportation that were not used through private arrangement. If more than one means of transport was taken to reach the provider, select all forms of transport used.

For example: the mother walked to the main road and from the main road took a mini bus to the health facility. You would record 'Walk' and 'Public Transportation'. If the provider came to the child's house, and was not brought to the house by the mother or family member, select 'None'.

4B.7 How long did it take you to travel there?

Record how long it took for the mother to travel from her home to the provider. Record the time in minutes. If the mother stopped along the way, for example to meet with a friend or perform errands, do not include this time.

For example: the mother says it took her 1 hour and 30 minutes to travel from her house to the provider, but she spent 20 minutes visiting with a friend along the way, record '70' minutes. This should only include the time to REACH the facility. It does not include the time to return home.

4B.8 How much did it cost you to travel <u>to and from</u> this place?

Record, in kwacha, the amount the mother spent travelling to and from this provider. If she only walked, enter '0'

4B.9 Did [NAME] have an RDT performed or a drop of blood taken from his/her finger or heel by this provider?

If the respondent is not sure what an RDT is, assess whether a blood test was done for this case of fever by asking if the respondent or child's "finger or heel was stuck with a needle to collect blood." If the respondent says "no," you will skip to Q 4B.11.

4B.10 What was the result of the test?

4B.11 What types of treatment were given to [NAME] at this time? READ ALL RESPONSES. CIRCLE ALL THE RESPONSES THAT APPLY.

These response categories are the same as in Section 4A:

A. Modern medicines: any sort of manufactured drug from a store, health facility, or other source.

B. ORS/ORT: fluid made from a packet of oral rehydration salts (ORS), a pre-packaged ORS liquid, or a government-recommended homemade fluid

C. Traditional/herbal/home remedies: this includes giving the child plants or herbs, performing special prayers or blessings, changing the child's diet, giving the child hot or cold baths, or other traditional practices

D. Other: If a treatment does not fit any of these categories – select other and record appropriately

It is possible that the child receive more than one type of treatment from a provider. For example, a healer may give the child an herbal concoction and a modern medicine such as paracetamol.

4B.12 What type of medicine was given to [CHILD] at this time? PROMPT: ANYTHING ELSE? RECORD ALL THAT APPLY. NAME IF TYPE OF MEDICINE IS UNKNOWN, SELECT 'OTHER' AND RECORD BRAND.

If 'Modern Medicine' is reported in 4B.11, record the type/s of the medicine. Continue to prompt the mother if any other medicines were given. If possible, ask to see the packaging for the drug/s if it is still available. If you do not know the type of medicine, select 'Other' and record the brand name of the medicine.

4B.13 How many days did you give [NAME] the [MEDICINE]?

For each medicine reported in 4B.12, record how many days the medicine was given to the child.

4B.14 How much money did you pay at this place?

Ask the mother the total amount of money that was paid for services from this provider. This should include any money paid for consultation fees, diagnostic testing, medicines, or books. If a gift or donation is given for services, please record this amount. If a non-monetary gift or payment is made, such as a gift of food or supplies, ask for an estimate of the value of these goods.

4B.15 Who sought treatment from this source?

The child's mother may not have been the person who took the child to the provider for treatment. It may have been another family member or a neighbor. Ask who took the child for care at this source.

For example: If the caregiver stayed home with her sick child, but her husband walked to the pharmacy to buy medicine, he is the individual who sought treatment. You would record 'Spouse.'

4B.16 Is [PERSON WHO TOOK CHILD TO PROVIDER] currently available?

If someone other than the mother you are interviewing took the child for care at this source, ask to speak to this individual to complete the rest of Section 4B for this source.

Questions 4B.17 – 4B.29 should be asked to the individual who took the child for treatment at this source. Questions 4B.17 – 4B.23 are scale questions. Read the statement and each of the responses. Then record the response that the respondent most agrees with.

4B.17 Was the cost of treatment at this source: Very cheap; Somewhat cheap; Somewhat expensive; Very expensive

Ask, in the respondent's opinion, how cheap or expensive they believed the care at the source.

4B.18 Were the providers at this source: Very respectful; Somewhat respectful; Disrespectful; Very disrespectful

Ask, in the respondent's opinion, how respectful they believed the provider.

4B.19 Was getting to this source: Very easy; Somewhat easy; Somewhat difficult; Very difficult

Ask, in the respondent's opinion, how easy was it to reach the provider.

4B.20 Was the wait for service at this source: No time – immediate; A short time; A long time; A very long time

Ask, in the respondent's opinion, how long a wait there was to see the provider after arriving.

4B.21 To handle illness in children under 5, were the provider(s) at this source: Very knowledgeable; Somewhat knowledgeable; Not very knowledgeable; Not at all knowledgeable

Ask, in the respondent's opinion, how knowledgeable they believe the provider is to be in managing illness in a child under the age of 5.

4B.22 How often do you seek care for other child illnesses at this source of treatment: Usually; Sometimes; Rarely; Never

Ask the respondent how often they seek treatment from this source for a sick child.

4B.23 Overall, how satisfied were you with the care you received at this source: Very satisfied; Somewhat satisfied; Somewhat dissatisfied; Very dissatisfied

Ask, in the respondent's opinion, how satisfied they were with the overall care they received at the source.

