INTEGRATED COMMUNITY CASE MANAGEMENT OF CHILDHOOD ILLNESS IN ETHIOPIA: IMPLEMENTATION STRENGTH AND QUALITY OF CARE

by
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Abstract

Problem statement: Ethiopia has scaled-up integrated community case management of childhood illness (iCCM). This study assessed iCCM implementation strength and quality of care provided by Health Extension Workers (HEWs).

Methods: A survey of 150 health posts, 201 HEWs and 257 sick children. Data collection consisted of direct observation of consultations with sick children; caretaker exit interviews; gold standard re-examinations; examinations of commodities; register reviews; and HEW interviews. Paper 1 presents estimates of iCCM implementation strength and quality of care. Paper 2 assesses methods of recruitment of sick children for assessment of quality of care, assesses the validity of register review (RR) and direct observation only (DO) compared to direct observation with re-examination (DO with RE) for assessing quality of care; and assesses the impact of observation on HEW performance. Paper 3 uses multivariate logistic regression to assess associations between quality of care and program interventions.

Results: Paper 1: Implementation of iCCM was strong. Most children (64%) were correctly managed. However, just 34% of children with severe illness were correctly managed. Intervention health posts had an average of only 16 sick child consultations in the previous month. Paper 2: Mobilization and recruitment of sick children were feasible and productive methods of obtaining a sample of sick children. Compared to DO with RE, RR and DO produced estimates of quality of care with mostly fair or moderate agreement. The differences between estimates of correct care for observed versus not observed children were small. Paper 3: Performance Review and Clinical Mentoring meetings, follow-up training and number of drugs available were significantly positively associated with quality of care, but supervision, clinical instruction at health centers and availability of supplies were not.

Conclusions: The Ethiopia iCCM program has been implemented well and HEWs are providing high quality care. However, low utilization of services will limit the impact of iCCM. Methodological lessons from this study include: 1) sick children can be mobilized or recruited in communities for observation, 2) RR and DO are reasonable, if imperfect, alternatives to DO with RE and 3) observation may not have a large effect on CHW performance.

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Acronyms

AB	Antibiotic
ACT	Artemisinin-Based Combination Therapy
AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Care
CCM	Community Case Management of Childhood Illness
CHW	Community Health Worker
CIDA	Canadian International Development Agency
CSA	Central Statistical Agency
DO	Direct Observation
DPT	Diphtheria, Pertussis and Tetanus Vaccine
FMOH	Federal Ministry of Health
HC	Health Center
HEP	Health Extension Program
HEW	Health Extension Worker
HH	Household
HIV	Human Immunodeficiency Virus
HP	Health Post
HSA	Health Surveillance Assistant
HSDP	Health Sector Development Plan
ICCM	Integrated Community Case Management of Childhood Illness
IEC	Information, Education and Communication
IFHP	Integrated Family Health Program

IIP-JHU	Institute for International Programs at Johns Hopkins University
IMCI	Integrated Management of Childhood Illnesses
JHSPH	Johns Hopkins University School of Public Health
LQAS	Lot Quality Assurance Sampling
L10K	Last 10 Kilometers Project
MoH	Ministry of Health
MUAC	Mid-Upper Arm Circumference
ORHB	Oromia Regional Health Bureau
ORS	Oral Rehydration Salts
ORT	Oral Rehydration Therapy
QoC	Quality of Care
RDT	Rapid Diagnostic Test
RE	Re-Examination
RHB	Regional Health Bureau
R-HFA	Rapid Health Facility Assessment
RR	Register Review
RUTF	Ready-To-Use Therapeutic Food
SAM	Severe Acute Malnutrition
SNNP	Southern Nations, Nationalities and Peoples
STI	Sexually Transmitted Infection
TA	Technical Assistance
TB	Tuberculosis
UNICEF	United Nations Children's Fund

USAID	United States Agency for International Development
VCHW	Volunteer Community Health Workers
WHO	World Health Organization
ZHD	Zonal Health Department
ZN	Zinc

Introduction

1. Background

1.1. Child Survival in Sub-Saharan Africa

Despite a 41% decline in the under-five mortality rate between 1990 and 2011, there were still approximately 6.9 million deaths among children younger than five years in 2011. Nearly half of these deaths occurred in sub-Saharan Africa.[1] Most high mortality countries, and particularly those in sub-Saharan Africa, are not on track to meet Millennium Development Goal four, which sets a target of reducing child mortality by two-thirds between 1990 and 2015.[2] Thirty-six percent of global under five deaths are caused by diarrhea, pneumonia and malaria, with undernutrition as an important underlying cause of mortality.[1] These deaths occur despite the availability of effective, relatively low-cost interventions to prevent and treat the main causes of child mortality. Two-thirds of under five deaths could be avoided through implementation of existing interventions.[3]

1.2. Access to Health Care & Community Health Programs

Treatment with oral rehydration salts (ORS), antibiotics and ACT are particularly effective in reducing deaths from diarrhea, pneumonia and malaria.[3] However, achieving adequate coverage of these interventions has proven difficult. Coverage[*] of treatment for pneumonia, diarrhea and fever in the 68 countries with the highest levels of child mortality is only 30%, 39% and 20% respectively.[4, 5] Coverage is lowest in the countries with the highest rates of child mortality.[2] Shortages of qualified health workers and low

[*] The proportion of children under five who receive correct treatment for a given illness.

utilization of health facilities have hindered efforts to increase intervention coverage.[6] Health worker density, which is highly associated with maternal, infant and under-five mortality,[7] is ten times higher in Europe and North America than in sub-Saharan Africa.[8]

The poorest children are less likely to have access to preventive and curative interventions, to be taken to an appropriate health care provider when they are sick and to receive high-quality care when they are taken for care.[9-11] These disparities lead to reduced coverage of effective child health interventions among the poorest[12] and those living in rural areas,[13] who are also the groups at higher risk of mortality.[14]

The inability to attain high coverage levels through services delivered at health facilities prompted a movement to bring health care closer to patients.[2, 15] Following the Alma Ata declaration[16] in 1978, many developing countries increasingly prioritized primary care and increasing access to health services among the poor. This led to the adoption of community health strategies for delivering health care interventions. A number of countries launched programs to provide preventive and curative care to rural populations through community health workers (CHWs). Box 1 presents definitions of key terms as applied in this research. By the early 1990s, community health programs were in decline, due largely to difficulties in scaling up and sustaining the programs and because of an increased focus on vertical disease control programs.[6, 8, 17] However, continued difficulties in attaining widespread access to health services, the human resources for health crisis in many low-income countries, increasing decentralization of services and the challenge of HIV/AIDS and other resurgent infectious diseases led to renewed interest in community health programs.[18]

Community health worker programs vary considerably between countries and programs.[6, 17] CHWs may be Ministry of Health employees, paraprofessionals, volunteers, or private sector workers, among others.[14] Child health activities performed by CHWs include immunization, breastfeeding promotion, growth monitoring, nutrition education, vitamin supplementation, therapeutic feeding, birth and newborn care, HIV/AIDS prevention, prevention of mother-to-child transmission of HIV and treatment of childhood illnesses.[6] CHWs are geographically closer to rural populations who may not otherwise have access to health care. As members of the community, they may also reduce cultural and linguistic barriers to seeking care. A number of interventions have been effectively implemented at the community level, including health promotion/behavior change; preventive interventions, such as mosquito net distribution and micronutrient supplementation; prevention of mother-to-child transmission of HIV; and case management of childhood illnesses.[8] A Cochrane review of lay health workers found that lay health workers may reduce child morbidity by 14% and child and neonatal mortality by 25% and 24% respectively.[18]

1.3. Community Case Management of Childhood Illness

To increase coverage of life-saving interventions, countries have increasingly implemented community case management of childhood illness (CCM) through CHWs.[19] The number of countries with policies for CCM increased from 11 to 29 between 2008 and 2010.[2] Community case management programs in developing countries generally target the main causes of child mortality; namely pneumonia, diarrhea, malaria, neonatal infections and malnutrition. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) recommend community-based treatment of pneumonia,[20] diarrhea,[21] malaria[22] and severe acute malnutrition

(SAM)[23] among children under five.

CCM can lead to improved access to appropriate case management, which leads to earlier treatment, fewer severe cases, improved recovery, fewer referrals and a reduced burden on health facilities.[14] There is strong evidence that CCM can increase coverage of appropriate treatment for childhood illnesses among the poor[24-26] and can lead to substantial reductions in child mortality.[8, 18, 27-30] Evidence for impact of CCM of pneumonia is particularly strong; a meta-analysis of pneumonia CCM found a 20% reduction in overall infant mortality and a 24% reduction in under-five mortality.[30] Economic analyses also suggest lower cost and high value from community health programs compared to health facility services.[31-33] Despite overwhelming evidence, few countries have moved to provide CCM at the regional or national level.[14, 34, 35]

1.4. Integrated Community Case Management of Childhood Illness

Integrated community case management of childhood illness (iCCM) is a strategy to train, support and supply CHWs to provide clinical care for common childhood illnesses in communities.[36] Winch et al. define iCCM as having the following characteristics: 1) CHWs are trained to systematically detect signs of the major causes of mortality among children under five years of age in the area where they are working; 2) CHWs classify the child as having one or more of these conditions using an integrated algorithm or other decision-making tool; 3) if the area is malarious, the algorithm or tool should take into consideration the clinical overlap of malaria and pneumonia; 4) CHWs provide treatment for all of the conditions identified, or refer if the child is severely ill or requires a treatment the CHW does not keep in stock and 5) CHWs counsel the caregiver of the sick child on how to administer all of the treatments provided.[34] Within iCCM programs, CHWs often use adapted Integrated Management of Childhood Illnesses (IMCI)[37] guidelines for diagnosing and treating sick children. A relatively comprehensive iCCM program would include antibiotic treatment for pneumonia, ORS and zinc for diarrhea, artemisinin-based combination therapy (ACT) or chloroquine for malaria and ready-to-use therapeutic foods (RUTF) for acute malnutrition.

Despite community demand for services that address a broader range of illnesses, significant overlap in clinical presentation of malaria and pneumonia,[38-41] and frequent co-infections,[39] most CCM programs have targeted only one single disease, usually malaria.[34] Single disease programs fail to capitalize on contacts with sick children to address the multiple causes of childhood illness and lead to a tendency to treat a single disease regardless of the actual cause(s) of illness.[25, 39, 42] For these reasons, programs focused on a single disease may have limited impact.[25, 43]

The WHO and UNICEF recommend iCCM as a strategy to improve equity in access to health care.[44] An integrated approach to treating childhood illnesses can improve access to health care[26] and early care seeking[45-48] and improve utilization of CHW services.[49, 50] ICCM has also been shown to reduce child mortality,[51-53] although more evidence on the impact of iCCM is needed,[54] with few assessments of large-scale iCCM programs, especially in sub-Saharan Africa.[8, 14, 55]

1.5. Quality of CCM Services

If an iCCM program is to have the desired impact on child mortality, the quality of services provided through the program must be high (See Box 1 for definition of quality of care). Poor quality of care is an important contributor to child mortality due to common illnesses.[56-59] Although there are concerns that CHWs will provide low quality services,[60] there is evidence from numerous trials and small-scale programs that CHWs can attain and maintain knowledge from training[61] and can adequately assess and treat malaria,[29, 62] pneunomia[26, 27, 63-68] and diarrhea.[67, 69, 70] Low-level health workers may perform better than doctors and nurses in some tasks, such as adhering to simple clinical guidelines and giving appropriate advice to caretakers.[8, 71-73] However, they may have difficulty recognizing signs and symptoms of pneumonia,[51] treating children with multiple signs and symptoms,[62] and recognizing and managing severe disease.[63, 64, 68]

There is evidence that integrated management of childhood illnesses can improve quality of care provided by health workers at first-level facilities.[74-77] However, evidence on quality of care provided by CHWs in an integrated case management program is rare and the results are mixed.[62, 78-81] Challenges of integrating case management include difficulty identifying danger signs when multiple signs are present[51, 62] and difficulty following more complex treatment guidelines and algorithms.[62]

1.6. Interventions to Improve CCM Quality of Care

Program processes such as training, supervision and supplying drugs are supposed to lead to improved quality of health care services, which in turn should lead to improved coverage of effective treatment and improved health status. However, these activities do not necessarily lead to equivalent improvements in health worker performance and quality of care[72, 73, 82-85] and knowledge of correct practices does not necessarily translate into correct management of patients.[82] Evidence indicates that training should be competency-based, focusing on key skills and with systematic assessments of competency.[86] Trainings should be clear and simple, emphasize hands-on practice and be adapted to the specific context.[87] Knowledge and skills acquired in training may be lost over time,[88] so refresher trainings are important. Other important determinants of quality of care include health worker motivation, job satisfaction, child factors and environmental factors.[80, 89-93] Thus, programs that focus only on training to improve quality of care often fail to achieve the desired results.[82]

Following training and deployment, supervision is beneficial to reinforce the knowledge and skills acquired in training and to avoid declining quality of care over time.[64, 82, 89] Regular supervision has been shown to be associated with better project outcomes and better CHW performance.[64, 87] Formative supervision that involves observation of case management and feedback to CHWs is recommended,[82] as is the use of checklists.[86] Regular supervision may also increase CHW retention.[90] However, supervision is difficult to sustain and this component is often not implemented as planned.[62, 91, 92] Supervisors often lack the necessary skills or don't have the necessary transportation or time to provide consistent support to CHWs.[82] A review of interventions to improve health worker quality of care had the following findings: "(1) Dissemination of written guidelines without additional interventions was generally ineffective; (2) supervision and audit with feedback was generally quite effective; (3) non-traditional training methods such as computer-based training might be less expensive than and as effective as traditional methods…(4) multifaceted interventions (e.g., training plus supervision), which address multiple determinants of performance, might be more likely to improve performance than single interventions."[82]

1.7. Ethiopia Background

The landlocked East African nation of Ethiopia has the second largest population in Africa at 82.3 million. Eighty-three percent of the population lives in rural areas and the primary occupation is subsistence agriculture. With a gross national income of USD 380 per year, Ethiopia is one of the poorest countries in the world.[93] The country ranked 173rd out of 186 countries in the 2013 Human Development Index.[94] The literacy rate is 30% overall and 18% for females and 53% of girls complete primary school. Life expectancy at birth is 56 years and health expenditure is USD 15 per person per year.[93] Table 1 provides key child health indicators in Ethiopia. A large proportion of child deaths in Ethiopia are attributable to diarrhea (22%), pneumonia (12%) and malaria (7%).[95] However, Ethiopia has made impressive progress in reducing child mortality, with the under-five mortality rate falling from 166/1,000 live births to 88/1,000 live births between 1997 and 2011.[96] Figures 1 and 2 illustrate the trend in under-five mortality and causes of under-five deaths in Ethiopia. Figures 3-5 show coverage of therapeutic and preventive interventions for pneumonia, diarrhea and malaria, respectively.

This research was conducted in Oromia Region, which is the largest region in the country, with 37% of the country's population (around 30 million). Like most of Ethiopia, the vast majority of the population depends on subsistence farming and animal rearing for its livelihood. Eighty-eight percent of the population of Oromia is of Oromo ethnicity and Islam is the most common religion (48%). The large majority of the population is rural, with 89% working in (mostly subsistence) agriculture. There are an average of 4.8 people per household in the region.[97] As of 2010, the region's health system had 44 hospitals, 1,013 health centers, 259 health stations and 5,407 health posts. These structures are serviced by 232 physicians, 692 health officers, 9,757 nurses, 1,035 environmental officers and 12, 875 Health Extension Workers (HEWs).[97] Child mortality in Oromia is higher than the national average, at 112 deaths/1,000 live births.[96]

1.8. The Ethiopian Health Extension Program

In recognition of the difficulties in reaching the majority rural population with health services, the Ethiopian government launched the Health Extension Program (HEP) in 2003. The HEP initially emphasized preventive activities, but was later expanded to include basic curative interventions as well. Although the HEP includes an urban program, the vast majority of HEWs work in rural areas. The program has trained around 35,000 female HEWs to provide preventive and curative care in communities.[98] Table 2 provides a summary of HEW characteristics.

The Ethiopian health system is divided into three tiers. The lowest level is the primary health care unit, which comprises one primary hospital, one health center and five satellite health posts. Each health post is run by two HEWs and serves one *kebele*,† with a population of approximately 5,000 people. The higher levels of the health system are the general hospital, which covers a population of one million, and the specialized referral hospital that serves five million.[97] Each health post is accountable to and receives technical support from the nearest health center. At the community level, HEWs are assisted by volunteer community health workers (VCHWs). There are on average 12-15 VCHWs in each *kebele*.[99, 100] The Ethiopian Federal Ministry of Health (FMOH) launched the Health Development Army in 2010 and expanded it to Oromia in 2012. As part of this initiative, up to three million community volunteers will be recruited to support HEWs in community health promotion.[101]

The HEP initially emphasized preventive and promotive activities and curative

† *Kebele* is the lowest administrative unit, followed by *woredas* (districts), zones and regions.

care was to remain in health facilities. HEWs were meant to spend 75% of their time working on community outreach activities, including training "model families" to serve as role models of good practices and to transmit health messages in their communities.[102] Over time, basic curative care for some common childhood illnesses was included. The program included treatment of children with diarrhea with oral rehydration salts (ORS), malaria with ACT or chloroquine, and SAM with RUTF. Pneumonia cases, on the other hand, were referred to health facilities for treatment. With a 2009 policy change allowing community treatment of pneumonia, the FMOH, with the support of UNICEF and other implementing partners, is now implementing iCCM in most regions of the country. Table 3 details the programs and service packages included in the HEP.

The Center for National Health Development is conducting a prospective evaluation of the HEP, consisting of a series of cross-sectional household surveys and surveys of HEWs and health posts. Results showed that the HEP had important effects on access to sanitation, use of contraceptives, post-natal care, appropriate treatment of diarrhea and malaria, mosquito net utilization and knowledge of HIV/AIDS. Little or no effect was seen with regards to ANC coverage, skilled attendants at birth, immunization and care seeking for fever. Community members surveyed reported disappointment that a broader range of curative services were not offered (pneumonia CCM was not offered at the time) and they felt that health post infrastructure, equipment and supplies were inadequate. However, most were generally satisfied with the services of HEWs and nearly all respondents reported that HEWs were accessible and available.[103]

1.9. The Ethiopia ICCM Program

Following the national policy change supporting community-based treatment of childhood pneumonia in late 2009, Ethiopia has scaled-up iCCM within the pre-existing HEP in six regions of the country (Amhara, Benishangul-Gumuz, Gambela, Oromia, SNNP and Tigray) with support from the Canadian International Development Agency (CIDA), the United Nations Children's Fund (UNICEF), the United States Agency for International Development (USAID) and other partners. This initiative aims to accelerate reduction in under-five mortality in Ethiopia by strengthening the health system and increasing equity in access to high-impact, cost-effective preventive and curative interventions. In the focus regions, treatment of childhood pneumonia with cotrimoxazole and zinc for treatment of diarrhea were introduced in addition to the already existing CCM of malaria, diarrhea (with ORS only) and malnutrition (routine CCM).[104‡] As part of the iCCM program, HEWs in the intervention areas received training on management of pneumonia, diarrhea, malaria and malnutrition among children under five years of age. Complicated cases as well as most cases among children under two months of age are given pre-referral treatment, if applicable, and referred to the nearest health center. The program was designed to strengthen the capacity of HEWs to assess, classify and treat malaria, diarrhea and SAM through refresher trainings, strengthened supervision, improved supply chain management for essential drugs and supplies and improved monitoring and evaluation. Table 4 provides a comparison of the iCCM and routine CCM programs.

1.10. The Evaluation of ICCM in Ethiopia

To date, there are few examples of iCCM programs implemented at the regional

‡ Although treatment of diarrhea with zinc is part of the iCCM policy, the iCCM program is currently being implemented without zinc due to a lack of supply of zinc in Ethiopia. It is not clear whether zinc will be included during the evaluation period.

or national level, especially in sub-Saharan Africa,[14, 87] and rigorous evaluations of the programs that exist are rare.[8] The effectiveness of iCCM varies across specific country contexts and depends largely on the strength of program implementation.[6, 34, 49, 51] It is therefore necessary to evaluate the effectiveness of the scale-up to provide a basis for future program improvement in the country and to provide global evidence on effective strategies for scaling up high-impact child survival interventions to accelerate reductions in under-five mortality. To this end, the Institute for International Programs at the Johns Hopkins University Bloomberg School of Public Health (IIP-JHU) was commissioned by CIDA and UNICEF to conduct an independent prospective evaluation of the implementation of iCCM in Ethiopia. The independent evaluation assessed the impact of the rapid scale-up of iCCM on increases in coverage of child survival interventions, reductions in child mortality and improvement in nutritional status among children under five years of age.

The evaluation was conducted in the Oromia Region, where iCCM implementation was phased in, allowing the identification of randomly selected intervention and comparison areas. Within the Oromia Region, the evaluation was conducted in Jimma and West Hararghe Zones and used a cluster-randomized design with stratification by zone. Within each zone, rural *woredas* were randomly assigned to intervention and comparison arms. A total of 16 *woredas* were randomly assigned to intervention areas and 15 *woredas* to comparison areas using a constrained randomization. Data collection for the evaluation consisted primarily of baseline and endline household surveys measuring child mortality and coverage of child health interventions. Following the end of the baseline survey in mid-February 2011, the intervention *woredas* began implementation of iCCM and were fully scaled-up as of July 2011. The comparison *woredas* began implementation of iCCM following the completion of the endline survey in May 2013. During the evaluation period, the comparison *woredas* continued to offer routine CCM (Table 4).

1.11. Measuring ICCM Implementation Strength & Quality of Care

Once program implementation was fully under way, the IIP-JHU evaluation team, in collaboration with UNICEF, the Oromia Regional Health Bureau (ORHB) and the FMOH, conducted an assessment of iCCM implementation strength and quality of care (Box 1) in the two evaluation zones to assess the scale and the intensity of the program and provide appropriate feedback to the FMOH, the ORHB and implementing partners. Furthermore, program evaluators needed measures of iCCM implementation strength to assess the relationship between the program and expected outcomes. For evaluators to be able to confidently make conclusions about the program's impact, they must have information on whether the program's key components were strongly implemented, as well as information on intermediate outputs, such as quality of care and utilization of services. It is also necessary to have measures of implementation strength in comparison areas to be able to document the strength of implementation of the routine CCM program.

The effectiveness of the iCCM program requires that each component of the program (access and availability of HEWs; training of HEWs in iCCM; supportive supervision; continued provision of drugs and supplies; and demand generation activities, such as community education and mobilization) be delivered at a high level of intensity that is sustained throughout the program. Likewise, improvements should be seen in the quality of services provided by HEWs and in utilization of services by the community. See Figure 6 for the iCCM program impact model.

The primary elements assessed in the Oromia implementation snapshot and quality of care assessment were:

1. Access and availability of deployed HEWs
2. Training of HEWs in iCCM
3. Availability of essential iCCM commodities, supplies and job aids
4. Supportive supervision of HEWs
5. Demand generation activities and utilization of services
6. Quality of services provided by HEWs.

1.11.1. Access & Availability

The Ethiopian HEP was introduced to address the problem of lack of access to quality health care for a large proportion of the population.[102] The term access refers to the likelihood that people will be able to reach and use health services. Geographic distance and transportation are obvious factors that determine access, and living within five or 10 kilometers from a health services delivery point is commonly considered as having access.[14] Other socio-economic, cultural and environmental factors may also be important. In 2005, an estimated 30% of the Ethiopian population lived within 10 kilometers of a health center or other health service delivery point. Urban areas, accounting for only 4-6% of the population, had 44% of all health facilities. The physician and nurse-to-population ratios were among the lowest in the world at 1:29,777 and 1:4,222 in 2005.[105] Availability of services refers to the likelihood the services will be available when accessed. A 2008-2009 household survey conducted by the Last 10 Kilometers Project (L10K) in Oromia, Amhara, Tigray and SNNP found that 70% of *kebeles* were served by a health post (52% in Oromia). Ninety-two percent of *kebeles* had at least one HEW (74% in Oromia).[100]

Measuring access to and availability of HEWs is central to understanding whether the iCCM program has the potential to improve children's health. If HEWs are not accessible and available, then all other efforts will be in vain. Because we were not able to map out households to determine distance to health posts, we used HEW density as a proxy for access. Density in this case is defined as the number of HEWs deployed per population under five years of age in the catchment area. HEW density gives an indication of the program's impact on access for the population in general. The degree to which CHWs increase access for the most vulnerable depends on the scope of the program and on the extent to which the program targets the poor and hardest-to-reach areas.

1.11.2. Training

Ethiopian HEWs are trained for one year at Technical and Vocational Education and Training Centers before they are deployed to their work sites. Training includes both didactic and practical learning components. In a survey of HEWs in four regions, HEWs deemed the amount of training inadequate.[99] In fact, they listed further training to improve their skills as the top measure to improve their motivation. About half of HEWs received refresher training in the previous year.[99] With the iCCM program, HEWs receive a six-day training on management of iCCM illnesses. They are also supposed to receive a follow-up training within six weeks of the iCCM training.

Additionally, HEWs are brought together in a central location on a bi-annual basis to review monitoring data and receive additional training in Performance Review and Clinical Mentoring Meetings (PRCM). HEWs may also receive further clinical instruction during visits to health centers.

1.11.3. Availability of Essential Commodities

Stockouts of essential drugs, supplies and other commodities not only inhibit the CHWs' ability to treat patients in the short-term, they also discredit the program and the CHW in the eyes of the community and lead to reduced utilization and decreased morale among CHWs.[89, 106] HEWs have reported that the most important challenge they faced was inadequate drug supplies.[99] A survey of health posts found that 55% of health posts reported stockouts of artemether-lumefantrine in the previous three months and 53% had stockouts of ORS.[107]

1.11.4. Supervision

In Ethiopia, HEW supervisors are usually nurses or environmental health professionals who are based in the health center. There is one supervisor for five health posts (~10 HEWs). With the iCCM program, additional supervision support is provided by program implementation partners. Supervisors use a standardized supervision checklist and should either observe the HEWs providing consultations or review cases in the iCCM sick child registers. A 2007 HEW survey found that 67% of health posts were supervised in the previous three months and 75% of supervisions included clinical reinforcement.[99]

1.11.5. Demand Generation & Utilization

To ensure high utilization of HEW services, a program should actively engage in demand-generation activities. Community members generally place a high value on curative services,[14] so including treatment of common illnesses should help increase demand. However, observed low utilization rates within the HEP indicate that provision of services at the community level does not guarantee improved coverage of interventions. Community members must be aware that the services exist and be convinced that the services will meet their needs and be of high quality. Caretakers will also have to be able to recognize CCM illnesses in children and have realistic expectations about what care will be provided. In addition to community mobilization, HEWs and VCHWs need to teach caretakers to recognize illness and danger signs and to appreciate the importance of early care seeking.[14]

The major strategies for community mobilization and demand generation within the HEP have been collaboration with VCHWs and training of "model families" that have achieved certain health-related milestones, such as digging a pit latrine, in their households. Despite a large majority (89%) of *kebeles* having at least one VCHW, only 36% of women reported knowing about the VCHW in their community and 15% said they were contacted by the VCHW in the previous year. In Oromia, only 27% knew about the VCHW and 7% had been contacted.[100] The Health Development Army will likely be the foundation of future demand generation activities related to iCCM.

1.11.6. Quality of Services Provided by HEWs

Only one assessment of HEWs' ability to treat sick children has been carried out in 2007 and that assessment did not include an assessment of actual performance. That assessment of HEW competence showed that technical knowledge was generally low to moderate. In a series of case scenarios, only 28% of HEWs surveyed said they would prescribe antibiotics for a child with signs and symptoms of pneumonia and 68% said they would refer a child needing referral.[99]

1.12. Previous Work on Measuring CCM Implementation Strength and Quality of Care

Most published literature on the quality of case management of childhood illnesses has been conducted in health facilities.[71, 73, 77, 85, 108-111] These assessments often also include measurements of most of the core aspects of program implementation strength (access and availability of health workers, training, availability of drugs and supplies, and supervision). The WHO health facility assessment tool[112] is a commonly used and respected methodology for assessing health worker performance and quality of care in health facilities.

Efforts to assess CCM quality of care are less common, but several examples affirm that existing assessment methods can be used with CHWs. Table 5 presents common methods for assessing health worker quality of care and the advantages and disadvantages of each method. This review identified 14 published studies evaluating CHW performance in delivering post-neonatal CCM services.[47, 48, 54, 61-64, 78, 79, 81, 91, 113-115] Table 6 provides a summary of studies measuring iCCM quality of care and the methods employed. There is significant variation in the methods used. Direct observation with re-examination (DO with RE) by an experienced clinician, is widely regarded as the gold standard for assessing quality of care in low-income countries. Most of the studies reviewed used direct observation, with a smaller number including re-examination.

Additional methods of assessing CHW performance included direct observation only (DO), register review (RR), caretaker exit interviews, role-play, videotaped cases, case scenarios and knowledge exams. Additionally, some studies included questionnaires on background characteristics to determine factors that are associated with high or low-quality care. Ten of the studies were carried out in the community where the CHWs worked. Low utilization rates of CCM services in some settings make the use of direct observation of sick child consultations at the CHWs' place of work difficult. An alternative that was employed in about half of the studies was to bring CHWs to a health facility with larger numbers of sick children to perform direct observation. Assessing CHWs at a central location may also have cost and logistical advantages. However, assessing the CHWs away from their normal work setting may introduce a number of biases. Improved working conditions, such as drugs in stock, diagnostics, supplies, lighting, etc. may lead to a positive bias.[116] Additionally, health facilities may have different types of patients with different illnesses and severity than would be typical at the community level. Assessments of other indicators of implementation strength and readiness to provide services, such as drug stocks, supplies, infrastructure and demand-generating activities, may be less reliable if data collectors do not visit the CHWs' actual place of work. Relying on CHW recall, as opposed to direct observation and review of records, will likely introduce bias.

A number of tools have been developed for assessment of health services provided at health facilities. A much smaller number of tools are available for assessing CCM services. Below is a summary of the most relevant existing tools that are either designed specifically for assessing CCM or are designed primarily for health facilities but have a CHW component.

a. IIP-JHU Malawi HSA survey

Researchers at IIP-JHU have developed and implemented a quality of care survey among Health Surveillance Assistants (HSAs) in Malawi.[81] The study protocol was adapted to the Malawi HSA context from the WHO health facility survey tool.[112] Data were collected in the communities where the HSAs work. The methods included:

- Direct observation of sick child consultations
- Clinician re-examination
- Exit interviews with caretakers
- Review of registers and records
- Case scenarios
- Inspection of drugs and supplies
- Interviews with HSAs on training, supervision and socio-demographic characteristics.

b. Ethiopia HEP evaluation of HEW competence and health post performance

The ongoing HEP evaluation conducted by the Center for National Health Development includes an assessment of HEW performance and health post performance.[99] The HEW performance study measured HEWs' competence. HEWs also filled out diaries that detailed the allocation of daily tasks. The primary objective of the health post performance study was to assess the level of implementation of the HEP at the health post level. The study assessed:

- Health post characteristics (infrastructure, human resources, utilities and facilities, medical equipment, drugs and supplies)

- Availability of HEP services and optimal use of available infrastructure
- Readiness of health posts to provide quality HEP services
- Productivity of the health posts
- Existence of support systems to provide quality HEP services (cold chain management, quality of delivery services, access to continuing education, supervision, availability and use of standard guidelines, protocols, registers and IEC material)
- The performance, utilization and functionality of the referral system.[107]

The methods applied in HEP assessment included:

- HEW competence exam
- Questionnaire on health post characteristics and functioning, training, supervision, drugs and supplies, utilization, demand-generating activities and socio-demographic characteristics
- Observation of the health post infrastructure, job aids, etc.
- Observation of drugs and supplies
- Register review.

c. Rapid Health Facility Assessment (R-HFA)

The R-HFA[117] was developed by Macro International and other partners to provide a tool for assessing the strength and quality of child survival programs in developing countries. The tool is designed to have the following characteristics: simplified to collect only essential information, high validity and reliability of information for a small set of indicators, comparability with data from other sources. The R-HFA is based on a number of previous assessment tools.[§] The tool covers the domains of access, inputs, processes and performance. Within these domains, the core indicators of implementation strength (access, training, drugs and supplies, supervision) are included, as are measures of utilization and quality of care. The tool is primarily for assessment of first-level health facilities, but does include a module on CHW assessment. The methods for assessing CHWs in the CHW module of the R-HFA include:

- Register review
- Examination of drugs and supplies
- Interviews with CHWs on training, supervision and socio-demographic characteristics.

d. CHW Program Functionality Assessment Tool

This tool was developed by the University Research Company at the request of USAID.[118] The tool is intended to facilitate rapid assessment of the functionality of CHW programs and the health workers within those programs. The assessment is carried out at the national, regional or district level, rather than at the level of the CHW. It assesses the supportive structures of the program rather than CHW performance. The 12 programmatic areas that are assessed are: recruitment, the CHW role, initial training, ongoing training, equipment and supplies, supervision, performance evaluation, incentives, community involvement, referral system, professional advancement and documentation and information management. The method of data collection is through a workshop with multiple stakeholders that are knowledgeable about the program.

[§] Integrated HFA (BASICS II), SPA (DHS/Macro), FASQ (MEASURE-Evaluation), HFS (WHO) and International Health Facility Assessment Network (MEASURE-Evaluation, WHO, Macro and others)

1.13. Knowledge Gaps Addressed by this Study

This was the first assessment of the implementation of the iCCM strategy in Ethiopia. All previous assessments of the HEP were concluded prior to the policy change allowing community-based treatment of pneumonia. This study was the first to assess the ability of HEWs to manage pneumonia and their ability to provide integrated care for childhood illnesses that are responsible for a large majority of child deaths. Additionally, no assessments of the actual performance and quality of care provided by HEWs, through observation of consultations and clinician re-examination, have been conducted. At the regional and global levels, there is little information on implementation strength or the quality of services for iCCM implemented at a regional or national scale.

More information on different methods of assessing quality of care provided by CHWs is needed. If DO with RE is used, solutions to the problem of low patient volume need to be addressed. Because of greater feasibility and lower cost, RR and DO only will continue to be common methods for assessing CHW quality of care. However, there is little information available on the validity, defined as the degree to which a method is able to depict the technical quality of services accurately, of these methods for assessing the performance of CHWs. This study also provides insight into the relationship between various iCCM program inputs and quality of care, which program implementers can use to further strengthen programs.

2. Methods

2.1. Objectives and research questions

The primary objectives and research questions associated with each objective are as follows:

(1) Assess the strength of iCCM program implementation and quality of iCCM services in intervention areas.

- To what extent have the iCCM program activities been implemented?
- What is the level of quality of iCCM services provided by HEWs?
- What is the level of utilization of iCCM services provided by HEWs?

(2) Document the strength of implementation for the routine CCM program in comparison areas.

- To what extent have the routine CCM program activities been implemented?
- What is the level of utilization of routine CCM services provided by HEWs?

(3) Evaluate methods for assessing quality of care of community health workers.

- Are active methods for recruiting sick children for observation and re-examination feasible and what are the characteristics of the samples of children that are obtained using these methods?
- Is register review a valid method for assessing CHW quality of care?
- Is direct observation only a valid method for assessing CHW quality of care?
- To what extent does observation of consultations during quality of care assessment change CHW performance?

(4) Assess the extent to which iCCM program inputs are associated with quality of care.

- To what extent are different components of iCCM implementation associated with quality of care?

2.2. Survey Organization

Funding for the survey was provided by UNICEF. IIP-JHU was responsible for the conception, design and implementation of the study. IIP-JHU identified and contracted a private Ethiopian research firm, (ABH) Services, PLC, 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 Population

The implementation snapshot was conducted in Jimma and West Hararghe Zones of Oromia Region. Figure 7 shows a map of the two zones. The two zones are located to the west and east of Addis Ababa and the zonal capital for each zone is approximately a five to six hour drive from Addis Ababa. Jimma has a population of approximately 2.9 million people and the population of West Hararghe is around 2.1 million. The two zones were selected for this study because they are the study zones for the iCCM evaluation, with randomized iCCM intervention and comparison *woredas*. Table 7 shows the evaluation *woredas* by zone and intervention and comparison areas. The zones were selected for the evaluation because the iCCM program was to be phased in Oromia, allowing for comparison areas, and based on the following criteria:

- Population size: The zones are large enough with regards to population and number of *woredas* to allow for *woreda*-level intervention and comparison areas.
- Partner strength: Strong child health partners (L10K and IFHP) are implementing

iCCM in the zones.