4B.24 Did you carry [NAME]'s barcode bracelet/card carried when you sought care from [PROVIDER]?

Ask the respondent if they took the barcode card with them when they sought care from the provider.

4B.25 Did [PROVIDER] scan the barcode?

If the respondent took the card when they sought care, ask if the provider scanned the card with a phone.

4B.26 Did [PROVIDER] give you a piece of paper like this [SHOW BAND]?

Ask the respondent if they received a colored slip of paper from the provider. Show the respondent the example of the token, but tell them that the paper could have been any color.

4B.27 Can you show me the paper?

If the respondent reports receiving the paper, ask to see the paper.

4B.28 RECORD SERIAL NUMBER

If the paper is presented, record the serial number on the end of paper. *For example*: This serial number is 73010

4B.29 What color was the paper?

If the paper is lost or not available, ask for the color the piece of paper they received from the source.

4B.30 Did you do anything else to treat the illness?

If 'Yes,' you will repeat Section 4A or 4B for the next source of care. If 'No,' you will return to Q 4.3. If there is another participating child in the household, you will repeat Sections 2 – 4 until the questions have been administered for all children enrolled in the study

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THIS IS THE END OF THE ENDLINE QUESTIONNAIRE. IF MORE THAN ONE ENROLLED CHILD, WILL REPEAT SECTIONS 2 – 4.

ZAMBIA MANAGEMENT OF CHILDHOOD ILLNESS STUDY

FIELD MANUAL FOR SUPERVISORS

Chainama College of Health Sciences
- and -
Johns Hopkins School of Public Health

January 11, 2016

INTRODUCING THE STUDY

WHEN YOU FIRST VISIT A PROVIDER, IT IS IMPORTANT THAT YOU CORRECTLY INTRODUCE THE STUDY AND ASSESS THEIR ELIGIBILITY. YOU WILL INTRODUCE THE STUDY USING THE PROVIDER RECRUITMENT SCRIPT (FORM 1.3) EXPLAINED HERE.

First, you should introduce yourself. Say:

"Hello, my name is _____. I work for Chainama College of Health Sciences."

Then explain the purpose of the study. Say:

"We are conducting a study to develop better ways to measure how children under 5 years of age are treated for common childhood illnesses. The study is designed to assess where children are taken for care, the treatment they receive, and how best to measure both things. The results will be used to improve maternal and child health programs."

Explain why you are approaching this provider. Say:

"We would like for you to participate because we believe you offer treatment for sick children."

Ask the provider to confirm that they offer care for sick children:

"Do you offer care for sick children?"

If the provider says they do offer care for sick children, briefly explain more about what the study involves. Most providers should be aware of the study because of the sensitization activities that have been happening in the community. Say:

"If you agree to participate, we will ask you to participate in one or both of the following activities: care-seeking event tracking, a readiness/quality of care assessment. You may agree to participate in only one or all activities.

<u>Care-Seeking Event Tracking:</u>

If you agree to participate in the Care-Seeking Event Tracking, you will be asked to document children under the age of five that are brought to you for treatment of a childhood illness. We will give you a mobile phone with an application for reading barcodes. Some children in your community have been given cards with barcodes. You will be asked to scan the barcode with the phone. This will create a record that the child was brought to your for care.

We will also give you tokens like these [SHOW TOKEN]. You will be asked to give a token to every caregiver that brings a child under the age of 5 to you for treatment of an illness.

<u>Readiness and QOC assessment:</u>

If you agree to participate in the readiness/quality of care assessment, you will be asked to complete a series of questions about the availability of different supplies and services at this outlet. We will also ask that you respond to a set of case scenarios about the management of a hypothetical sick child.

Help the provider feel comfortable with the study. Explain that their information will be kept secret and that participation is completely voluntary. Say:

"We are not here to inspect your business and no information about this specific outlet will be passed on to the regulatory authorities. We will not share individual information about you or other participants with anyone beyond our research team. Participation in this study is voluntary. You are free to decide if you want to take part or not. If you do agree, you can change your mind at any time. You can refuse to answer any specific questions, or stop the interview at any time. If you choose to participate in the event tracking, you will receive a small payment for your participation."

AFTER INTRODUCING THE STUDY YOU WILL ADMINISTER THE PROVIDER CONSENT (FORM 2.4).

TRAINING PROVIDERS ON EVENT TRACKING

IF A PROVIDER CONSENTS TO PARTICIPATE IN THE EVENT TRACKING YOU WILL TRAIN THE PROVIDER ON THE EVENT TRACKING PROTOCOL. THIS INVOLVES SHOWING THE PROVIDER HOW TO USE THEIR SMARTPHONE, HOW TO RESPOND THE TRACKING QUESTIONNAIRE, AND WHEN TO DISTRIBUTE TOKENS.

TRAINING THE PROVIDER INCLUDES:

1. INSTRUCT ON USE OF PHONE
2. HOW TO ACCESS THE EVENT-TRACKING FORM
3. SUBMITTING COMPLETED FORMS
4. COMPLETING THE EVENT-TRACKING: TREATMENT FORM
5. DISTRIBUTING TOKENS

EVENT-TRACKING: TREATMENT FORM

YOU WILL EXPLAIN THE EVENT-TRACKING TREATMENT FORM TO THE PROVIDER. WALK THE PROVIDER THROUGH THE CONTENT OF THE FORM USING THIS SCRIPT. AFTERWARD YOU WILL HAVE THE PROVIDER PRACTICE USING THE FORM WITH A PRACTICE SCENARIO.

INSTRUCTIONS TO SUPERVISOR: Remind the provider that they should always ask the caregiver if they have a barcode card. If they do, it is important to scan the barcode and record information on how they treated child.

1. Scan the barcode

When the blinking box appears focus the phone's camera on the barcode on the child's card. The phone will automatically read this code. The number embedded in the code will appear on the screen. Check that this number matches the number written underneath the barcode.

2. What is the name of the person who brought this child for care?

Enter the name of the person (adult or older child) who the child for care. Then click the right arrow.

3. What symptoms does the child have?

A list of symptoms will appear. If a child presented with a symptom (either visible at the time of consultation or recalled by the caregiver) click on the name of the symptom. Select all of the child's symptoms. Common symptoms will be listed on the first screen. More severe symptoms/danger signs will appear on the following screen. If the child has an important symptom is not included in the list, you can select 'Other' and type in the additional symptom/s.

4. What diagnostic tests did you perform?

Select all of the diagnostic tests you performed. This includes checking the child for fever.

5. What was the result of the malaria diagnostic test?

If you tested the child for malaria, you will be prompted to record the result of the test. If the lab test is done in a separate facility/room and you do not know the result of the test at the time of treatment, select 'Don't know'.

6. Did you or another health worker:

- **weigh the child**
- **check weight against growth chart**
- **check child's vaccination history**

For each of these 3 actions select either 'Yes' or 'No'

7. What diagnosis(es) did you give?

Record the diagnosis(es) you gave the child. If you diagnosed more than one illness, select each of the illnesses.

8. Is the illness severe?

Depending on the diagnosis you recorded for the child, you may be prompted to record whether or not that particular illness was severe. This is only true for diagnoses where a "severe" illness would change how the child was managed.

9. What treatment have you prescribed?

You will be prompted to record the treatment you prescribed for the child. Treatment includes prescribing drugs (antimalarials, antibiotics, ORS, etc), prescribing herbs, traditional medicine, or prayer. It can also include referring the child to another healthcare provider, such as the hospital.

You may have given the child more than one type of treatment.

For example: You diagnosed severe malaria and gave the child an antimalarial and referred them to the hospital. You would select both "Referred to another provider" and "antimalarial".

If you prescribe a medicine for the child, but it is currently out of stock, you should still record the prescription here. We will collect information about stocked out prescriptions later.

If you gave the child a medicine, you will be asked for the type of medicine you gave the child. You will be asked to select the generic name of the medication you gave. If the type of medicine is not listed, or you are not sure of it's generic name, you should select 'Other' and type the brand name.

10. What is the name of the provider you referred the child to?

If you indicated in Q 9 that you referred the child to another provider, you will be asked to record the name of that provider here.

11. What was the formulation of the [DRUG] prescribed?

If you indicated you gave the child an antibiotic or antimalarial you will be asked to specify the formulation of the drug: tablet, dispersible tablet, syrup/suspension, injection/IV, or suppository.

12. What was the dosage of the active ingredients in the [DRUG] you prescribed?

13. How many tablets of [DRUG] did you prescribe for the child?

You state you gave the child a tablet or dispersible tablet form of cotrimoxazole, amoxicillin, artemether-lumefantrine, DHA-PPQ, quinine, or zinc, you will be asked to select the dosage of drug. If it is a known dosage, you will then be asked to record the number of tablets prescribed. This should be the total number of tablets, not the per-day number of tablets.

14. Were any of the medications you prescribed out of stock?

15. Which medication/s was out of stock?

If any of the medications you prescribed in Q 9 were out of stock, please indicate this here. You will be asked to specify which medication/s was out of stock.

16. Did you tell the caregiver where the purchase the medication/s?

17. Where did you tell the caregiver to purchase the medication/s?

If a medicine was stocked out please indicate if you instructed the caregiver where they could purchase the stocked-out drug. Please specify the provider you instructed the caregiver to visit to purchase the medications.

18. Did you counsel the caregiver on management of the illness at home?

Did you instruct the caregiver how to give the treatment at home? Did you inform the caregiver of any complications or worsening symptoms to look out for? If you did counsel the caregiver, select 'Yes'.

THIS IS THE END OF THE EVENT-TRACKING TREATMENT FORM. ASK IF THE PROVIDER HAS ANY QUESTIONS. HAVE THE PROVIDER PRACTICE WITH THE PHONE USING YOUR PRACTICE SCENARIO.

DISTRIBUTING TOKENS

Give the provider their designated tokens.

Please instruct the provider that they should give a token to any caregiver bringing a child for care.

Even if the child does not have a barcode card and is not enrolled in the study, they should still give the token to the mother or caregiver that brought the child. Tell the provider they should instruct the caregiver to store the token at home.