- Geographic location: Both zonal capitals are reachable by car from Addis Ababa in one day.
- The iCCM baseline survey was conducted between December 2010 and February 2011 and provides background characteristics by intervention and comparison *woredas* in Jimma and West Hararghe Zones. Table 8 provides characteristics of the intervention and comparison areas from the iCCM baseline household survey.

2.4. Inclusion Criteria

The inclusion criteria for the survey were as follows:

a. Health posts: All functional health posts in the study zones were included in the sampling frame. In cases where an HEW was providing clinical services, but an official health post structure had not been constructed, the HEW's primary location for providing case management services was considered as the health post.

b. HEWs: All HEWs present and providing case management services in selected health posts were included.

c. Patients (in intervention health posts only) presenting spontaneously or presenting as a result of mobilization by the HEWs at selected health posts had to meet the following criteria:

    i. Between 2 and 59 months of age (inclusive). Children younger than two months were excluded because the clinical algorithms are different and we did not expect to obtain a sufficient sample size of children in this age group to be able to draw meaningful conclusions.

ii. Described as sick by the caretaker. Sick children had to have at least one of the following complaints: danger signs (change in consciousness/lethargy, convulsions, vomiting everything, not eating or drinking), fever/malaria, cough, fast/difficulty breathing, pneumonia, diarrhea/vomiting, ear problem, measles, nutrition or feeding problems.

iii. Initial consultation: the first time the patient had been seen at the health post or by either of the HEWs (including in the home/community) for the current illness episode.

iv. Recruited patient consultations: In cases where fewer than two eligible children presented spontaneously or as a result of HEW mobilization at a health post for a consultation on the day of data collection, data collectors recruited sick children in the surrounding community to receive consultations by the HEWs. Children recruited for consultations had to meet the same eligibility criteria as children spontaneously presenting at the health post. Additionally, the child could not have already received a consultation from any appropriate health care provider (government health facility, HEW or private health clinic) for the current illness episode.

d. Data collectors observed/re-examined a maximum of five sick children per health post.

2.5. Sampling Frame & Sample Selection

We conducted a cross-sectional survey in a random sample of health posts, with stratification by intervention and comparison arms. The sampling frames were made up of all functional health posts within intervention and comparison *woredas* in the two zones and were obtained from the zonal health officials with confirmation from the iCCM implementing partners and *woreda* health officials. The sampling frames of health posts in intervention and comparison areas consisted of 490 and 448 health posts, respectively. The sample of the survey was designed to provide estimates of indicators of interest within intervention and comparison areas separately. Selection of health posts within each stratum (intervention and comparison areas) was done through systematic random sampling.

2.6. Sample Size

Some indicators, such as drug stock-outs, supervision, etc. were calculated at the health post level. Other indicators, such as training of HEWs and the proportion of patients to receive correct assessment, classification and treatment, were calculated at the HEW level and patient level, respectively. Since there was more than one HEW per health post on average and teams obtained at least two patients per health post, determining the sample size based on a sample of health posts guaranteed a large enough sample size for the primary indicators at the health post, HEW and patient levels.

We assumed that the proportions of the variables of interest were 50%, as this gave the most conservative sample size for an absolute margin of error expressed in percentage points. The confidence level was set at 95%. Non-response of 5% was factored in for the sample of health posts. We assumed a design effect of 1.3 and non-response of 10% for HEW-level and patient-level indicators.

A total of 150 health posts were selected: 104 from intervention *woredas* and 46 from comparison *woredas*. This sample size allowed for estimates of the primary health post-level indicators in intervention health posts with precision of at least +/- 10 percentage points. Precision of primary HEW and patient-level indicators is between +/- 9 and 10 percentage points. Sample sizes required at various levels of precision for health post and HEW-level variables are shown in Table 9. Due to budget constraints, we were not able to select an equally large sample size in the comparison areas. In the comparison *woredas*, the smaller sample allows for less precise estimates of indicators of implementation strength for the routine CCM program. In comparison areas, the primary indicators are estimated with a precision of at least +/- 15 percentage points.

2.7. Data and Indicators

The data collected comprise core indicators of implementation strength, as well as supplemental indicators on demand-generating activities, utilization and the quality of services provided by HEWs. Table 10 shows the primary indicators to be assessed in the implementation snapshot. This is not a comprehensive list of indicators. Additional data were collected on factors that may influence implementation strength, utilization and quality of care, such as HEW and health post characteristics.

2.8. Study Instruments

Of the existing tools for assessing implementation strength and community health worker quality of care, the IIP-JHU Malawi HSA Survey seemed the most appropriate as a model for the current study. First, the Malawi survey was based on the WHO health facility assessment methodology, which applies rigorous methods, is highly regarded and has been widely used. Second, the tool was designed specifically for assessment of community health workers. Third, the study was conducted by researchers working with IIP-JHU, which facilitated transfer of knowledge, experiences and tools. The adaptation of the Malawi tools also ensured consistency of data and indicators across countries involved in the evaluation of the Catalytic Initiative. Finally, the Malawi tools provided the most comprehensive assessment of iCCM implementation strength and quality of care. None of the other tools reviewed included rigorous assessment of health worker performance.

The tools from the Malawi survey were adapted to the Ethiopia context and the objectives of this study. We used six questionnaires to collect data in the health posts (Table 11):

a. The ***Health Post Questionnaire Panel*** was used to collect basic information about the health post and the health post catchment area.
b. The ***Observation Checklist*** was used to record the actions taken and decisions made by the HEW in assessing, classifying and treating sick children and in counseling the caretaker.
c. The ***Caretaker Exit Interview*** was administered to assess how well the caretaker understood the prescriptions given by the HEW.
d. The ***Re-examination Form*** was used to conduct a gold standard re-examination of the sick child, which was used to evaluate the HEW's performance.
e. The ***Equipment, Supplies and Support Checklist*** was used to collect information about availability of essential iCCM commodities, supplies and job aids; supervision received at the health post; service provision; and health promotion and demand generation activities. This questionnaire also includes a register review to measure utilization of iCCM services and to assess management of sick children and

completeness of registration.

f. The ***HEW Questionnaire*** was used to interview HEWs about their demographic profile, training received and time spent on different work-related activities.

Table 11 lists the questionnaires used in intervention and comparison health posts. Questions in the survey tools that were posed directly to respondents were translated into Afan Oromo, the local language of Oromia Region.

2.9. Study Procedures

The study protocol and tools were developed by the IIP-JHU study team, in collaboration with researchers from ABH, UNICEF, iCCM implementation partners and the Oromia Regional Health Bureau (ORHB). This work was an iterative process and involved repeated field-testing to ensure that the tools were accurate, complete and appropriate. ABH was responsible for translation of the protocol, training guide and tools into Afan Oromo, the local language for Oromia.

Two pre-tests were completed in a total of four health posts in Chancho *Woreda*, Finfinne Special Zone (40 kilometers north of Addis Ababa) by ABH investigators with support from IIP-JHU. The first pre-test was conducted on February 7-9, 2012. Following the pre-test, necessary changes were made to the questionnaire, protocol and training materials. A second pre-test was conducted on April 25-27, 2012 that focused mainly on testing data collection using tablet computers.

A total of 20 data collectors were recruited based on the following criteria: minimum qualification of bachelor's degree in nursing or a Health Officer with training in iCCM and IMCI, knowledge of the HEP, ability to speak Afan Oromo, readiness to be deployed to rural locations, prior experience in quantitative data collection and availability for the entire period of training and field deployment. Most data collectors were iCCM trainers or supervisors.

Training of survey teams was held from April 30 to May 6, 2012 and was conducted by ABH in collaboration with IIP-JHU. Twenty people participated in the seven-day training, which covered the study procedures, the questionnaire, data collection techniques, iCCM clinical guidelines, quality assurance procedures and study ethics. The training focused heavily on role-play and simulations of data collection. Concordance testing was conducted to assess observation and re-examination skills of data collectors. Data collectors were assigned roles (supervisor, observer, re-examiner) based on their performance on the assessments. Training continued until all observers and re-examiners achieved at least 90% concordance with gold standard results on three consecutive exams. A programmer from the Johns Hopkins University School of Public Health (JHSPH) conducted the training of the data collectors in the proper use of the tablet computers used for data collection.

Following the in-class training, the survey was piloted to test the survey procedures and tools and to further train the survey personnel under conditions that simulated the actual survey. The pilot took place from May 7-9, 2012 in 18 health posts in Chancho *woreda*, Finfinne Special Zone. All data collectors and supervisors that participated in the training also participated in the pilot. The pilot followed the procedures of the study to replicate actual data collection to the extent possible. Each survey team collected data in three health posts during the pilot. At the end of the pilot, 18 of the 20 participants were selected for the survey.

Six survey teams were deployed for data collection. Each team was made up of one supervisor and two data collectors (observer and re-examiner). Data collectors did not carry out data collection in the same *woreda* in which they normally work to avoid influencing the behavior or performance of the HEWs as much as possible. Two coordinators (one for each zone) provided coordination and logistical support to the survey teams. Finally, study researchers from IIP-JHU and ABH provided supervision, quality control and support to data collection teams. ABH was responsible for recruiting and hiring survey personnel and other human resources and logistical matters.

Data collection began on May 20, 2012 and took 42 days. Survey procedures were as follows:

a. HEWs were notified of upcoming study visits and were told the exact date of the visit. Since HEWs do not spend all of their time in the health post, we expected a large non-response due to absent HEWs if they were not informed ahead of time and instructed to be present. Additionally, utilization of health posts for clinical services is low and we did not expect to achieve a sufficient sample of sick children with unannounced visits. To overcome this limitation, HEWs were asked to mobilize caretakers of children in their catchment area to bring sick children to the health post on the day of the survey visit.

b. On the day of the survey visit, survey teams arrived at each health post before regular working hours began (around 8:00am).

c. All HEWs working in selected health posts that provide clinical services were included in the study. The survey team met with the HEWs and introduced themselves and explained the purpose of the visit (emphasizing that results would be used to assess and improve health services, not to assess or punish individual HEWs). The supervisors asked each HEW to give verbal consent to participate in the study. The survey team explained that after patients were re-examined, the treatments prescribed to the patient and other care may be altered if the HEW's prescription was not consistent with the gold standard re-examination.

d. *Enrolling children*: As patients arrived at the health post, the supervisor screened the children for eligibility. If the child was eligible, the supervisor read the informed consent to the caretaker in Afan Oromo and requested verbal consent.

e. *Health post information*: Prior to the first consultation, the team asked the HEWs to provide basic information about the health post and the HEWs. This information was entered in the Health Post Questionnaire Panel. One Health Post Questionnaire Panel was completed per health post.

f. *Observation of the consultation*: The supervisor randomly selected (with a coin toss) one of the HEWs to provide the first consultation with an eligible patient. The observer silently observed the consultation and used the Observation Checklist to record the HEW's assessment, classification, treatment and counseling of the patient. One Observation Checklist was completed per eligible patient.

g. *Caretaker exit interview:* Once the HEW's consultation was completed, the observer took the patient and caretaker to a separate location away from the HEW. The observer asked the caretaker about the medicines that were prescribed for home treatment to assess the caretaker's understanding of the prescription. The caretaker was asked to explain the dose, duration and schedule of the treatments, as well as when to return for follow-up.

h. *Patient re-examination*: Following the HEW consultation and caretaker exit interview, the re-examiner performed a consultation with the patient and caretaker using the Re-examination Form that closely followed the Ethiopia iCCM clinical guidelines. The re-examination was used to obtain gold standard classifications and treatments with which the HEW's classifications and treatments were compared. One Re-examination Form was completed per eligible patient.

i. *Malaria testing*: If a rapid diagnostic test (RDT) was performed by the HEW, the observer recorded the result of the test and whether the HEW performed the test correctly (HEW performed the test according to the product guidelines and interpreted the result correctly). During the re-examination, if an RDT was required according to the iCCM guidelines, the re-examiner would check if an RDT was performed by the HEW. If the RDT was performed correctly, according to the observer, the re-examiner would use the result of the HEW's RDT in the re-examination. If the RDT was not performed by the HEW when it was indicated or if the RDT was performed incorrectly, the re-examiner would perform an RDT for the child and record the result for the gold standard classification.

j. Before releasing the patient, the re-examiner checked the treatment prescribed by the HEW. If a patient received incorrect treatment or did not receive a needed treatment, the re-examiner would discuss the error with the HEW and ensure that the patient received all needed treatments. If any needed treatments were out of stock in the health post, the re-examiner provided the treatments from a reserve supply that was carried by the survey team.

k. When the first patient had finished the consultation by the HEW, the exit interview and the re-examination, the next eligible patient would receive a consultation by the HEW that did not perform the first consultation. The data collectors would then perform the caretaker exit interview and re-examination. This procedure was continued up to a maximum of five patients per health post.

l. If fewer than two children presented at the health post within the first two hours or so, the supervisor, along with an HEW or community volunteer, would recruit additional sick children from the community so that at least two children were observed and re-examined, including children who presented spontaneously, who were mobilized and who were recruited. The supervisor would locate a sick child and assess the child's eligibility. If the child was eligible, the data collector would ask the caretaker if he/she was willing to take the child to the health post to receive a consultation by the HEW and a re-examination. If the caretaker agreed, verbal consent would be obtained. The child would then be brought to the health post and would undergo a consultation with the HEW and re-examination as detailed above.

m. *Equipment, Supplies and Support Checklist*: The data collectors asked the HEWs to show them all drug stocks and other iCCM commodities, supplies and job aids. The data collectors completed the Drugs and Supplies Module by inspecting iCCM commodities, supplies and job aids. Stockouts of drugs and diagnostics in the previous three months were based on the HEWs' recall. The data collectors interviewed the HEWs about the functioning of the health post, health promotion and demand generation activities, supervision received and referral of severely ill children. One Equipment, Supplies and Support Checklist was filled out per health post.

n. *Register review*: Data collectors recorded information on sick child consultations in the previous month from the iCCM patient registers. Then, data for the most recent consultations of sick children under two months of age and 2-59 months were extracted from the patient registers. Data collectors recorded information for the children that were seen by the HEWs on the day of data collection plus the last three children 2-59 months and the last three children under two months seen prior to the day of data collection.

o. *HEW Questionnaire*: Data collectors interviewed each HEW about their socio-demographic background, their history as an HEW and their time allocation. One HEW Questionnaire was completed per HEW.

p. Data collectors entered data electronically using tablet computers.

q. Once all data collection was finished in the health post, the team thanked the HEWs and provided feedback. Before leaving the health post, the supervisor reviewed all data collected in the health post to ensure completeness and consistency. Any missing or inconsistent data were rectified before leaving the health post.

r. The procedures above apply to health posts in the *intervention woredas*. For selected health posts in the comparison *woredas*, data collectors did not carry out observation of consultations, caretaker exit interviews, or re-examination of sick children. All other procedures were the same as in the intervention areas.

Survey personnel at each level were assigned specific tasks and responsibilities to ensure data quality.

Data collectors:

- Reviewed completed forms for accuracy, completeness and consistency immediately following data collection.

Supervisors:

- Edited each completed questionnaire for completeness and consistency before leaving the health post;
- Noted missing data or potentially incorrect recording of key variables and ensured that these omissions or errors were addressed, when possible;
- Observed data collection to ensure that it was properly conducted, that the questions were asked correctly and that responses were recorded correctly;
- Provided help to data collectors to resolve problems that arose during the course of data collection and to understand key concepts contained in the tools;
- Met with data collectors to review all forms completed that day and to discuss any problems, challenges and/or questions.

Study researchers/senior supervisors:

- Checked randomly selected health posts to ensure that the data collectors visited the correct health posts and correctly completed data collection;
- Observed data collection to ensure that it was properly conducted, that the questions were asked correctly and that responses were recorded correctly;
- Provided help to data collectors to resolve problems that arose in the course of data

collection and to understand key concepts contained in the tools;

- Met with data collectors to review completed forms and to discuss any problems, challenges and/or questions.

Survey teams recorded the HEWs' phone numbers and photographed the visited health posts and patient registers. This allowed study researchers to ensure that study teams had visited assigned health posts and to contact the HEWs to confirm information and clarify any inconsistencies in the data.

2.10. Data Management

Data entry was conducted by the data collectors in the field using electronic tablet computers. Open Data Kit (ODK)[121] software was used to create the survey instruments for the tablet computers. The data were sent periodically to the data manager via email. The data were then uploaded to a web-based database (Research Electronic Data Capture, RedCap)[122] and edited by a study researcher. Any missing data or inconsistencies were sent to the supervisor, who would correct the errors through discussion with the data collectors or by contacting the HEWs.

2.11. Analysis

2.11.1. Descriptive statistics

There were three main units of analysis for the indicators: health posts, HEWs and children. A stratified analysis will be done to report results for all of the indicators for 1) the intervention *woredas* as a group and 2) the comparison *woredas* as a group. The study was not intended to evaluate individual health posts or individual HEWs, so results for individual HEWs or health posts were not reported.

Binary measures, such as health post supervised in last 3 months (yes/no), were calculated as proportions with 95% confidence intervals. Continuous variables, such as number of community mobilization activities carried out by HEWs in the last 3 months, were reported as means with the range also reported. Population density indicators were calculated per 1,000 children under five in each health post catchment area.

Results were also shown for each zone within the intervention and comparison areas. Standard errors and associated 95% confidence intervals for HEW and child-level variables were calculated using the Taylor linearization method to account for clustering of HEWs and children within health posts.[123] Analyses were carried out in Stata 12[124] and Stata 13.[125]

2.11.2. Assessment of Methods for Assessing Quality of Care of CHWs

For the examination of methods of recruiting sick children, we compared patient characteristics stratified by recruitment method using point estimates of proportions of children with a given characteristic and the corresponding 95% confidence intervals.