PROVIDER READINESS ASSESSMENT: OVERVIEW

IF A PROVIDER CONSENTS TO PARTICIPATE IN THE READINESS ASSESSMENT YOU WILL ADMINISTER THE PROVIDER READINESS ASSESSMENT.

SECTION	WHO IS THE RESPONDENT?
SECTION 1: PROVIDER INFO AND SERVICES This section collects basic information about the location of the provider, hours of operation, available services, and cost of services. This section also collects information on the type and number of staff members at the outlet.	**Highest-Ranking Staff Member**
SECTION 2: CHILD HEALTH SERVICES This section collects information on the type of child health services offered by the outlet. It also asks about training and job aides for providing child health services.	**Member of Staff in Charge of Child Services**
SECTION 3: INFRASTRUCTURE This section captures information on the outlet's infrastructure, including communications, emergency transport, power, basic amenities and infection control.	**Highest-Ranking Staff Member**
SECTION 4: SUPERVISION This section is captures information on the most recent supervision visit from the DHMT or other regulatory body. This section is only administered to health centers, CHWs, and pharmacies.	**Highest-Ranking Staff Member**
SECTION 5: EQUIPMENT AND SUPPLIES This section collects information on the availability of basic health equipment, diagnostic supplies, and medicines.	**Staff in Charge of Pharmacy or Lab**

SECTION 1: PROVIDER INFO AND SERVICES

THIS SECTION SHOULD BE ADMINISTERED TO THE HIGHEST RANKING STAFF MEMBER. QUESTIONS 1.1 – 1.5 CAN BE COMPLETED BEFORE SPEAKING WITH THE PROVIDER. IF UNCERTIAN ABOUT Q 1.4 - 1.5, ASK STAFF MEMBER.

1.1 Enter provider of facility name

Record the name of the facility or health provider. If the outlet is a business or other facility with multiple staff, record the name of the facility (ex. Choma Chemist). If the outlet is an individual such as a CHW or traditional healer, record the name of the individual (ex. Michael Banda).

1.2 Record the GPS coordinates of this provider

Record the GPS coordinates before entering the facility/business/home. Anything blocking your view of the sky can prevent the phone from taking the GPS reading. It is best to record the GPS location in the yard outside in front of the outlet. It may take up to 1 minute to get an accurate GPS reading, depending on cloud cover.

1.3 In what HFCA is the provider located?

Select the correct HFCA from the list of HFCAs

1.4 What is the provider's managing authority?

Identify the provider's managing authority:

- **Government/public**: This includes health centers and CHWs that are paid and managed by the Government of Zambia/Ministry of Health
- **NGO/Not-for-profit**: This includes health workers or facilities that are maintained by a non-profit organization, such as a Marie Stopes Clinic
- **Mission/Faith-based**: This includes mission clinics or facilities managed by a faith-based organization
- **Private for profit**: This includes all other providers, such as private clinics, traditional healers, faith healers, pharmacies, drug shops, and kiosks

1.5 What type of provider is this?

Select the appropriate provider type

THE FOLLOWING QUESTIONS 1.6 – 1.17 SHOULD BE ADMINISTERED TO THE HIGHEST RANKING STAFF MEMBER

1.6 Does the outlet currently offer any of the following services:

You will ask about each service individually. Read the type of service and select either 'yes' or 'no'. Record the providers response, regardless of you opinion of their services. For example: if a traditional healer says they treat HIV, and you know this means treatment with traditional remedies rather than medicines, still record H = 'Yes'

A. **Treat sick children <5 years**: offer curative services for sick children including diagnosis and/or treatment of illness. Treatment can include medicines, traditional remedies, or prayers.
B. **Immunization**: provide vaccines
C. **Routine health check-ups**: provide services for healthy children to ensure proper growth and development
D. **Sell/provide medicines**: sell or provide medicines either with or without consultation. Ex: CHW may be trained to diagnose and refer children, but may not be given medicines to treat children – select 'No'. Ex: kiosk sells paracetamol but does not assess children – select 'Yes'.

E. **Treat sick adults or children over 5 years of age**
F. **Disease prevention**: includes selling/providing water treatment, mosquito bed nets, IRS, etc
G. **VCT:** offer voluntary counseling and testing for HIV
H. **HIV Treatment:** offer treatment for HIV
I. **Family planning, including spacing methods:** offer counseling on family planning, sell/provider family planning commodities (condoms, oral contraceptives, IUD), or perform family planning surgeries (vasectomies or tubal ligation, etc)
J. **Antenatal care:** provide health services for pregnant women, such as blood pressure monitoring and antenatal vitamins
K. **Delivery care:** attend births
L. **Cesarean section**: offer cesarean sections
M. **Postnatal care:** offer services for newborns and/or mothers

AT THIS POINT THE APPLICATION WILL AUTOMATICALLY ASSESS THE PROVIDERS ELIGIBILITY FOR THE PROVIDER ASSESSMENT. IF THE PROVIDER REPORTS PROVIDING EITHER (A) TREATMENT OF SICK CHILDREN OR (D) SELL/PROVIDE MEDICINES, THEY ARE ELIGIBLE AND YOU WILL CONTINUE TO Q 1.7. IF THEY DO NOT OFFER EITHER SERVICE, YOU WILL END THE INTERVIEW. THEY ARE NOT ELIGIBLE TO PARTICIPATE IN THE STUDY.

1.7 Does provider charge for any services offered at the outlet?

This includes monetary fees as well as required donations or gifts

1.8 Do you accept payment in installments for any of these services?

If patients are allowed to pay for the services on credit (not at the time of service) or pay for the service incrementally select 'Yes'.

1.9 Does provider charge for any of the following in the treatment of sick children?

If the provider states they charge for services, ask about specific charges for <u>services for sick children</u>.

A. **Consultation:** fee to assess/test a sick child
B. **Diagnostic tests:** fee for specific diagnostic tests
C. **Medicines/treatment**: fees for medicines or other treatments

1.10 On average, how much do you charge for a child consultation?

This fee should exclude costs for specific tests and medications. If a flat fee is charged regardless of treatment given, record cost here. If the provider does not require a monetary fee, but rather is paid in gifts or donations, ask them to estimate the approximate value of those gifts.

1.11 On average, how much do you charge for medicines to treat the following illnesses in children under 5?

For each illness (uncomplicated malaria, uncomplicated respiratory illness, and uncomplicated diarrhea) ask for the average cost of treatment if the patient is under 5 years of age. If the provider is uncertain, ask them to think about the medicines or treatment they would prescribe for the illness in a child. Then ask them to estimate the cost of that treatment.

1.12 On average, how much do you charge for a malaria diagnostic test?

This includes either RDTs or microscopy.

1.13 What days of the week is the outlet open?

Record the number of days of the week is outlet is open for normal services. Do not include emergency services.

1.14 How many hours per day is this facility open from Monday - Friday?

1.15 How many hours is this facility open on Saturday?

1.16 How many hours is this facility open on Sunday?

Q 1.14 – 1.16 refer to the hours for regular services, and should not include emergency care. If individual does not have posted hours, ask that they estimate the average number of hours they provide services in an average day.

1.17 How much time does a provider typically take to attend to an emergency?

If an emergency occurs outside of posted hours, how long does it typically take for a clinical staff member to attend to the emergency? This includes the time for the staff member on-call to be notified of the emergency and then reach the facility or location of the emergency.

INPATIENT SERVICES: Q 1.18 – 1.19 ARE ONLY ADMINISTERED TO HEALTH FACILITIES THAT HAVE THE POTENTIAL TO OFFER INPATIENT SERVICES

1.18 Does facility offer inpatient services?

Inpatient services refer to admitting patients to stay at the facility overnight or for multiple days. This is a service that is typically reserved for higher-level facilities that can treat severe illnesses.

1.19 Excluding any delivery beds, how many overnight/inpatient beds in total does this facility have, both for adults and children?

If a facility offers inpatient services, ask how many inpatient beds the facility has for both adults and children. This count should excluded beds reserved for pregnant/recently delivered women.

STAFFING: Q 1.20 – 1.21 ARE ONLY ADMINISTERED TO DRUG RETAILERS WHICH MAY HAVE LICENSED PROVIDERS

1.20 Do you or any of your staff members have a clinical or pharmacy qualifications?

We are interested in understanding if drug retailers have trained pharmacists or other clinically trained staff. Even a traditional or faith healer may have received some form of community health worker training.

1.21 What qualifications do you or your staff members have?

STAFFING: Q 1.22 IS ONLY ADMINISTERED TO HEALTH FACILITIES WITH MULTIPLE STAFF

1.22 How many staff with each of the following qualifications are currently assigned to, employed by, or seconded to this outlet?

For each staff type, record the correct number of that staff type at the outlet. If a facility doesn't have any staff of a specific type, record '0' for that category. If the facility has another type of clinically trained staff member, but the category is not listed, select 'Other' and record the information. Do not include non-clinical staff, such as cleaners with no health training.

SECTION 2: CHILD HEALTH SERVICES

THIS SECTION SHOULD BE ADMINISTERED TO THE HIGHEST RANKING STAFF MEMBER OR MEMBER OF STAFF MOST FAMILIAR WITH CHILD HEALTH SERVICES.

2.1 Please tell me if this facility provides the following services:

Read each service and select either 'Yes' or 'No'

2.2 What sort of referral services do you offer?

If a provider say they refer children with severe or complicated illness (2.1 J = 'Yes'), ask if the referral is facilitated (they provide an ambulance or some means of transport to the facility) or verbal (tell caregiver where to take child, but does not give support to reach facility).

2.3 What provider do you refer children with severe or complicated illness to?

Record the name of the referral facility.

2.4 Please tell me if the following documents are available in the facility today:

a. **IMCI guidelines for the diagnosis and management of childhood illnesses**
b. **Any check-lists and/or job-aids for IMCI**

Ask to see these documents if they say they are available.

2.5 Have you or any provider(s) of curative care services for sick children received any training in the Integrated Management of Childhood Illnesses (IMCI) in the last two years?

SECTION 3: INFRASTRUCTURE

THIS SECTION SHOULD BE ADMINISTERED TO THE HIGHEST RANKING STAFF MEMBER OR MEMBER OF STAFF MOST FAMILIAR WITH THE AVAILABILITY OF THESE ITEMS.