For the assessment of the validity of register review and direct observation, we calculated estimates of indicators of quality of care based on DO with RE, from RR and from DO for the same children. We selected key indicators that could be determined from DO with RE and from RR. For DO with RE, the determination of correct management was based on the classification from the re-examination. For RR, correct management was determined by checking consistency between recorded signs and symptoms, results of diagnostic tests and treatment/referral in the patient register. If an item in the register was empty, we assumed that the sign or symptom was not present; the task was not performed; or the diagnostic test, classification, treatment, or referral was not given. For DO, we determined correct treatment by assessing consistency between the HEW's classification and the treatment given. We calculated sensitivity, specificity and kappa statistic for RR and for DO, considering DO with RE to be the gold standard. Sensitivity is calculated as the proportion of children who are correctly managed or receive a given task according to the gold standard that are categorized as having been correctly managed/having received the task according to RR. Specificity is the proportion of children who were not correctly managed or did not receive a given task according to the gold standard that were categorized as being incorrectly managed or not having received the task according to RR. The kappa statistic measures the level of agreement beyond what was not due to chance.[126] The kappa statistic was categorized as: no agreement better than chance alone, poor, fair, moderate, substantial and near perfect agreement if the value was < 0, 0.00-0.20, 0.21-0.40, 0.41-0.60, 0.61-0.80 and 0.81-1.00, respectively.[127]

To assess the influence of the Hawthorne effect, we compared data from RR for children who were observed by the study team and from RR for children who were not observed by the study team (i.e. children who received consultations by the HEWs prior to the study visit). Again, we determined values of indicators of quality of care based on consistency between recorded signs and symptoms, results of diagnostic tests and treatment/referral. We calculated the absolute differences in point estimates of values of indicators of quality of care for children observed by the survey team and for children not observed by the survey team. We tested for a significant difference by examining the confidence interval of difference between groups of children (whether the confidence interval included zero) and by calculating a p-value for a two-sample test of difference in proportions.

2.11.3. Assessment of the Association Between Quality of Care and ICCM Interventions

We used logistic regression analysis to examine associations between quality of care and iCCM program interventions expected to improve HEW performance. The outcome variable was whether a child received correct management for major iCCM illnesses. The predictors of interest were: 1) HEW received follow-up training on iCCM, 2) HEW attended at least one PRCM meeting, 3) health post received supervision on iCCM in the previous three months, 4) HEW receive clinical instruction on iCCM during a visit to a health center in the previous three months, 5) number of essential iCCM drugs available on the day of data collection and 6) number of essential iCCM supplies available on the day of data collection.

Potential confounders of the relationship between the interventions and quality of care were assessed. These included zone, *woreda*, distance from the health post to the nearest referral health facility, malaria burden of the health post catchment area and the number of sick child consultations at the health post in the previous month (caseload). Other child and HEW-level variables could potentially have affected quality of care, but these were not expected to be associated with the interventions, therefore they would not be confounders of the associations of interest. The first step was to run bivariate logistic regressions of the outcome on potential confounding variables. Potential confounders with a p-value ≤ 0.1 or those determined a priori to be important potential confounders, were retained for further assessment. For these variables, we assessed differences in the coefficients of the predictors of interest between a null model with the predictors of interest, but without the potential confounder and a full model with the predictors of interest and the confounder. Likelihood ratio tests with the null and full models were conducted to assess model fit with and without the confounder. Variables that changed the coefficient of at least one predictor of interest by $\geq$20% and improved model fit were included in the final model. We also assessed for interactions between caseload and the predictors. We assessed the p-values of the interaction variable ($p \leq 0.05$ was considered statistically significant) in the full model and conducted likelihood ratio tests to assess whether model fit significantly improved with the interaction variable included. Interaction variables that were statistically significant and improved model fit were included in the final model. Once we assessed potential confounders and interactions, we looked at whether to include random effects to account for random variation in quality of care among health posts and among HEWs. We ran a two-level random intercept with child and health post levels and tested whether the intra-cluster correlation coefficient (ICC) was statistically different from zero. This was then repeated for a random intercept with child and HEW levels. The final model was assessed for goodness of fit using a Pearson chi-squared goodness-of-fit test. Finally, we performed multivariate logistic regression analysis to assess associations between the quality improvement interventions and quality of care. Variables in the final multivariate model were considered statistically significant if the p-value of the coefficient was $\leq$0.05.

2.12. Ethical Considerations

2.12.1. Risks & Benefits to Subjects

Risks to study subjects for involvement in the survey were minimal. Loss of time by HEWs and community respondents was the main burden from participation. There may have been emotional risks associated with discussion of ill children and negative outcomes. Interviewers were trained to minimize this risk. No direct benefit was accrued by the respondents in the proposed study. However, information obtained will be used to improve health service delivery in their communities.

2.12.2. Informed Consent

Informed consent was obtained from all study respondents prior to any data collection. Data collectors obtained oral consent from HEWs and caretakers of children who are observed receiving consultations in the health posts and from caretakers of children who are selected from communities to receive consultations from HEWs. Assent was obtained from caretakers who were under 15 years of age and unmarried and consent was obtained from their parents.

2.12.3. Costs & Compensation

There were no monetary compensation for the respondents and the respondents did not incur any out-of-pocket costs.

2.12.4. Confidentiality Assurances

Potentially sensitive and personal information on child health and illness was collected from caretakers. HEWs related information about their work practices or other personal details that they may not want others to know. Confidentiality of every respondent was protected to the extent possible. All data were carefully stored in lockers and accessible only to the investigators. All data were stored on password-protected computers with access only to the investigators. The data sets collected through the evaluation will be made available for public access two years after the major results are published.

2.12.5. Intervention in Case of HEW Error or Life-Threatening Action

If an HEW failed to prescribe needed treatments according to the gold standard classification or if the HEW prescribed any harmful treatments, the data collectors would discuss any discrepancies with the HEW and ensure that the correct treatment was provided. Survey teams carried a stock of iCCM drugs and RDTs in case the health post was out of stock. If necessary, the survey team facilitated referral to a health facility for children with severe illness.

If a data collector observed sick child consultations and determined that the HEW's actions threatened the life of the patient (e.g. a health worker preparing to give an injection that appeared to be a lethal overdose, or a health worker not treating obvious cardiopulmonary distress), the data collectors were trained to intervene and assist the HEW in giving correct treatment.

2.12.6. Referring Participants for Care

If the data collectors encountered a life-threatening illness in a participant that could not be managed appropriately in the setting where the observation took place, study personnel were instructed to do their utmost to assist in obtaining appropriate care for the child, including providing transportation to a higher-level health facility.

2.12.7. Conflict of Interest

There were no other gains from taking part in this study other than the normal scholarly gains.

2.12.8. Ethical Clearance

Ethical approval was obtained from the Oromia Regional Health Bureau and the Institutional Review Board of JHSPH.

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Box 1: Definitions of key terms

Integrated community case management: In general, iCCM refers to the concurrent management of more than one common childhood illness. ICCM in Ethiopia (implemented in study intervention areas) is integrated management by an HEW at the community level of all of the following childhood illnesses: pneumonia, diarrhea (ORS and zinc), malaria, malnutrition, measles, anemia, and ear infection.

Routine CCM: The routine CCM program in Ethiopia (implemented in study comparison areas) includes community case management of diarrhea (ORS only), malaria, malnutrition, measles, ear infection, and anemia. Pneumonia cases are referred to health centers.

Implementation strength: This term refers to the quantity of effective program activities carried out to reduce child mortality. These activities include training, supportive supervision, and continued availability of essential iCCM commodities.

Quality of care: We assessed quality based on whether HEWs correctly assessed, classified, treated, and referred children with iCCM illnesses and provided counseling to caretakers based on Ethiopia iCCM clinical guidelines.

Correct classification: All HEW classifications matched gold standard classifications.

Correct treatment: All HEW treatments matched gold standard treatments including correct dose, duration, and frequency.

Eligible iCCM illness: Lethargy or unconsciousness, convulsions, not eating or drinking, fever/malaria, cough, fast/difficulty breathing, diarrhea, vomiting, ear problem, signs/history of measles, malnutrition, feeding problems, or anemia.

Uncomplicated illness: Uncomplicated pneumonia, diarrhea, malaria, measles, malnutrition, eye infection, or anemia.

Severe illness: A child was considered to have a severe illness if the child had any of the following: any general danger sign (not able to drink/breastfeed, vomits everything, convulsions, lethargic or unconscious), severe pneumonia, diarrhea with severe dehydration, severe persistent diarrhea, persistent diarrhea, dysentery, very severe febrile disease, severe complicated measles, severe complicated malnutrition, or severe anemia.

General danger signs: Able to drink/breastfeed, vomits everything, had convulsions, and lethargy.

Major iCCM illnesses: Pneumonia, diarrhea, malaria, measles, malnutrition, and danger signs.

Essential commodities for iCCM: Cotrimoxazole, ORS, zinc, ACT, chloroquine, RUTF, and rapid diagnostic tests [RDT] for malaria.

Essential commodities for routine CCM: ORS, ACT, chloroquine, RUTF, and RDT. Cotrimoxazole and zinc are not part of the routine CCM package.

Box 1: Definitions of key terms, continued

Essential commodities for routine CCM: ORS, ACT, chloroquine, RUTF, and RDT. Cotrimoxazole and zinc are not part of the routine CCM package.

Essential supplies and job aids for iCCM: Functional timer, thermometer, weighing scale, clean water, MUAC, supplies to mix ORS, iCCM chart booklet, iCCM patient register.

Essential supplies and job aids for routine CCM in comparison areas: Functional timer, thermometer, weighing scale, clean water, MUAC, supplies to mix ORS, and patient register.

Supervision with clinical reinforcement: Supervision with observation of patient consultations or register review.

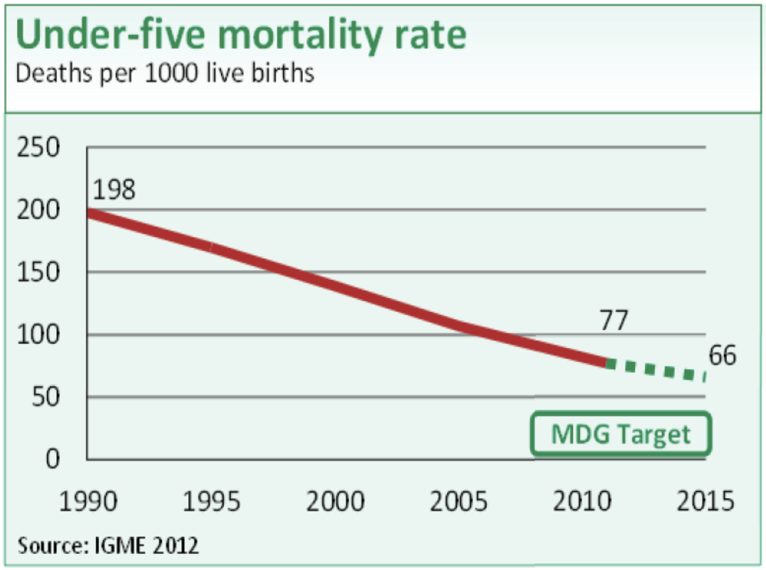
11 key assessment tasks: Checked whether child is able to drink/breastfeed, checked whether child vomits everything, checked whether child has had convulsions, checked whether child has lethargy, checked for cough or fast/difficult breathing, checked for diarrhea, checked for fever, checked for edema, checked for low MUAC ($\geq$ six months) or visible severe wasting (< six months), checked for palmar pallor, checked child's vaccination status.

Validity: The degree to which a method is able to depict the technical quality of services accurately.

Table 1: Key child health indicators in Ethiopia

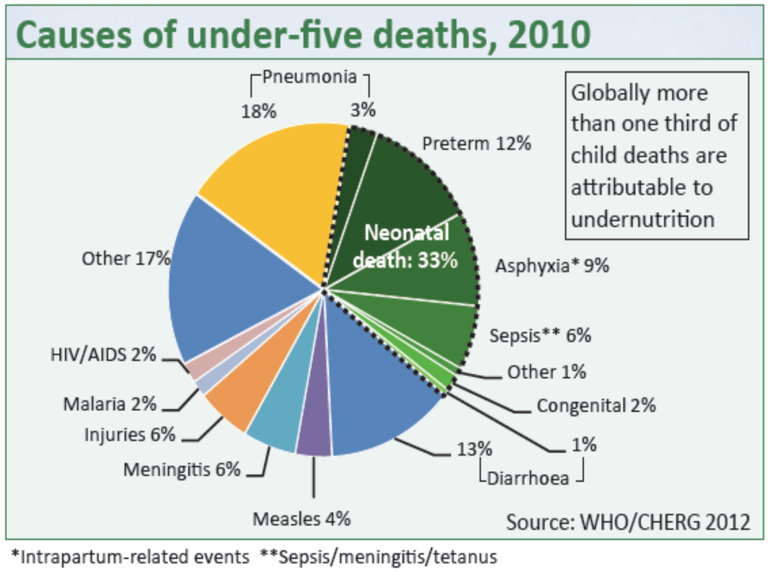
Indicator	Rate/%	Year	Source
Under-five mortality rate	88/1,000 live births	2007-2011	EDHS[96]
Infant mortality rate	59/1,000 live births	2007-2011	EDHS
Neonatal mortality rate	37/1,000 live births	2007-2011	EDHS
Fully vaccinated (12-23 months)	24%	2011	EDHS
Measles vaccination coverage	56%	2011	EDHS
DPT3 coverage	37%	2011	EDHS
Vitamin A supplementation (6-59 months, previous 6 months)	53%	2011	EDHS
Stunting (<5s)	44%	2011	EDHS
Wasting (<5s)	10%	2011	EDHS
Fever in previous 2 weeks (<5s)	17%	2011	EDHS
Under-fives with fever who took antimalarial	4%	2011	EDHS
Under-fives with diarrhea in previous 2 weeks	13%	2011	EDHS
Under-fives with diarrhea who took ORT	31%	2011	EDHS
Under-fives with ARI in previous 2 weeks	7%	2011	EDHS
Under-fives with ARI who took antibiotic	7%	2011	EDHS

Figure 1: Trend in under-five mortality in Ethiopia



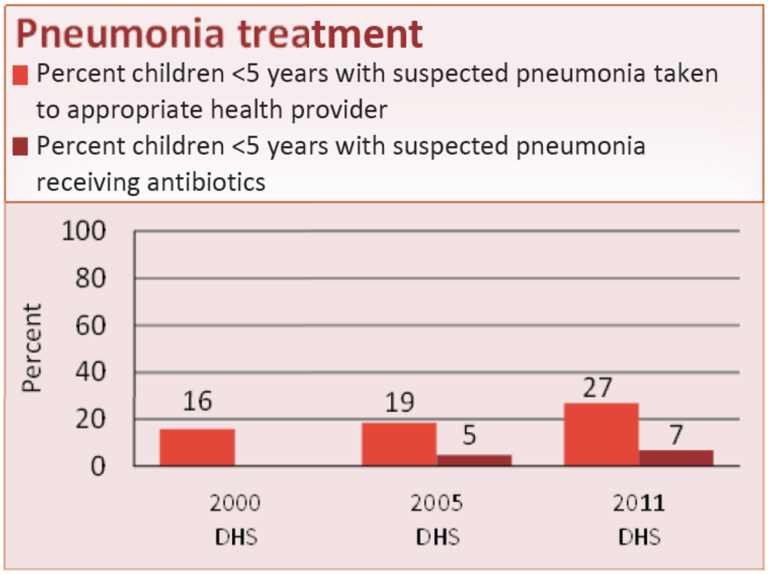
Source: Countdown to 2015[128]

Figure 2: Causes of under-five deaths in Ethiopia, 2010



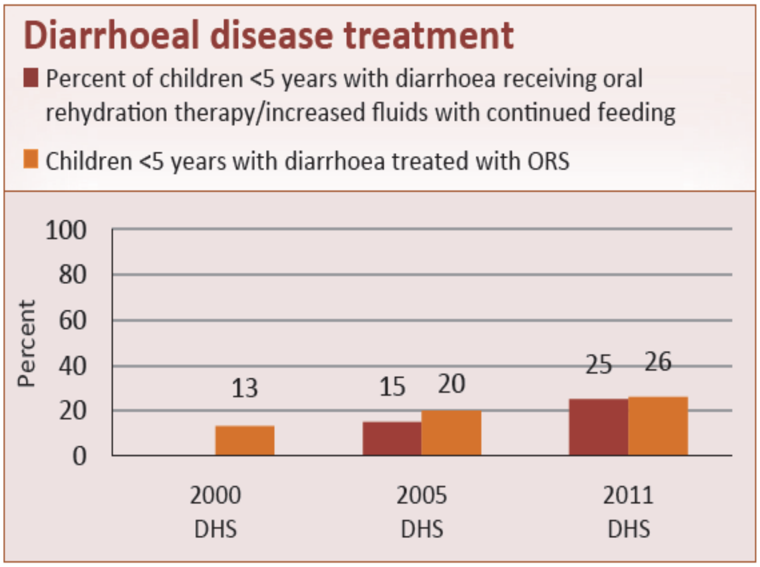
Source: Countdown to 2015

Figure 3: Care seeking and coverage of antibiotic treatment for pneumonia among children under five years of age, Ethiopia



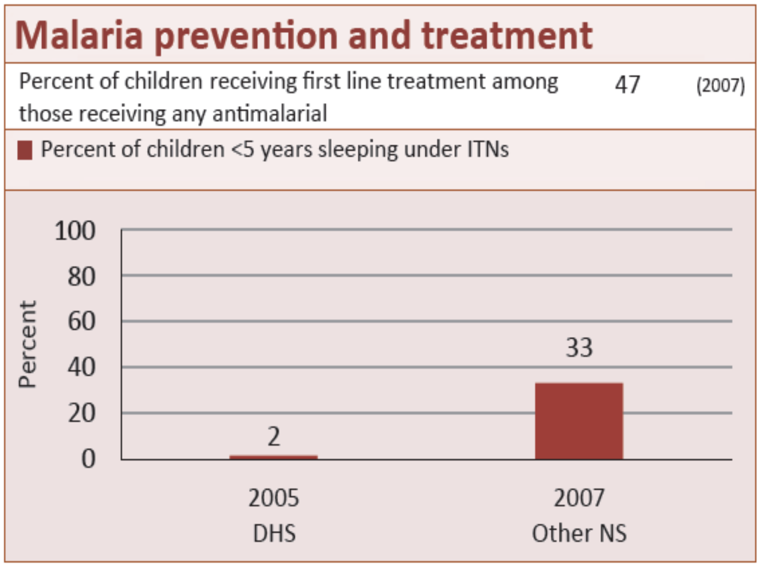
Source: Countdown to 2015

Figure 4: Coverage of antibiotic treatment for diarrhea among children under five years of age, Ethiopia



Source: Countdown to 2015

Figure 5: Coverage of antimalarial treatment for malaria and ITN coverage among children under five years of age, Ethiopia



Source: Countdown to 2015

Table 2: HEW Characteristics

Training	One year, includes practical training
Payment/incentives	Government employees with regular salary of around 670 birr (USD 39[a]) per month
Gender	Female
Literacy required	Yes
Education	Completed grade 10
From the community in which they work	Yes[b]
Community involved in selection	Yes[b]
Catchment population	5,000 per health post
Live in the community	Yes[b]
Supervision	1 supervisor for 5 HPs (10 HEWs)

Source: Health Extension and Education Center[102]

[a] Based on the exchange rate from September 2, 2011.