3.1 Does this outlet have any of the following communication devices in functioning condition?

Read each device type. Select all devices the outlet has that are in functioning condition.

AMBULANCE/EMERGENCY TRANSPORT: Q 3.2 – 3.4 ARE ONLY ADMINISTERED TO HEALTH FACILITIES THAT HAVE THE POTENTIAL TO OFFER INPATIENT SERVICES

3.2 Does this facility have a *functional ambulance* or other vehicle for emergency transportation for clients that is stationed at this outlet or operates from this outlet?

3.3 Is fuel for the ambulance or other emergency vehicle available today?

3.4 Does this facility have access to an ambulance or other vehicle for emergency transport for clients that is stationed at another facility or that operates from another facility in near proximity?

POWER SUPPLY: Q 3.5 – 3.6 ARE ADMINISTERED TO ALL PROVIDERS

3.5 Does this outlet have electricity from any source (e.g. electricity grid, generator, solar, or other) including for stand-alone devices (EPI cold chain)?

3.6 During the past 7 days, was electricity available at all times from the main or any backup source when the facility was open for services?

BASIC CLIENT AMMENITIES: Q 3.7 – 3.11 ARE ADMINISTERED TO ALL PROVIDERS

3.7 What is the *most commonly used* source of water for the outlet *at this time*?

Select the most commonly used source of water. If services are typically provided at a patient's home, select the type of water source that is most commonly available in the community. These water sources are the same as in the Baseline Household Questionnaire. Refer to the data collector manual for detailed explanations of each category.

3.8 Is a water outlet from this source available within 500 meters of the outlet?

3.9 Is there a room with auditory and visual privacy available for patient consultations?

Is there a room at the facility or the provider's business/home where the provider can have a consultation with a patient in private, away from other patients?

3.10 Is there a toilet (latrine) in *functioning condition* that is available for general client use?
CC.

3.11 What type of toilet?
DD.

These toilet types are the same as in the Baseline Household Questionnaire. Refer to the data collector manual for detailed explanations of each category. If multiple toilets are available, consider the most modern type.

INFECTION CONTROL: Q 3.12 IS ONLY ADMINISTERED TO HEALTH FACILITIES, CHWS, AND PHARMACIES. Q 3.13 IS ADMINISTERED TO ALL PROVIDERS.

3.12 Does this facility have any guidelines on standard precautions for infection prevention?

3.13 Please tell me if the following resources/supplies used for infection control are available in the general outpatient area of this facility today.

For each item, ask if the provider has the item for cleanliness or preventing infection/contamination. If they say 'yes', ask to see the item. Specify whether the item was observed.

SECTION 4: SUPERVISION

THIS SECTION SHOULD BE ADMINISTERED TO THE HIGHEST RANKING STAFF MEMBER OR MEMBER OF STAFF MOST FAMILIAR WITH SUPERVISION VISITS. THESE QUESTIONS WILL ONLY BE ADMINSTER TO HEALTH FACILITIES, CHWS, AND PHARMACIES THAT HAVE A SUPERVISORY STRUCTURE.

4.1 When was the last time this outlet received a supervision visit from the higher level (DHMT or other)?

Supervision structures vary by provider type and may not exist for some providers:

- **Government health facilities:** supervision visit from the DHO or other MOH body
- **Private or mission facilities**: supervisory body that ensures the facility meets specific standards
- **CHWs**: facility staff, district staff, or a program-specific staff member that supervise CHW
- **Pharmacy**: Pharmacy regulating authority

4.2 During the supervision visit, did the supervisor assess the following?

Read each item and select 'Yes' or 'No'.

SECTION 5: EQUIPMENT AND SUPPLIES

THIS SECTION SHOULD BE ADMINISTERED TO THE HIGHEST RANKING STAFF MEMBER, LABORARTORY TECHNICIAN, OR PHARMACIST AS APPROPRIATE.

5.1 Please tell me if the following basic equipment and supplies used in the provision of client services are available and functional in this facility today.

For each item, ask if the item is available at the outlet. If the item is available, ask to see the item and then record whether or not it is functioning.

Items A – J will be asked among all providers.
Items K – R will only be asked among health facilities.

INSTRUCTIONS TO INTERVIEWER: Ask to be shown the location in the facility where malaria services are provided. Find the person most knowledgeable about malaria services in the facility. Introduce yourself, explain the purpose of the survey and ask the following questions.

5.2 Do providers in this outlet diagnose malaria?

5.3 Which of the following methods are used at this facility for diagnosing malaria?

Read each of the 3 methods for diagnosing malaria and select 'Yes' or 'No' for each as appropriate. A facility may use more than one method for diagnosing malaria.

5.4 Does this facility have malaria rapid diagnostic test kits (with valid expiration date) in stock in this service site today?

If the outlet states they use RDTs, ask to see an RDT. There should be an expiration date printed on the box. IF you observed a valid RDT (not expired) select 'YES, OBSERVED'. If the outlet reports they have valid RDTs in stock, but you are not able to observe the RDT, select 'YES, REPORTED NOT SEEN'

5.5 Has there been a stock-out of malaria RDT kits in the past 4 weeks?

5.6 How many days of stock-out?

Ask if the provider has stocked out of RDTs at any point in the previous 4 weeks. If there was a stock out, record the total number of days in which there were no RDTs.

5.7 I would like to know if the following general equipment items are available and functional today.

If the outlet reports they use microscopy to diagnose malaria, ask to see the following items related to malaria microscopy. For each item, record whether you 'Observed' the item, if the item was 'Reported Not Seen,' or 'Not available'. If an item is either observed or reported to be available, record whether the item is functioning.

5.8 Does this outlet have an accredited/certified microscopist?

5.9 Do you have the national guidelines for the diagnosis and treatment of malaria available in this outlet today?

If available, ask to see the document.

5.10 Have you or any provider(s) of malaria services received any training in malaria diagnosis with RDTs in the last two years?

5.11 Have you or any provider(s) of malaria services received any training in malaria treatment in the last two years?

Note that this question is asking about training for malaria treatment, which may include malaria diagnosis or management.

THE APPLICATION WILL AUTOMATICALLY CHECK IF THE PROVIDER REPORTED THEY SELL OR PROVIDE MEDICINE IN Q 1.6 = D. IF THE PROVIDER SELLS/PROVIDES MEDICINES, YOU WILL BE PROMPTED TO ASK Q 5.12 – 5.13 ON THE AVAILABLITY OF ESSENTIAL MEDICINES FOR CHILDREN.

INSTRUCTIONS TO INTERVIEWER: Ask to be shown the main location in the facility where medicines and other supplies are stored. Find the person most knowledgeable about storage and management of medicines and supplies in the facility. Introduce yourself, explain the purpose of the survey and ask the following questions.

5.12 Are any of the following medicines available in the outlet today?

For each medicine, ask if the drug is ever available at the outlet. If it is available ask to observe the medicine and record whether or not at least one of the packages is valid. If the drug is sometimes available, but not currently in stock, ask if the drug has been out of stock for more or less than 1 week.

5.13 Has there been a stock-out of the below drug in the past 3 months?

For each medicine, ask if the drug has been out-of-stock at any point in the past 3 months.

THIS IS THE END OF THE PROVIDER READINESS ASSESSMENT. YOU WILL PROCEED TO CONDUCT THE QOC ASSESSMENT WITH ONE OR MORE STAFF MEMBERS.

QUALITY OF CARE ASSESSMENT

FOR EACH PROVIDER THAT OFFERS CHILD CURATIVE SERVICES, YOU WILL ADMINISTER AT LEAST ONE QUALITY OF CARE ASSESSMENT. THE QOC ASSESSMENT INCLUDES 5 "CASE SCENARIOS" WHICH PRESENT 5 HYPOTHETICAL SICK CHILDREN.

Who to Interview:

Individual Provider: If the outlet is a single individual, such as CHW or traditional healer, you will administer the QOC assessment to that individual.

Facility or business with multiple staff: If an outlet has more than one staff member that treats sick children, you will administer the question to a sample of the staff members.

Using the "Staffing" section of the Provider Readiness Assessment, identify if there is more than one cadre of health worker at the outlet that treats sick children. The cadres are the staff positions used in the "Staffing" section, such as "clinical officer," "nurse," etc.

In a facility, if a pharmacists or laboratory technicians only fills prescription or perform tests, these cadres should not be included in the assessment. However, pharmacists should be included at a pharmacy or chemist where a caregiver may present the sick child to the pharmacist for consultation.

Within a facility, you should interview all staff members on duty that perform clinical assessment of children. Within a cadre, if there more than 5 staff members on duty, take a random sample of 5 staff members. If there are fewer than 5 staff members within the cadre on duty, interview all consenting staff members. If no one from a cadre is on-staff at the time of the QOC assessment, schedule a time to return to the facility to administer the case scenarios to at least one member of the absent cadre.

For example: A health facility has 1 medical doctor, 3 clinical officers, and 10 nurses of staff. At the time of the assessment, the medical doctor is not available, 2 clinical officers are available, and 7 nurses are available. You should:

- Interview all 2 clinical officers
- Select 5 nurses to interview
- Set a time to return to interview the medical doctor

How to Administer the QOC Assessment:

The QOC case scenarios will take approximately 10 minutes to complete per staff member and will be completed in a private location. After identifying a respondent, administer the QOC Provider Consent (Form 2.5). This a verbal consent form. Do not record the respondent's name. Instead, if they agree to participate you will sign the consent form indicating their agreement. If this is the person you consented for the Readiness Assessment, you do not need to administer Form 2.5.

Start a blank "QOC Assessment." Record the outlet name and the staff member's qualification.

You will read the full case scenario and ask the provider how the child would be managed. You should NOT read the potential responses. Continue to prompt the respondent with "Anything else?" until they say "no".

If the provider states an action that is included in the list of responses, select the response. Select as many matching responses as the provider states. There are many correct answers. If the provider gives an action that is not listed, do not select anything. This question does not give the option for adding additional responses. After completing all 5 case scenarios, thank the respondent for their time and proceed to the next staff member.