[b] According to policy, but this may not always be the case in practice.

Table 3: HEP Programs and Service Packages

Programs	Service packages
Disease prevention and control	HIV/AIDS STIs TB Malaria First aid
Case management of illnesses	Malaria Diarrhea Pneumonia Trachoma Helminthiasis
Family health	Maternal and child health Family planning Immunization Nutrition Adolescent reproductive health
Hygiene and environmental sanitation	Excreta disposal Solid and liquid waste disposal Water supply and safety Food hygiene and safety Healthy home environment Control of insects and rodents Personal hygiene
Health education and communication	Cross-cutting

Source: Health Extension and Education Center[102]

Table 4: Comparison of case management guidelines and program inputs for the Ethiopia iCCM program versus routine CCM

	ICCM	Routine CCM
Management of iCCM illnesses for children 2-59 months		
Pneumonia	– Cotrimoxazole	– Referral to health center
Severe pneumonia	– Pre-referral treatment with cotrimoxazole – Referral to health center	– Referral to health center
Diarrhea (some dehydration, no dehydration)	– ORS/ORT – Zinc	– ORS/ORT
Severe diarrhea (severe dehydration, persistent diarrhea, severe persistent diarrhea, dysentery)	– ORS – Vitamin A (for persistent and severe persistent diarrhea only) – Referral to health center	– ORS – Vitamin A (for persistent and severe persistent diarrhea only) – Referral to health center
Malaria	– Antimalarial	– Antimalarial
Severe febrile disease	– Pre-referral treatment with cotrimoxazole – Referral to health center	– Referral to health center
Uncomplicated malnutrition	– RUTF or supplementary feeding program	– RUTF or supplementary feeding program
Severe complicated malnutrition	– Pre-referral treatment with amoxicillin and vitamin A – Referral to health center	– Pre-referral treatment with amoxicillin and vitamin A – Referral to health center
Program inputs		
Training	– 6-day training on iCCM	– No additional training
Supervision	– Standardized supportive supervision on iCCM supported by partner NGOs plus standard government supervision – Bi-annual Performance Review and Clinical Mentoring meetings	– Standard government supervision
Supply of commodities	– Support for purchase and supply of drugs and other commodities by UNICEF and partners – Provision of iCCM registers, iCCM chart booklets, timers and other supplies	– Standard government commodity supply chain system – No additional supplies or job aids
Monitoring and evaluation	– Enhanced data collection during supervisions and PRCM meetings – Data management support by UNICEF	– Standard government monitoring and evaluation

Source: UNICEF Ethiopia

Figure 6: ICCM impact model

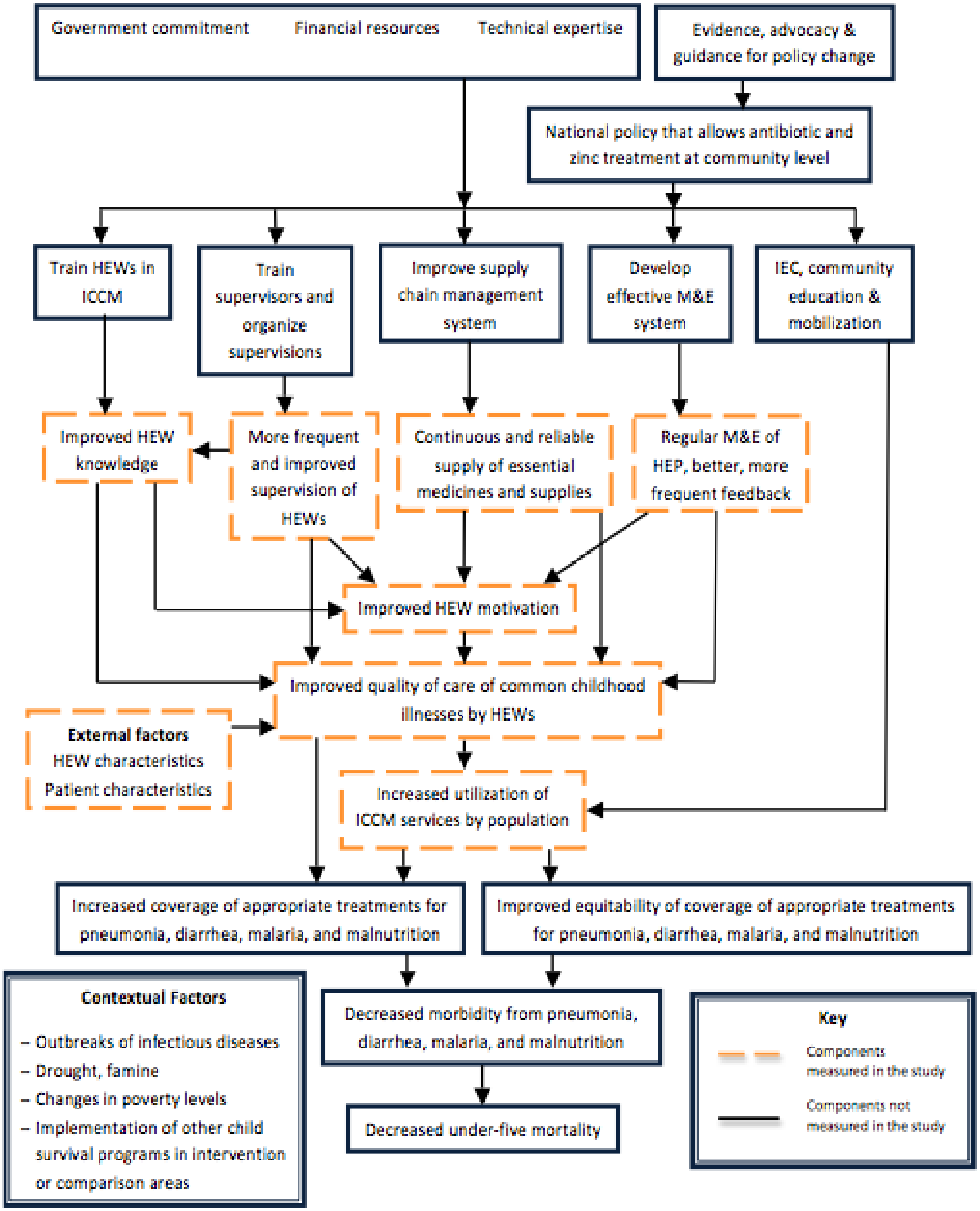


Table 5: Health worker assessment methods and advantages/disadvantages of each method

Method	Measurement objective	Advantages	Drawbacks
Observation of consultations with sick children and clinician re-examination	Quality of care	– Gold standard assessment – Allows measurement of quality of care	– Can be time-consuming – Need clinician as data collector
Observation of consultations with sick children	Performance	– Closest to gold standard observation and clinician re-examination – Allows observation of actual performance	– Don't know actual gold standard diagnosis – Difficult to observe some actions by CHWs
Observation of consultations with sick children found in the community	Performance	– Close to observation of routine consultation – Allows observation of actual performance	– May be logistically difficult – May be time-consuming – Potential bias in case mix – Potential bias in performance – Ethical issues
Simulated consultations based on videotaped patients	Competence	– Provides approximation of observation of consultations – Assesses more than knowledge – Can be used for assessment of severe illness	– Potential bias in performance – Logistically difficult to show videos – May not reflect actual performance
Simulated consultations using role-play with an actor	Competence	– Provides approximation of observation of consultations – Assesses more than knowledge – Can be used for assessment of severe illness	– Potential bias in performance – Logistically difficult and expensive to use actor – May not reflect actual performance
Simulated consultations using role-play with a doll	Competence	– Provides approximation of observation of consultations – Assesses more than knowledge – Logistically easy and cheap – Can be used for assessment of severe illness	– Potential bias in performance – May not reflect actual performance

Patient register review	Routine performance	– Logistically easy and cheap – Good for assessing treatment – Provides information on severe illnesses – Assesses actual performance	– Provides little information – May not be complete or accurate
Written or oral case scenarios	Knowledge	– Logistically easy and cheap – Good for assessment of severe illness	– Limited to assessment of knowledge – May not reflect actual performance
Interviews with caretakers of children who were previously seen by the HEWs	Patient satisfaction, routine performance	– Exit interviews found to be fairly reliable – Assesses actual performance	– Recall bias likely – Logistically difficult – Time-consuming

Table 6: Summary of studies to measure CCM quality of care and the methods employed

Reference	Year	Country	Study Site	Methods	Measures
Rogers et al.	1991	Papua New Guinea	Community	– Direct observation	– QoC
Zeitz et al.	1993	Bolivia	Health facility	– Direct observation – Role play with doll – Videotaped case – Exam – Medication evaluation	– QoC
Ashwell & Freeman	1995	Papua New Guinea	Community	– Direct observation – Exam – Questionnaire	– QoC
Freeman et al.	1995	Papua New Guinea	Community & health facility	– Direct observation	– QoC
Fagbule & Kalu	1995	Nigeria	Health facility	– Direct observation – Caretaker exit interview – Checklist for drugs & supplies – CHW interview	– Training – Drugs & supplies – Supervision – QoC
Beracochea et al.	1995	Papua New Guinea	Community	– Direct observation – Questionnaire	– QoC
Curtale et al.	1995	Nepal	Community	– CHW Interview	– Training – Drugs & supplies – Supervision – QoC
Mehnaz et al.	1997	Pakistan	Community	– Register review – Re-examination by clinician	– QoC
Kelly et al.	2001	Kenya	Health facility	– Direct observation	– QoC
Hadi et al.	2003	Bangladesh	Community	– Direct observation – Re-examination by clinician	– QoC
Rowe et al.	2007a	Kenya	Health facility	– Register review	– QoC
Rowe et al.	2007b	Kenya	Health facility	– Direct observation – Re-examination by clinician – Caretaker exit interview – Questionnaire	– QoC
Baqui et al.	2009	Bangladesh	Community	– Re-examination by clinician	– QoC
Darmstadt et al.	2009	Bangladesh	Community	– Re-examination by clinician	– QoC
Mukanga et al.	2011	Uganda	Health facility	– Direct observation – Re-examination by clinician	– QoC
Gilroy et al.	2012	Malawi	Community	– Direct observation – Caretaker exit interview	– Training – Drugs &

	– Checklist for drugs & supplies – CHW interview – Case scenarios	supplies – Supervision – QoC

Figure 7: Map of Jimma and West Hararghe Zones, Oromia Region, Ethiopia

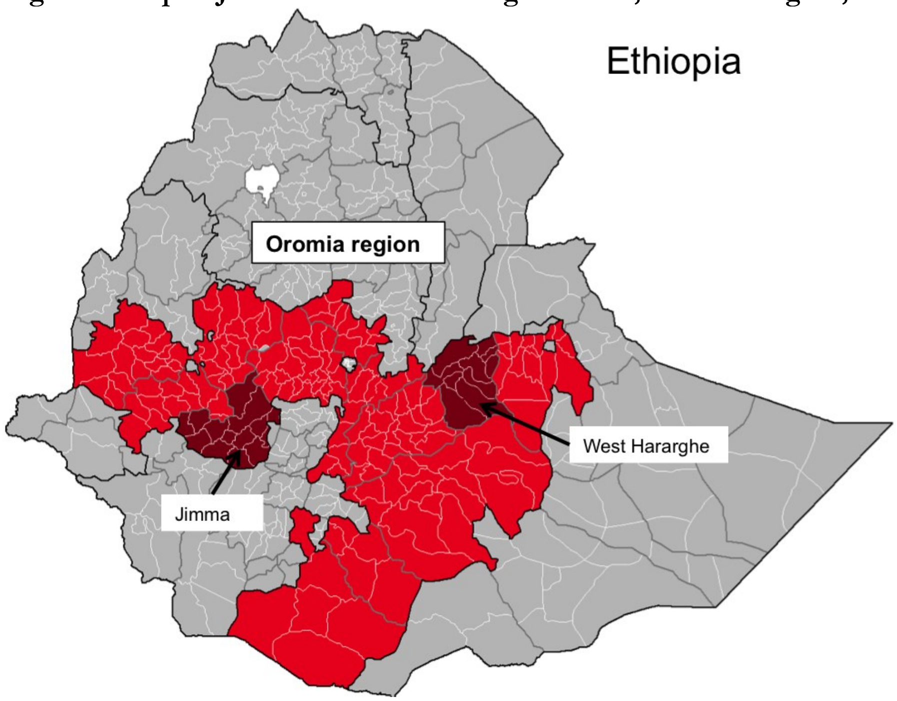


Table 7: ICCM evaluation interventions and comparison *woredas,* Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Jimma		West Hararghe	
Intervention *Woredas*	**Comparison *Woredas***	**Intervention *Woredas***	**Comparison *Woredas***
Chora Botor	Dedo	Boke	Anchar
Gera	Gumay	Chiro	Burka dimtu
Goma	Limu Seka	Doba	Daro Labu
Kersa	Nono Benja	Gemechis	Habro
Limu Kosa	Seka Chokorsa	Guba Koricha	Mesela
Mana	Sokoru	Hawi Gudina	Mieso
Shebe Senbo	Tiro Afeta	Oda Bultum	Tulo
Omo Nada	Sigamo		
Setema			

Table 8: Characteristics of the iCCM intervention and comparison areas, Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Household Characteristics

	Intervention *Woredas*	**Comparison *Woredas***	**Total**
Household headship			
Male	82.3	82.2	82.3
Female	13.1	15.5	14.2
Missing	4.6	2.3	3.5
Mean household size	5.3	5.5	5.4
Improved water source	44.2	42.2	43.3
Improved latrine[a]	3.0	3.4	3.2
Number of Households	1577	1573	3150

Characteristics of Women 15-49 Years

	Intervention *Woredas*	**Comparison *Woredas***	**Total**
Women's schooling			
No schooling	70.8	73.1	71.9
Primary	20.4	20.9	20.6
Secondary or higher	4.5	3.6	4.1
Missing	4.3	2.3	3.4
Religion			
Orthodox	10.0	6.4	8.3
Catholic	1.1	0.2	0.7
Protestant	1.6	3.9	2.7
Muslim	84.1	88.5	86.2
Traditional, Animist	0.4	0.1	0.3
Other	2.7	0.9	1.9
Wealth quintile			
Lowest	21.2	17.8	19.6
second	16.3	22.9	19.4
Middle	17.1	23.0	19.9
Fourth	20.2	20.0	20.1
Highest	24.0	15.5	20.0
Missing	1.2	0.8	1.0
Number of women	1541	1564	3105

Characteristics of Children Under 5 Years

	Intervention *Woredas*	**Comparison *Woredas***	**Total**
Age in months			
0-11 months	22.8	21.8	22.3

12-23 months	16.2	18.1	17.1
24-35 months	19.7	18.6	19.2
36-47 months	24.0	22.7	23.3
48-59 months	17.4	18.8	18.0
Sex			
Male	53.1	49.8	51.5
Female	46.9	50.2	48.5
Number of children under 5	1369	1477	2846

[a] Connection to sewer or septic system, pour-flush latrine, pit latrine or VIP.

Table 9: Sample size required in the intervention *woredas* at varying levels of precision

Health Post-level Indicators (Proportions)			HEW or Patient-level Indicators (Proportions)		
Precision	**Sample size (# of HPs)**	**Sample size (# of HEWs)**	**Precision**	**Sample size (# of HEWs)**	**Sample size (# of HPs)**
.05	406	609	.05	557	372
.06	282	423	.06	386	258
.07	207	311	.07	284	190
.08	159	239	.08	219	146
.09	126	189	.09	172	115
.1	103	156	.1	141	94
.11	85	128	.11	116	78
.12	71	107	.12	97	65
.13	60	90	.13	83	56
.14	52	78	.14	71	48
.15	46	69	.15	63	42

Assumptions:

- Confidence level = 0.95
- Proportion = 50%
- Non-response = 5%
- 1.5 HEWs per health post

Assumptions:

- Confidence level = 0.95
- Proportion = 50%
- Design effect = 1.3
- Non-response = 10%

Table 10: Names, definitions and measurement methods for primary indicators measured in the implementation snapshot and quality of care assessment in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Indicator Name	Indicator Definition	Numerator	Denominator	Measurement Method
HEW trained in iCCM	Proportion of HEWs who received the standardized iCCM in February 2011 or later	Number of HEWs who received the standardized iCCM in February 2011 or later	Number of HEWs	HEW interview
Availability of iCCM commodities	Proportion of health posts with all essential iCCM commodities in stock on the day of data collection	Number of health posts with all essential iCCM commodities in stock on the day of data collection	Number of health posts	Health post inspection
Continued medicine and diagnostic availability	Proportion of health posts with no stockout of any essential iCCM commodities lasting longer than seven consecutive days in the previous three months	Number of health posts with no stockout of any essential iCCM commodities lasting longer than seven consecutive days in the previous three months	Number of health posts	Health post inspection
Availability of iCCM supplies and job aids	Proportion of health posts with all essential supplies and job aids available on the day of data collection	Number of health posts with all essential supplies and job aids available on the day of data collection	Number of health posts	Health post inspection
ICCM supervision	Proportion of health posts that received at least one supervisory contact related to iCCM in the previous three months	Number of health posts that received at least one supervisory contact related to iCCM in the previous three months	Number of health posts	HEW interview
ICCM supervision with clinical reinforcement	Proportion of health posts that received at least one supervisory contact during the previous three months during which a sick child consultation was observed or the iCCM registration book was reviewed	Number of health posts that received at least one supervisory contact during the previous three months during which a sick child consultation was observed or the iCCM registration book was reviewed	Number of health posts	HEW interview

Health center visits with iCCM instruction	Proportion of HEWs who visited a health center and were instructed in iCCM clinical practice in the previous three months	Number of HEWs who visited a health center and were instructed in iCCM clinical practice in the previous three months	Number of HEWs	HEW interview
Utilization of iCCM services	Mean number of sick child consultations for children under five in the previous month in surveyed health posts	Number of sick child consultations for children under five in the previous month in surveyed health posts	Number of health posts	Register review
Assessment of general danger signs	Proportion of children who were assessed for all four general danger signs	Number of children who were assessed for all four general danger signs	Number of children	Observation of HEW consultation
Assessment of cough, diarrhea, fever and malnutrition	Proportion of children who were assessed for presence of cough or fast/difficult breathing, diarrhea, fever and malnutrition	Number of children who were assessed for presence of cough or fast/difficult breathing, diarrhea, fever and malnutrition	Number of children	Observation of HEW consultation
Index of integrated assessment	Arithmetic mean of 11 key assessment tasks	Number of key assessment tasks performed for each child	Number of children	Observation of HEW consultation
Assessment of respiratory rate	Proportion of children with cough or difficult breathing who were assessed for fast breathing through counting of respiratory rate	Number of children with cough or difficult breathing who were assessed for fast breathing through counting of respiratory rate	Number of children with cough or difficult breathing	Observation of HEW consultation and re-examination
Respiratory rate correctly assessed	Proportion of children whose respiratory rate counted by HEW was within +/- 2 breaths of the gold standard	Number of children whose respiratory rate counted by HEW was within +/- 2 breaths of the gold standard	Number of children whose respiratory rate was counted by the re-examiner	Observation of HEW consultation and re-examination

Assessment of vaccination status	Proportion of children who did not need referral who had their vaccination status assessed by the HEW	Number of children who did not need referral who had their vaccination status assessed by the HEW	Number of children who did not need referral	Observation of HEW consultation and re-examination
Classification of iCCM illnesses	Proportion of children who were correctly classified for all major iCCM illnesses	Number of children who were correctly classified for all major iCCM illnesses	Number of children	Observation of HEW consultation and re-examination
Classification of immunization status	Proportion of children under 24 months of age not up-to-date on immunizations who were classified as not up-to-date on immunizations	Number of children under 24 months of age not up-to-date on immunizations who were classified as not up-to-date on immunizations	Number of children under 24 months of age not up-to-date on immunizations	Observation of HEW consultation and re-examination
Management of iCCM illnesses	Proportion of children who were correctly treated/referred for all major iCCM illnesses	Number of children who were correctly treated/referred for all major iCCM illnesses	Number of children	Observation of HEW consultation and re-examination
Treatment of pneumonia	Proportion of children with pneumonia who were correctly treated for pneumonia	Number of children with pneumonia who were correctly treated for pneumonia	Number of children with pneumonia	Observation of HEW consultation and re-examination
Treatment of diarrhea	Proportion of children with diarrhea who were correctly treated for diarrhea	Number of children with diarrhea who were correctly treated for diarrhea	Number of children with diarrhea	Observation of HEW consultation and re-examination

Treatment of malaria	Proportion of children with malaria who were correctly treated for malaria	Number of children with malaria who were correctly treated for malaria	Number of children with malaria	Observation of HEW consultation and re-examination
Treatment of malnutrition	Proportion of children with malnutrition who were correctly treated for malnutrition	Number of children with malnutrition who were correctly treated for malnutrition	Number of children with malnutrition	Observation of HEW consultation and re-examination
Treatment of measles	Proportion of children with measles who were correctly treated for measles	Number of children with measles who were correctly treated for measles	Number of children with measles	Observation of HEW consultation and re-examination
Management of severe illness	Proportion of children with severe illness were correctly treated/referred	Number of children with severe illness were correctly treated/referred	Number of children with severe illness	Observation of HEW consultation and re-examination
Referral	Proportion of children needing referral who received referral	Number of children needing referral who received referral	Number of children needing referral	Observation of HEW consultation and re-examination
First dose	Proportion of children who did not need referral and who needed treatment who received the first dose of all needed treatments[a] in presence of the HEW	Number of children who did not need referral and who needed treatment who received the first dose of all needed treatments in presence of the HEW	Number of children who did not need referral and who needed treatment	Observation of HEW consultation and re-examination

Vitamin A supplementation	Proportion of children six months or older who needed vitamin A supplementation who received vitamin A	Number of children six months or older who needed vitamin A supplementation who received vitamin A	Number of children six months or older who needed vitamin A supplementati on	Observation of HEW consultation and re-examination
Mebendazole supplementation	Proportion of children 24 months or older who needed mebendazole who received mebendazole	Number of children 24 months or older who needed mebendazole who received mebendazole	Number of children 24 months or older who needed mebendazole	Observation of HEW consultation and re-examination
Treatment demonstration	Proportion of children who did not need referral and were prescribed home treatment for whom the HEW demonstrated to the caretaker how to administer all treatments	Number of children who did not need referral and were prescribed home treatment for whom the HEW demonstrated to the caretaker how to administer all treatments	Number of children who did not need referral and were prescribed home treatment	Observation of HEW consultation and re-examination
Caretaker comprehension	Proportion of children who did not need referral and who received treatment whose caretaker could correctly describe how to give all treatments	Number of children who did not need referral and who received treatment whose caretaker could correctly describe how to give all treatments	Number of children who did not need referral and who received treatment	Observation of HEW consultation and re-examination

Advising on extra fluids and continued feeding	Proportion of children with diarrhea who did not need referral whose caretaker was advised to give extra fluids and continue feeding	Number of children with diarrhea who did not need referral whose caretaker was advised to give extra fluids and continue feeding	Number of children with diarrhea who did not need referral	Observation of HEW consultation and re-examination
Advising on when to return immediately	Proportion of children who did not need referral whose caretaker was advised to return immediately if child cannot drink/breastfeed or gets sicker	Number of children who did not need referral whose caretaker was advised to return immediately if child cannot drink/breastfeed or gets sicker	Number of children who did not need referral	Observation of HEW consultation and re-examination
Advising on when to return for follow-up	Proportion of children who did not need referral whose caretaker was advised on when to return for follow-up	Number of children who did not need referral whose caretaker was advised on when to return for follow-up	Number of children who did not need referral	Observation of HEW consultation and re-examination
Rationale use of antibiotics	Proportion of children who did not need an antibiotic who left the health post without having received an antibiotic	Number of children who did not need an antibiotic who left the health post without having received an antibiotic	Number of children who did not need an antibiotic	Observation of HEW consultation and re-examination
Rationale use of antimalarials	Proportion of children who did not need an antimalarial who left the health post without having received an antimalarial	Number of children who did not need an antimalarial who left the health post without having received an antimalarial	Number of children who did not need an antimalarial	Observation of HEW consultation and re-examination
Health post opening hours	Mean number of hours that health posts were open and offering clinical services in the previous week	Number of hours that health posts were open and offering clinical services in the previous week	Number of health posts	HEW interview

Time spent by HEWs providing clinical services	Mean hours spent by HEWs providing clinical services in the previous day (by health post and community)	Hours spent by HEWs providing clinical services in the previous day	Number of HEWs	HEW interview

[a] Includes cotrimoxazole, ORS, zinc, vitamin A, ACT, chloroquine and amoxicillin.

Table 11: Survey questionnaires implemented in selected intervention and comparison health posts in Jimma and West Hararghe Zones, Oromia Region, Ethiopia, 2012

Questionnaire	Intervention	Comparison
Health Post Questionnaire Panel	Yes	Yes
Observation Checklist	Yes	No
Caretaker Exit Interview	Yes	No
Re-examination Form	Yes	No
Equipment, Supplies and Support Checklist	Yes	Yes
HEW Questionnaire	Yes	Yes

Paper 1: Integrated community case management of childhood illness in Ethiopia: Implementation strength and quality of care

1. Introduction

Pneumonia, diarrhea and malaria are among the leading causes of mortality in children under five years globally.[1] Effective therapies for these conditions exist,[2] but children in poor rural communities often do not have access to formal health care[3, 4] and coverage of these interventions remains low in many countries.[5] Delivery of care through community health workers (CHWs) can increase coverage of specific treatments[6-8] and lead to substantial reductions in child mortality.[9-13] The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) recommend integrated community case management (iCCM) of pneumonia, diarrhea and malaria.[14] However, few rigorous assessments of iCCM services have been conducted and the limited evidence on quality of care is mixed.[15-19]

Following a national policy change supporting community-based treatment of childhood pneumonia by Health Extension Workers (HEWs) in early 2010, Ethiopia has scaled-up a comprehensive iCCM program in most regions of the country. Antibiotic therapy (with cotrimoxazole) for pneumonia and zinc for treatment of diarrhea have been added to the pre-existing community case management (routine CCM) program, which included management of childhood diarrhea (with oral rehydration salts [ORS] only), malaria, malnutrition, measles, ear infection and anemia. The iCCM program also provides training for HEWs, strengthened supervision, improved supply chain management for essential commodities and enhanced monitoring and evaluation.

The iCCM program was phased in by zones and *woredas* (districts) in Oromia Region, which is the largest region and accounts for 37% of the population of Ethiopia.[20] This allowed for randomization of intervention and comparison *woredas* in two zones for an independent prospective evaluation of the impact of iCCM. As part of this evaluation, we conducted an assessment of the strength of iCCM implementation and the quality of care provided by HEWs. This survey was the first to evaluate the scale-up of iCCM in Ethiopia and the first rigorous assessment of the quality of care provided by HEWs. It is also one of the first studies to assess the quality of iCCM services in sub-Saharan Africa.

2. Methods

We conducted a cross-sectional survey including random samples of rural health posts in intervention and comparison areas in Jimma and West Hararghe Zones. All HEWs present and providing case management services in selected health posts were enrolled. Patients in intervention areas presenting spontaneously, as a result of mobilization by the HEWs, or recruited from the community by the survey team had to meet the following inclusion criteria: 1) two to 59 months of age,[*] 2) having at least one complaint consistent with an eligible iCCM illness and 3) initial consultation for the current illness episode.

We selected 104 health posts from intervention areas and 46 from comparison areas. Sample sizes were calculated under the following assumptions: proportions of the indicators were 50%; 95% confidence; and non-response of 5% for health posts, 5% for HEWs and 10% for patients. A design effect of 1.3 was included to account for

[*] Children younger than two months of age were excluded because we expected an extremely small sample of children in this age group, which would not justify the extra expense of training data collectors on the algorithm for children younger than two months of age.

clustering of HEWs and patients in health posts. Assuming an average of 1.5 HEWs per health post, 104 health posts allowed for estimates of health post and HEW-level indicators in intervention areas with a precision of +/- 10 percentage points. Assuming two sick children per health post, primary patient-level indicators would have a precision of +/- 9 percentage points. The smaller sample size in comparison areas allowed a precision of +/- 15 percentage points for health post and HEW-level indicators.

The survey instruments and primary indicators of implementation strength and quality of care were adapted from the WHO Health Facility Survey tool,[21] a survey of Health Surveillance Assistants in Malawi,[19] and the CCM Global Indicators.[22] Definitions of key terms are shown in Box 1. Ethical approval was obtained from the Institutional Review Boards of the Oromia Regional Health Bureau and the Johns Hopkins University Bloomberg School of Public Health.

2.1. Data collection

Data were collected in May and June 2012, about one year after completion of iCCM implementation in the intervention areas. Data collectors were health professionals who had worked as iCCM trainers or supervisors. Survey personnel were trained for seven days and all observers and re-examiners achieved at least 90% concordance with gold standard clinicians on three consecutive role-play exams. Data collectors were sent to *woredas* in which they did not normally work to avoid biasing the results. HEWs were notified of upcoming study visits and asked to mobilize caretakers to bring sick children to the health post on the day of the survey team visit. If fewer than two children presented at the health post, the team supervisor, along with an HEW or community volunteer, recruited sick children from nearby households. Eligible children received a consultation from an HEW, while a data collector silently observed and recorded details of the HEW's assessment, classification, treatment, referral and counseling. Next, the observer took the patient and caretaker away from the HEW and asked the caretaker to explain how they would administer any treatments prescribed for the child. Then the re-examiner performed a consultation with the patient and caretaker using a re-examination form that followed Ethiopia iCCM clinical guidelines. Data collectors then inspected iCCM commodities, supplies and job aids in the health post. Finally, data collectors conducted interviews with the HEWs and recorded information on sick child consultations from patient registers.

The procedures above apply to intervention areas. In comparison areas, data collectors did not observe consultations, conduct caretaker exit interviews, or re-examine children. All other procedures were the same. Data collection was limited in comparison areas because program evaluators needed measures of the strength of implementation of routine CCM, but quality of care in these areas was not assessed to reduce the time and cost of data collection. The full research protocol and study instruments are available online.[23]

2.2. Data analysis

Data were entered directly into tablet computers using Open Data Kit (ODK)[24] as the data capture software and were stored in a Research Electronic Data Capture (REDCap) database.[25] Descriptive statistics comprising proportions or means were calculated for selected indicators. Standard errors and associated 95% confidence intervals for HEW and patient-level variables were calculated using the Taylor linearization method to account for clustering within health posts.[26] Indicators of correct classification or treatment were calculated by comparing the HEWs' classifications and treatments to the gold standard re-examination and the associated treatments/referral recommended by the iCCM clinical guidelines. All analyses were carried out in Stata 12.[27] We performed clinical pathways analyses, stratified by children with severe and uncomplicated illness, to identify where case management errors occurred during assessment, classification, treatment and referral of sick children.[19, 28]

3. Results

One health post in the intervention areas was excluded because it was closed indefinitely, giving final samples of 103 health posts in intervention areas and 46 in comparison areas. All HEWs encountered in health posts were included in the study, giving samples of 137 in intervention areas and 64 in comparison areas. A total of 257 children were included in intervention areas.

Table 1 shows the characteristics of the HEWs included in the sample. All HEWs are women, and HEWs in both study arms had an average of about four years' experience as an HEW. Ninety-one percent of HEWs in intervention areas and 86% in comparison areas reported living in the same *kebele* (sub-district) in which they work. However, only 12% of HEWs in intervention areas and 6% in comparison areas reported living in the *kebele* in which they work prior to beginning their HEW training, indicating that most HEWs were not selected from the communities in which they now work.

Table 2 presents the characteristics of sick children in the sample. According to the gold standard classifications, diarrhea (66%), pneumonia (15%), malnutrition (13%) and ear infection (12%) were the most common diagnoses. Few children presented with malaria (1%), measles (2%), or anemia (4%). Spontaneous consultations accounted for only 18% of the sample of children. Thirty-seven percent were mobilized by the HEWs, and active recruitment of sick children accounted for 45%.

3.1. Program Implementation Strength

Table 3 shows the proportion of HEWs that received training and the proportion of health posts that received supervision in intervention and comparison areas. Nearly all HEWs in the intervention areas (98%) received the standardized six-day iCCM training. HEWs in 87% of health posts received at least one supervision visit related to iCCM in the previous three months and 85% of health posts received supervision that included clinical reinforcement. As expected, no HEWs in comparison areas had received the iCCM training. Only 43% of health posts in comparison areas had been supervised on routine CCM in the previous three months and 19% received supervision with clinical reinforcement.

Table 4 presents the proportions of health posts with key iCCM/routine CCM commodities, supplies and job aids on the day of data collection, and health posts with no stockout of more than seven consecutive days in the previous three months in intervention and comparison areas. Nearly 70% of intervention health posts had all seven essential commodities for iCCM on the day of data collection. For individual items, the proportion of health posts with the item in stock ranged from 99% (cotrimoxazole) to 80% (RUTF). Only 4% of health posts in comparison areas had all five essential commodities for routine CCM in stock. About half of health posts in intervention areas and all health posts in comparison areas reported a stockout lasting longer than seven consecutive days in the previous three months of at least one of the essential items. Just under half of intervention health posts and no comparison health posts had all essential supplies and job aids in stock on the day of the visit. Aside from the initial HEW training, all indicators of implementation strength were significantly higher in intervention areas than in comparison areas.

3.2. Quality of Care

Table 5 presents key indicators of quality of care in intervention areas. HEWs completed an average of 9.2 out of 11 key assessment tasks. A large majority of children (81%) were assessed for the presence of cough, diarrhea, fever and malnutrition. Fewer children (62%) were assessed for all four general danger signs. Just over half of children (53%) were correctly classified for all major iCCM illnesses.

Nearly two-thirds of children (64%) were correctly managed for all major iCCM illnesses. HEWs correctly treated 72% of children with pneumonia, 79% with diarrhea and 59% with malnutrition. Sample sizes of children with malaria and measles were too small to draw meaningful conclusions about management of those illnesses. Overuse of medications was rare, with only 6% of children receiving an antibiotic when it was not indicated and no children receiving an unnecessary antimalarial. Only 34% of children with severe illness were correctly managed, and HEWs referred just over half (54%) of children needing referral to a health center. Furthermore, few children (14%) received the first dose of all needed treatments in the presence of the HEW. Only 18% of children needing a vitamin A supplement received vitamin A and 20% of children needing deworming medication received mebendazole. Over three-quarters of caretakers (77%) received a demonstration on how to administer all treatments by the HEW and

83% of caretakers correctly described how to give all treatments.

Figures 1-2 present analyses of clinical errors for children with uncomplicated illness only and children with at least one severe illness in intervention areas. Around one-third of children were assessed for all 11 selected signs and symptoms of iCCM illnesses. The most common assessment errors were failure to assess convulsions, edema and lethargy. Incorrect classification of pneumonia was the most common classification error for children with uncomplicated illness, partially due to incorrect assessment of fast breathing. The most common treatment errors were failure to give cotrimoxazole to children with pneumonia and failure to give ORS for diarrhea, even though these items were in stock. Misclassification was common among children with severe illness and incorrect treatment was common regardless of whether children were correctly classified. The most common treatment errors for children with severe illness were failure to give cotrimoxazole for pneumonia, failure to give amoxicillin and vitamin A for severe complicated malnutrition and not referring children to health centers when this was required.