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controlled trial. 2015 [cited 2016 Dec 13]; Available from: http://www.trialsjournal.com/imedia/4057088391761923_manuscript.pdf

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Curriculum Vitae

EMILY DARE CARTER

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EDUCATION AND TRAINING

Degree	Year	Institution	Field
PhD	2017	Johns Hopkins School of Public Health, Baltimore MD	International Health / Global Disease Epidemiology and Control
MSPH	2014	Johns Hopkins School of Public Health, Baltimore MD	International Health / Global Disease Epidemiology and Control
BA	2010	University of North Carolina, Chapel Hill, NC	Biology & International American Studies

PROFESSIONAL EXPERIENCE

Research Assistant 2013 - Present Johns Hopkins School of Public Health – Institute for International Programs

Principal Responsibilities:

- Designed, implemented, and analyzed study on management of childhood illnesses in Zambia, including validating maternal report of care-seeking behavior and linking household and health care provider data for improved estimation
- Developed code and evaluated procedure for generating sub-regional estimates using displaced Demographic and Health Survey cluster coordinates
- Developed and implemented study of the cost and cost-effectiveness evaluation of the Rapid Scale-up for MNCH in Malawi
- Conducted systematic review on harmful practices in diarrhea treatment in children

Research Assistant 2012 - 2013 Johns Hopkins School of Public Health – International Health Department

Principal Responsibilities:

- Developed and implemented tools and protocols for mixed-method experiential education program evaluation
- Analyzed data including pre-post psychometric survey, key informant interviews, and focus group discussions

Malaria and Child Survival Associate 2010 - 2012 Population Services International

Principal Responsibilities:

- Provided technical support for research projects in Southeast Asia and sub-Saharan Africa including: 1) household surveys on treatment of child illness, 2) antimalarial availability outlet surveys, 3) evaluation of community case management programs
- Managed technical proposals, research contracts, timelines, and budgets
- Created study protocols, data collection tools, and delivered multi-day trainings
- Supervised field work, data quality, data entry and management
- Developed proposals, logical frameworks, project reports/presentations, recommendations to strengthen program design

PROFESSIONAL ACTIVITIES

Society Membership and Leadership

- American Society for Tropical Medicine and Hygiene (2013-Present)

Consultations

- American Society for Tropical Medicine and Hygiene (2013-Present)
- ICF International/Demographic and Health Survey (2015-2016)
- Save the Children (2014)
- Human Rights Data Analysis Group (2014)
- Population Services Khmer (2013)

HONORS AND AWARDS

Honors

- Gordis Teaching Fellowship, JHPSH (2016)
- Morehead-Cain Scholar, UNC (2006)

Awards

- Robert and Helen Wright Award, JHSPH (2016)
- ASTMH Young Investigator Award Finalist, ASTMH (2016)
- Delta Omega Scholarship, JHSPH (2015)
- John Snow, Inc Award, JHSPH (2013)
- Chancellor's Award in American Studies, UNC (2010)

PUBLICATIONS

- Carter E, Bryce J, Perin J, Carvajal L, and Newby H. Harmful Practices in the Management of Childhood Diarrhea in Low- and Middle-Income Countries: A Systematic Review. BMC Public Health 15.1 (2015): 788.
- Perin J, Carvajal-Velez L, Carter E, Bryce J, and Newby H. Fluid Curtailment during Childhood Diarrhea: A Countdown Analysis. BMC Public Health 15.1 (2015): 588.
- Wang W, Temsah G, and Carter E. 2016. Levels and Determinants of Out-of-Pocket Health Expenditures in the Democratic Republic of the Congo, Liberia, Namibia, and Rwanda. DHS Analytical Studies No. 59. Rockville, Maryland, USA: ICF International.
- Wang W, Winter R, Mallick L, Florey L, Burgert-Brucker C, and Carter E. 2015. The Relationship between the Health Service Environment and Service Utilization: Linking Population Data to Health Facilities Data in Haiti and Malawi. DHS Analytical Studies No. 51. Rockville, Maryland, USA: ICF International.

PRESENTATIONS

- Carter E, Ndhlovu M, Nkhama E, Munos M, Katz J, and Eisele T. Validation of Maternal Recall of Care-seeking Events for Childhood Illness in Southern Province, Zambia. 2016 meeting of the American Society of Tropical Medicine and Hygiene, Atlanta, GA.
- Carter E, Ndhlovu M, Nkhama E, Munos M, Katz J, and Eisele T. Linking Household and Point-of-care Data to Estimate Coverage of Appropriate Management of Childhood Illness in Southern Province, Zambia. 2016 meeting of the American Society of Tropical Medicine and Hygiene, Atlanta, GA.
- Perin J, Carvajal L, Carter E, Bryce J, and Newby H. Fluid Curtailment during Childhood Diarrhea: Analyses of 6 National Datasets. 2014 World Congress on Epidemiology. Anchorage, AK.

TEACHING

Instructor

- Intro to Public Health Evaluation Using Population-Based Surveys, AS.280.429 (Fall 2016)

Teaching Assistant

- Global Disease Control Programs and Policies (Oct - Dec 2013; Mar - May 2014; Mar - May 2015)
- Infectious Disease and Child Survival (Jan - Mar 2014; Jan - Mar 2015)
- Large-scale Effectiveness Evaluations of Health Programs (Mar - May 2014; Mar - May 2015; Mar - May 2016)
- Design and Conduct of Community Trials (Jan - Mar 2015)