3.3. Utilization and Service Provision

Table 6 presents the mean number of sick child consultations and selected indicators of service provision in intervention health posts. Intervention health posts saw an average of 16 sick children in the previous month (range 0-95) and virtually no children under two months of age. Although utilization in intervention areas was low, it was over three times higher than in comparison areas (mean of five sick children per month). When asked about their activities the day prior to the interview, HEWs in intervention areas reported spending an average of about four hours providing or offering clinical services in the health post, half an hour providing clinical services in the community and nearly one hour carrying out community mobilization/education activities. Intervention health posts were reportedly open and offering clinical services an average of 23 hours in the week prior to the interview.

4. Discussion

Virtually all indicators of program implementation strength were significantly higher in the intervention areas than in comparison areas. HEWs performed most basic assessment tasks and correctly managed most children. HEWs consistently counseled caretakers and most caretakers understood how to give treatments to children. Rational use of medications was excellent. Despite these achievements, there were important shortcomings related to management of severe illness, which is consistent with prior research.[18, 29]

Comparison of these results to those from an assessment of quality of management of childhood illness conducted in hospitals and health centers in Ethiopia[30] shows that adherence to clinical guidelines appears to be at least as high for HEWs as for health workers at higher-level facilities. Quality of care provided by HEWs also compares favorably to performance in management of multiple childhood illnesses by community-based health workers in Malawi,[19] Kenya,[18] and Papua New Guinea.[16]

Despite the successful scale-up of iCCM, low levels of utilization limit the potential impact. Few children are accessing care from HEWs and virtually no children under two months of age, the group with the highest risk of mortality, are being seen. Box 2 presents an estimation of the gap between expected and actual sick child consultations in intervention health posts. There are 0.26 consultations at health posts per child per year in intervention areas. This accounts for only 21% of the number of consultations we would expect to see in health posts. The experience of recruiting children for this survey suggests that there are large numbers of children with easy access to HEWs who fail to use their services despite being seriously ill. More encouragingly, significantly higher utilization in intervention areas suggests that utilization may be increasing as services improve. The Ethiopian Government's launch of "The Health Development Army," for which up to three million community members will be mobilized nationally to serve as community health volunteers, presents a promising platform through which to carry out large-scale demand creation.[31] However, a thorough evaluation of this new initiative is needed.

We can draw some methodological lessons from this study. First, it was possible to carry out a large-scale assessment of quality of care, with 99% of selected health posts surveyed, in very remote and difficult-to-reach rural areas. However, the number of sick children seen in health posts may be too low to efficiently obtain a sufficiently large sample of patients presenting for spontaneous consultations for assessment of quality of care. In this study, the methods of requesting HEWs to mobilize caretakers in the community and active recruitment of sick children by the survey team were feasible and provided a large sample of sick children that included a high proportion with severe illness.

This study has a number of limitations. First, HEWs may have performed better under observation than they normally would.[32, 33] Second, informing HEWs of survey visits may have further biased the results positively. Third, recruitment and mobilization of sick children may have provided a sample of patients that was different from spontaneous patients, although concerns that we would obtain few children with severe illness proved unfounded. Fourth, some information was based on self-report by HEWs, which may be biased. Finally, iCCM program implementers knew which *woredas* were selected as intervention areas, so extra effort may have been given to these areas and iCCM implementation may have been stronger than in other areas of the country. These limitations may have resulted in observed levels of implementation strength and quality of care that were higher than they would have been under normal circumstances.

This study shows that the Ethiopia iCCM program has been implemented extremely well in Jimma and West Hararghe Zones, and that HEWs are providing care at levels of quality at least equal to that provided in higher-level health facilities in Ethiopia and at the community level in other low-income countries. The results also indicate that community-based health workers can effectively manage multiple childhood illnesses. However, fundamental concerns that must be addressed are mismanagement of severe illness and low utilization of case management services.

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Box 1: Definitions of key terms

Integrated community case management: In general, iCCM refers to the concurrent management of more than one common childhood illness. ICCM in Ethiopia (implemented in study intervention areas) is integrated management by an HEW at the community level of all of the following childhood illnesses: pneumonia, diarrhea (ORS and zinc), malaria, malnutrition, measles, anemia, and ear infection.

Routine CCM: The routine CCM program in Ethiopia (implemented in study comparison areas) includes community case management of diarrhea (ORS only), malaria, malnutrition, measles, ear infection, and anemia. Pneumonia cases are referred to health centers.

Implementation strength: This term refers to the quantity of effective program activities carried out to reduce child mortality. These activities include training, supportive supervision, and continued availability of essential iCCM commodities.

Quality of care: We assessed quality based on whether HEWs correctly assessed, classified, treated, and referred children with iCCM illnesses and provided counseling to caretakers based on Ethiopia iCCM clinical guidelines.

Correct classification: All HEW classifications matched gold standard classifications.

Correct treatment: All HEW treatments matched gold standard treatments including correct dose, duration, and frequency.

Eligible iCCM illness: Lethargy or unconsciousness, convulsions, not eating or drinking, fever/malaria, cough, fast/difficulty breathing, diarrhea, vomiting, ear problem, signs/history of measles, malnutrition, feeding problems, or anemia.

Uncomplicated illness: Uncomplicated pneumonia, diarrhea, malaria, measles, malnutrition, eye infection, or anemia.

Severe illness: A child was considered to have a severe illness if the child had any of the following: any general danger sign (not able to drink/breastfeed, vomits everything, convulsions, lethargic or unconscious), severe pneumonia, diarrhea with severe dehydration, severe persistent diarrhea, persistent diarrhea, dysentery, very severe febrile disease, severe complicated measles, severe complicated malnutrition, or severe anemia.

General danger signs: Able to drink/breastfeed, vomits everything, had convulsions, and lethargy.

Major iCCM illnesses: Pneumonia, diarrhea, malaria, measles, malnutrition, and danger signs.

Essential commodities for iCCM: Cotrimoxazole, ORS, zinc, ACT, chloroquine, RUTF, and rapid diagnostic tests [RDT] for malaria.

Box 1: Definitions of key terms, continued

Essential commodities for routine CCM: ORS, ACT, chloroquine, RUTF, and RDT. Cotrimoxazole and zinc are not part of the routine CCM package.

Essential supplies and job aids for iCCM: Functional timer, thermometer, weighing scale, clean water, MUAC, supplies to mix ORS, iCCM chart booklet, iCCM patient register.

Essential supplies and job aids for routine CCM in comparison areas: Functional timer, thermometer, weighing scale, clean water, MUAC, supplies to mix ORS, and patient register.

Supervision with clinical reinforcement: Supervision with observation of patient consultations or register review.

11 key assessment tasks: Checked whether child is able to drink/breastfeed, checked whether child vomits everything, checked whether child has had convulsions, checked whether child has lethargy, checked for cough or fast/difficult breathing, checked for diarrhea, checked for fever, checked for edema, checked for low MUAC (≥ six months) or visible severe wasting (< six months), checked for palmar pallor, checked child's vaccination status.

Table 1: Distribution of HEWs by selected characteristics in intervention (n=137) and comparison (n=64) areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Characteristic	Intervention areas		Comparison areas	
	n	%	n	%
Age				
18-20	13	9.5	9	14.1
21-23	83	60.6	35	54.7
24-26	35	25.6	18	28.1
27-29	4	2.9	1	1.6
30-32	2	1.5	1	1.6
Marital status				
Married	80	58.4	39	60.9
Single	56	40.9	25	39.1
Separated/divorced	1	0.7	0	0.0
HEW lives in same kebele as health post	125	91.2	55	85.9
HEW lived in kebele one year prior to completing basic HEW training	16	11.7	4	6.3

Table 2: Distribution of sick children by selected characteristics in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia (n=257)

Characteristic	n	%
Age (months)		
2-11	94	36.6
12-23	92	35.8
24-35	39	15.2
36-47	22	8.6
48-59	10	3.9
Sex		
Male	129	50.2
Female	128	49.8
Gold standard disease classifications		
Pneumonia	39	15.2
Diarrhea	169	65.8
Malaria/severe febrile disease	3	1.2
Measles[a]	5	2.0
Malnutrition	32	12.5
Ear infection	30	11.7
Anemia	11	4.3
Severe illness	38	14.8
Needs referral[b]	63	24.5
Method of recruitment		
Spontaneous	45	17.5
Mobilized by HEWs	96	37.4
Recruited by survey team	116	45.1

[a] Currently or in the last three months.
[b] In addition to severe illnesses, acute ear infection and anemia require referral.

Table 3: Selected indicators of training and supervision in intervention and comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Indicator	Intervention areas		Comparison areas		p-value[b]
	N[a]	% (95% CI)	N	% (95% CI)	
HEW trained in iCCM	137	97.8 (93.3-99.3)	64[c]	0.0	<0.001
Health post received supervision on iCCM in the previous three months	100[d]	87.0 (78.8-92.9)	42[e]	42.9 (27.7-59.0)	<0.001
Health post received supervision on iCCM that included register review or observation of consultations in the previous three months	100[d]	85.0 (76.5-91.4)	42[e]	19.1 (8.6-34.1)	<0.001
HEW received instruction in iCCM clinical practice at a health center in the previous three months	137	57.7 (48.8-66.0)	64	7.8 (3.1-18.3)	<0.001

[a] Number of HEWs or health posts eligible for indicator.
[b] Two sample binomial test of difference in proportions between intervention and comparison areas.
[c] HEWs in comparison areas were not expected to be trained in iCCM, so this result confirms that there was little to no spillover of iCCM training to HEWs outside of the intervention areas.
[d] Three health posts excluded because HEWs reported not being present for the majority of the previous three months.
[e] Four health posts excluded because HEWs reported not being present for the majority of the previous three months.

Table 4: Availability of essential iCCM commodities, supplies and job aids on the day of data collection and for no stockout of essential commodities in the three months preceding the survey in intervention (n=103) and comparison (n=46) areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Item	Available on day of data collection					No stockout >7 days in last 3 months				
	Intervention areas		Comparison areas		p-value[a]	Intervention areas		Comparison areas		p-value
	n	% (95% CI)	n	% (95% CI)		n	% (95% CI)	n	% (95% CI)	
All essential commodities for iCCM/routine CCM	71	68.9 (59.1-77.7)	2	4.4 (0.5-14.8)	<0.001	53	51.5 (41.4-61.4)	0	0.0 -	<0.001
Cotrimoxazole[b]	102	99.0 (94.7-100)	1	2.2	<0.001	102	99.0 (94.7-100)	2	4.4 (0.5-14.8)	<0.001
ORS	100	97.1 (91.7-99.4)	28	60.9 (45.4-74.9)	<0.001	93	90.3 (82.9-95.2)	28	60.9 (45.4-74.9)	<0.001
Zinc[b]	99	96.1 (90.4-98.9)	0	0.0	<0.001	83	80.6 (71.6-87.7)	0	0.0 -	<0.001
ACT	91	88.4 (80.5-93.8)	23	50.0 (34.9-65.1)	<0.001	90	87.4 (79.4-93.1)	26	56.5 (41.1-71.1)	<0.001
Chloroquine	92	89.3 (81.7-94.5)	17	37.0 (23.2-52.5)	<0.001	91	88.4 (80.5-93.8)	18	39.1 (25.1-54.6)	<0.001
RUTF	82	79.6 (70.5-86.9)	16	34.8 (21.4-50.2)	<0.001	80	77.7 (68.4-85.3)	14	30.4 (17.7-45.8)	<0.001
RDT	92	89.3 (81.7-94.5)	29	63.0 (47.5-76.8)	<0.001	91	88.4 (80.5-93.8)	29	63.0 (47.5-76.8)	<0.001
All essential supplies and job aids for iCCM/routine CCM	47	45.6 (35.8-55.7)	0.0	0.0 -	<0.001					

Functional timer	94	91.3 (84.1-95.9)	5	10.9 (3.6-23.6)	<0.001
MUAC tape	102	99.0 (94.7-100)	41	89.1 (76.4-96.4)	0.005

[a] Two sample binomial test of difference in proportions between intervention and comparison areas.
[b] Cotrimoxazole and zinc were not part of the routine CCM program, so health posts in comparison areas are not expected to have these drugs available.

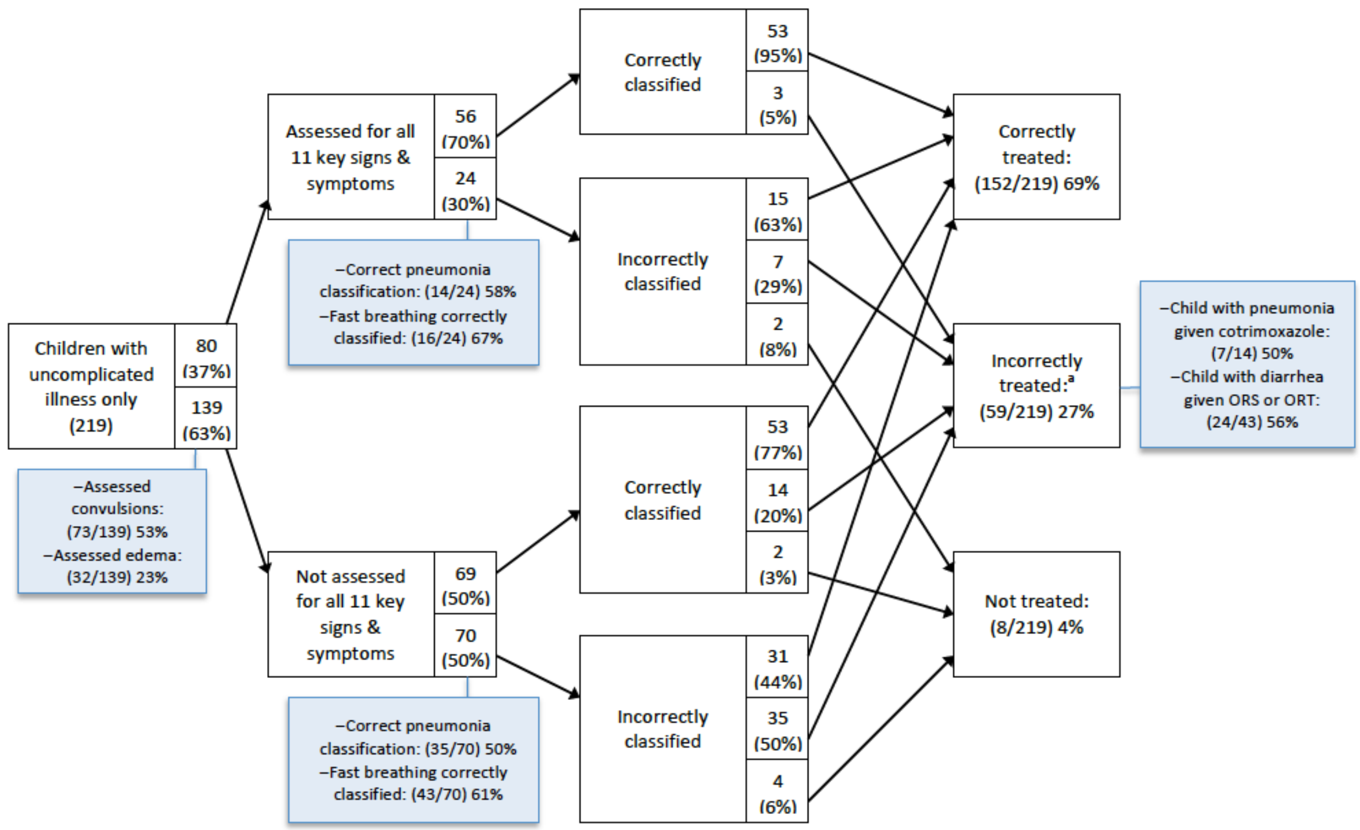
Table 5: Selected indicators of quality of case management by HEWs in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Indicator	N[a]	%	95% CI
Assessment			
Child assessed for 4 general danger signs	257	61.9	(52.5-70.4)
Child checked for presence of cough, diarrhea, fever and malnutrition	257	80.5	(73.6-86.0)
Child with cough or difficult breathing assessed for fast breathing through counting of respiratory rate	148	93.2	(85.8-96.9)
Child's vaccination status checked (children under 12 months)	94	97.9	(91.7-99.5)
Child's respiratory rate counted by HEW within +/- 2 breaths of the gold standard	130	40.0	(31.9-48.7)
Classification			
Child correctly classified for all major iCCM illnesses	257	52.9	(45.6-60.1)
Child not up-to-date on immunizations classified as not up-to-date	77	36.4	(26.1-48.1)
Treatment and referral			
Child correctly treated[b] and/or referred for all major iCCM illnesses	257	64.2	(57.4-70.5)
Child with pneumonia correctly treated for pneumonia	39	71.8	(55.8-83.7)
Child with diarrhea correctly treated for diarrhea	169	79.3	(71.5-85.4)
Child with malnutrition correctly treated for malnutrition	32	59.4	(40.4-76.0)
Child with malaria correctly treated for malaria	3	66.7	(2.0-100)
Child with measles correctly treated for measles	5	20.0	(0.3-94.9)
Child with severe illness correctly treated and/or referred	38	34.2	(21.5-49.7)
Child needing referral correctly referred	63	54.0	(40.7-66.7)
Child received first dose of all needed treatments in presence of HEW[c]	163	13.5	(8.4-21.0)
Child needing vitamin A supplementation received vitamin A	66	18.2	(9.9-31.0)
Child needing mebendazole received mebendazole	30	20.0	(9.0-38.8)
Child received an unnecessary antibiotic	257	5.5	(3.0-9.7)
Child received an unnecessary antimalarial	257	0.0	-
Counseling			
Caretaker received demonstration of how to administer all treatments by HEW[c]	160	74.4	(63.4-82.9)
Caretaker correctly described how to give all treatments[c]	156	83.3	(75.5-89.0)
Caretaker advised to give extra fluids and continued feeding for diarrhea[d]	140	85.0	(77.7-90.2)

Caretaker advised to return Immediately if child cannot drink/breastfeed or becomes sicker[d]	213	36.2	(27.3-46.0)
Caretaker advised on when to return for follow-up[d]	213	93.4	(88.0-96.5)

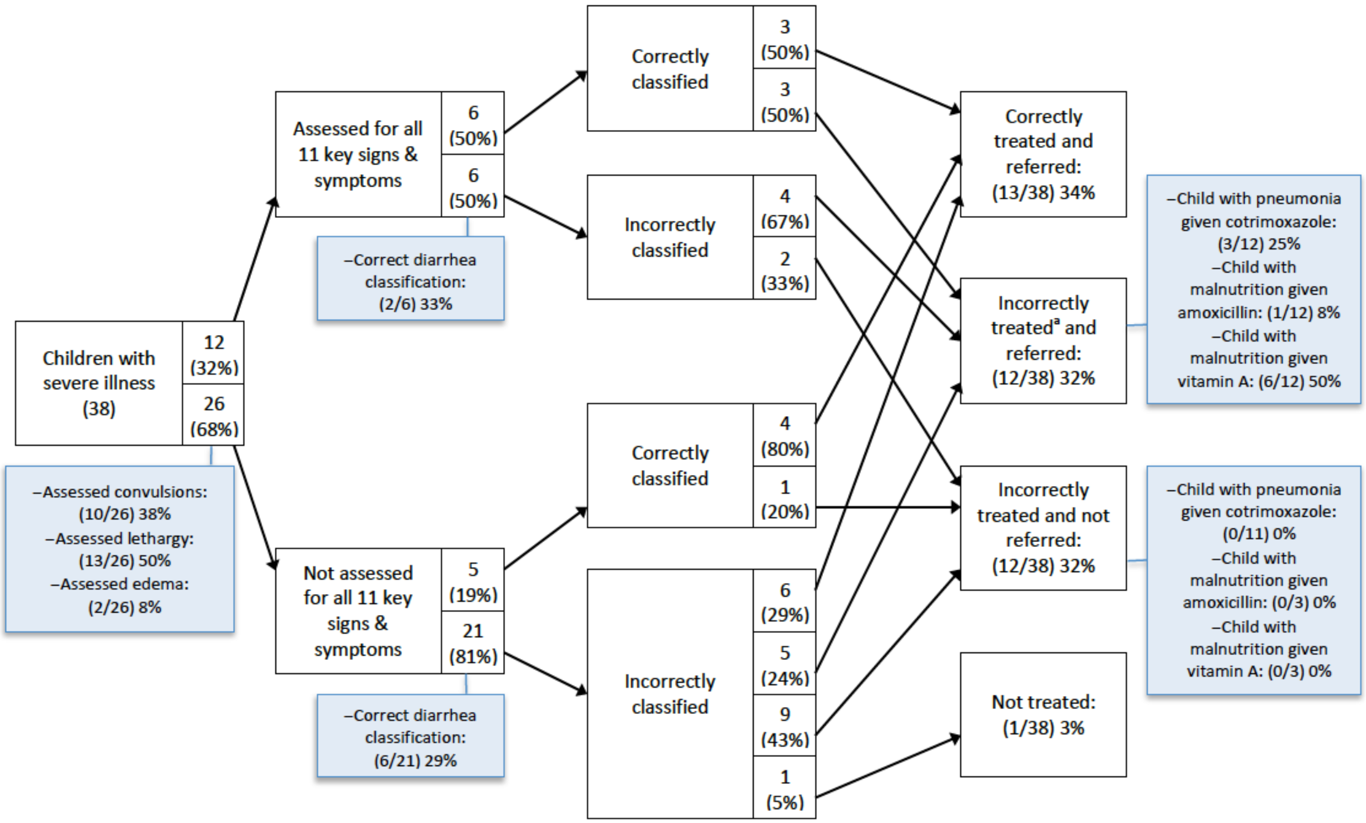
[a] Number of children eligible for task.
[b] Includes prescription with correct dose, duration and frequency.
[c] Includes cotrimoxazole, ORS, zinc, vitamin A, ACT, chloroquine and amoxicillin. Excludes children who were referred.
[d] Excludes children who were referred.

Figure 1: Clinical errors analysis for children with uncomplicated illnesses in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia



[a] Child was given at least one treatment, but not all HEW treatments matched gold standard treatments.

Figure 2: Clinical errors analysis for children with at least one severe illness in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia



[a] Child was given at least one treatment, but not all HEW treatments matched gold standard treatments.

Table 6: Mean number of sick child consultations per health post and selected indicators of service provision in intervention health posts in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Indicator	Intervention areas		Comparison areas	
	Mean (95% CI)	Range	Mean (95% CI)	Range
Sick child consultations in previous month				
Total	16.0 (13.2-18.8)	0-95	5.0 (2.3-7.7)	0-32
0-<2 months	0.3 (0.1-0.5)	0-9	0.03 (0.0-0.1)	0-1
2-59 months	15.7 (13.0-18.4)	0-94	5.0 (2.4-7.6)	0-31
Female	8.0 (6.6-9.5)	0-40	2.3 (0.7-3.9)	0-19
Male	7.9 (6.4-9.4)	0-57	2.4 (1.2-3.7)	0-13
Unspecified	0.1 (0.0-0.1)	0-4	0.3 (0.0-0.7)	0-6
Hours health post was open in previous week	23.3 (21.0-25.5)	0-40	20.2 (17.0-23.5)	0-40
Hours spent by HEW in the previous day				
Providing clinical services in the health post	4.0 (3.5-4.5)	0-10	1.8 (1.1-2.5)	0-8
Providing clinical services in the community	0.5 (0.3-0.6)	0-7.5	0.8 (0.3-1.2)	0-5
Community education/mobilization, disease prevention	0.9 (0.6-1.1)	0-8	1.5 (0.9-2.2)	0-8
Other health-related activities	0.8 (0.5-1.1)	0-8	1.4 (0.7-2.1)	0-8
Other non health-related activities	0.2 (0.1-0.4)	0-8	0.4 (0.1-0.8)	0-7
Travel outside kebele	0.7 (0.3-1.2)	0-12	0.5 (0.1-0.9)	0-8
Total work-related activities	6.1 (5.6-6.6)	0-11	5.5 (4.9-6.2)	0-9

Box 2: Estimation of the gap between expected and actual iCCM consultations in intervention health posts in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

To illustrate the gap between expected and actual rates of utilization of iCCM services in intervention areas, we can conduct a rough hypothetical estimation:

- There are an average of 744 children under five per health post in intervention health posts in Jimma and West Hararghe, according to statistics available in the health posts.
- On average a child will have 3.7* episodes of iCCM illnesses per year, totaling 2,753 episodes.
- If we assume that caretakers should seek care for one-third of those episodes from health posts/HEWs (others may seek care from other appropriate sources), then we expect 908 iCCM consultations per health post per year.
- The current number of iCCM consultations per intervention health post per year, based on utilization in the month prior to data collection, is 192.
- Using the assumptions above, there is a **gap of 716 consultations** per health post per year. In other words, **79% of expected consultations in health posts are not being seen** in health posts.
- With 192 consultations per year for 744 children, **there are only 0.26 consultations per child per year at health posts**.

*Based on UNICEF-Ethiopia estimates of burden of pneumonia, diarrhea, malaria, and severe acute malnutrition.

Paper 2: Assessing the Quality of Sick Child Care Provided by Community Health Workers: Recruitment of sick children, validity of register review and direct observation and the Hawthorne effect

1. Introduction

Community case management of childhood illness (CCM) is increasingly promoted in low-income countries to increase access to life-saving therapies and to reduce child mortality (see Box 1 for definitions of key terms).[1, 2] As CCM programs expand, there is a need to assess the quality of care provided by community-based health workers (CHWs).[3] Direct observation with re-examination (DO with RE) is usually considered to be the 'gold standard' method for assessing health worker quality of care.[4-7] In this method, a data collector silently observes consultations and records details of the health worker's assessment, classification, treatment, referral and counseling of the patient and caretaker. Then a second data collector performs a re-examination with the same patient to obtain gold standard classifications and treatments. Information from the observation and the re-examination are combined to obtain estimates of indicators of quality of care, such as the proportion of children correctly treated. The main advantages of this method are that the patient's true signs and symptoms are known and the health worker's actions are verified. However, DO with RE has several drawbacks. The method is resource-intensive, requiring multiple highly skilled data collectors who spend several hours at each location. Long distances and difficult terrain make traveling to the CHWs' place of work difficult and expensive.[2] Moreover, the Hawthorne effect, where health workers perform better than under normal circumstances because they are being observed, has been documented.[8-11] Furthermore, caseloads of sick children seen by CHWs are often small,[10, 12] making it difficult to attain an adequate sample of children efficiently. Finally, some children may be managed by CHWs in their home, rather than at a fixed health post. Because of these limitations of DO with RE, alternative methods of recruiting sick children for observation and of assessing quality of care of CHWs need to be developed and assessed.

Reviewing data in patient registers is a common method for assessing health worker performance due to its feasibility and relatively low cost.[10, 13-16] A large number of records can be reviewed quickly and a large sample of records of children with severe or rare illnesses can be attained.[5] Register review (RR) also allows for assessment of routine performance without potential bias caused by the Hawthorne effect. Perhaps the greatest advantage of RR is that it can be conducted as part of routine supervision visits, as long as appropriate procedures are in place to ensure objective reporting of results. On the other hand, patient registers often have insufficient data, are incomplete, or are not used at all.[5] Additional limitations are that data in registers may not reflect the actual practices of the health worker and health workers must be literate enough to fill out registers properly.

Alternatively, direct observation only (DO), without a re-examination by a data collector, offers the benefit of verification of health worker actions without the need for a second data collector. Although this method requires travel to the CHW's place of work and a sample of sick children, DO could be conducted by a supervisor as part of routine visits if sick children can be found for observation. Few studies have compared RR or DO to DO with RE for assessing health worker quality of care in low-income countries,[4, 5] and only one study has compared these methods for assessing CCM.[17]

Ethiopia scaled up integrated community case management of childhood illness (iCCM) in most regions of the country in 2011 and 2012. The iCCM program is implemented through the Health Extension Program, in which Health Extension Workers (HEWs) provide clinical care in community-based health posts. The iCCM program provided training for HEWs on iCCM, strengthened supervision, improved supply chain management for essential commodities and enhanced monitoring and evaluation to enable HEWs to manage childhood pneumonia, diarrhea, malaria, malnutrition, measles, anemia and ear infection. Through the iCCM program, HEWs are equipped with patient registers that closely follow iCCM clinical guidelines, with spaces for registration of patient information, signs and symptoms, results of diagnostic tests, classification, treatment, referral, counseling and follow-up. The Ethiopia iCCM sick child register is presented in Figure 1. These registers were designed to record information on each step in the iCCM algorithms and provide more comprehensive information about patients' signs and symptoms and the decisions and actions taken by the HEW than what is provided in most CHW registers.

As part of an independent evaluation of iCCM in Ethiopia, we conducted an assessment of the quality of sick child care provided by HEWs. The assessment provided the opportunity to examine and compare methods for assessing the quality of care provided by CHWs. This study had three objectives: 1) to develop and assess alternative methods of recruitment of sick children for observation in a community setting with low patient volume; 2) to assess the validity of RR and DO compared to DO with RE for assessing CHW quality of care; and 3) to assess the effect of observation on CHW performance.

2. Methods

In May and June 2012, we conducted a cross-sectional survey in 104 randomly selected health posts that were implementing iCCM in Jimma and West Hararghe Zones of Oromia Region, Ethiopia. Survey teams were composed of one supervisor, one observer and one re-examiner, all of whom were health professionals who had worked as iCCM trainers or supervisors. After seven days of training, all observers and re-examiners achieved at least 90% concordance with gold standard clinicians on three consecutive role-play exams that simulated observation of HEW consultations and re-examinations. A detailed description of survey methods is available elsewhere.[12] The survey instruments and primary indicators of quality of care were adapted from the WHO Health Facility Survey tool,[18] a survey of Health Surveillance Assistants in Malawi,[19] and the CCM Global Indicators.[20] The indicators used for these analyses are key indicators of quality of care that were available from both RR and DO with RE. The indicators measure correct classification, treatment and referral for major iCCM illnesses; rational use of medications; assessment of immunization status; and provision of vitamin A supplements and anti-helminth medicine. Ethical approval was obtained from the Institutional Review Boards of the Oromia Regional Health Bureau and the Johns Hopkins University Bloomberg School of Public Health.

Low patient volume in health posts prompted us to develop alternative methods of recruiting sick children for the assessment. HEWs were notified of upcoming survey visits and were asked to mobilize caretakers to bring sick children to the health post on the day of the visit. If fewer than two children presented at the health post within the first two hours of operation, the team supervisor, along with an HEW or community volunteer, recruited sick children from households in the surrounding area. Recruitment was done through door-to-door inquiries among households known to have children under five. If no sick children were present, the household members were asked if they knew of any other sick children in nearby households. The resulting sample of children was obtained through one of three recruitment methods: 1) spontaneous consultation, 2) HEW mobilization, or 3) recruitment by the survey team. Before each consultation, caretakers of sick children were asked to report which recruitment method brought them to the health post. Survey teams spent one day in each health post collecting data. 'Gold standard' measures of quality of care were obtained through DO with RE. Data collectors then extracted information on sick child consultations from iCCM patient registers. They recorded information for the same children that were included in DO with RE on the day of data collection plus the last three children aged 2-59 months that were seen by HEWs prior to the day of data collection. Data were entered directly into tablet computers using Open Data Kit (ODK)[21] as the data capture software and were stored in a Research Electronic Data Capture (REDCap) database.[22]

2.1. Analysis

Standard errors and associated 95% confidence intervals for point estimates were calculated using the Taylor linearization method to account for clustering of children within health posts.[23]

For the examination of methods of recruiting sick children, we compared distributions of patient demographic characteristics, illness classifications and severe illness, and corresponding 95% confidence intervals, stratified by recruitment method.

For the assessment of the validity of RR and DO, we calculated estimates of indicators of quality of care based on DO with RE, RR, and DO for the same children. The objective of this analysis was to compare the estimates obtained had we collected data using RR only or DO only compared to using the gold standard method of DO with RE. For RR, correct management was determined by checking consistency between recorded signs and symptoms, results of diagnostic tests, treatment and referral in the patient register. If an item in the register was empty, we assumed that the sign or symptom was not present, the task was not performed, or the diagnostic test, classification, treatment, or referral was not given. For DO, estimates of indicators of quality of care were based on consistency between the HEW's classification of a child and the treatment the child received. Because observers did not record the presence or absence of various signs and symptoms during the observation, we could not base the estimates from DO on consistency between signs and symptoms and treatment, as was done for RR. We calculated the sensitivity, specificity and kappa statistic for RR and for DO, considering DO with RE to be the gold standard. The kappa statistic was categorized as no agreement better than chance alone, poor, fair, moderate, substantial and near perfect agreement if the value was <0, 0.00-0.20, 0.21-0.40, 0.41-0.60, 0.61-0.80 and 0.81-1.00, respectively.[24]

To assess the influence of the Hawthorne effect, we compared estimates of indicators of quality of care from RR for children who were observed by the survey team to estimates from RR for children who were not observed by the survey team (i.e. children who received consultations by the HEWs prior to the survey visit). We calculated the arithmetic differences in point estimates of indicators of quality of care between observed and not observed children. Finally, we tested for a significant difference by examining the confidence intervals of the differences between groups of children (whether the confidence intervals included zero) and by calculating p-values for two-sample tests of difference in proportions. All analyses were carried out in Stata 12.[25]

3. Results

3.1. Characteristics of sick children by recruitment method

Of the 104 selected health posts, one was not surveyed because it was closed indefinitely. In the remaining 103 health posts, teams surveyed 137 HEWs and observed and re-examined 257 sick children. Table 1 presents the characteristics and gold standard disease classifications for sick children by recruitment method. Spontaneous consultations accounted for only 18% of the final sample. Another 37% were mobilized by the HEWs and active recruitment of sick children in the community by the survey team accounted for 45% of the sample. The age distribution of sick children was fairly consistent among the three recruitment methods. Spontaneous consultations provided predominantly female children (62%), but mobilization by HEWs and recruitment by the survey team produced samples that were fairly evenly divided between genders. Diarrhea and malnutrition were more common among children mobilized by HEWs (76% and 20%, respectively) than among children presenting spontaneously (53% and 11%) and children recruited by the survey team (62% and 7%). Among children presenting spontaneously, 22% had pneumonia, compared to 12% of mobilized children and 16% of recruited children. Malaria and measles were rare in all groups. Children mobilized by HEWs had the highest proportion of multiple classifications (41.5%) and severe illness

(27%). Severe illness was classified in 11% of children presenting spontaneously and in 6% of those recruited by the survey team. The proportion with severe illness was significantly higher among mobilized children than among children recruited by survey teams.

Because the distributions of illness classifications and recruitment methods varied substantially between the two study zones, we also looked at the proportion of children with severe illness by recruitment method by zone (data not shown). Within each zone, children mobilized by HEWs had the highest proportion of severe illness (18% in Jimma and 33% in West Hararghe). In Jimma, the proportion of severe illness was similar among children presenting spontaneously and those recruited by the survey team (6% and 7%, respectively). In West Hararghe, 23% of children presenting spontaneously had severe illness, while only 3% of children recruited by the survey team were severely ill.

3.2. Validity of register review and DO

Eleven of the 257 observed children were missing from the patient registers, so they were excluded from this analysis, giving a final sample of 246 children. The point estimates, sensitivity, specificity and kappa statistics for indicators of quality of care from RR and DO compared to DO with RE are shown in Table 2. Results for children with malaria and measles are not shown because of small sample sizes. The point estimates for most indicators of quality of care were similar for most indicators among all three methods. Sensitivity of RR was reasonably high ($\geq$75%) for eight of the 12 indicators. However, specificity was below 70% for 11 indicators. The summary indicator of correct management of major iCCM illnesses had a sensitivity of 83% and specificity of 64%. The Kappa statistic ranged from -0.029 to 0.501. One indicator was classified as having no agreement better than chance alone, one indicator had poor agreement, six indicators had fair agreement and four indicators had moderate agreement. For the indicator of correct management of major iCCM illnesses, kappa was 0.485, which is moderate agreement. DO performed somewhat better than RR. Sensitivity of DO was $\geq$75% for eight of 10 indicators assessed (Correct classification could not be assessed for DO because observers did not record presence or absence of signs and symptoms and assessment of immunization status was not included because direct observation is the source of information on assessment tasks performed for DO and DO with RE, so the results are exactly the same.). Specificity was $\geq$75% for four indicators and was below 70% for six indicators. Kappa statistics for DO were between 0.301 and 1.0, with fair agreement for four indicators, moderate agreement for four indicators, substantial agreement for one indicator and near perfect agreement for one indicator. Agreement for DO was borderline substantial (0.602) for the indicator of correct management of major iCCM illnesses.

3.3. Hawthorne effect

We abstracted data for 544 children from iCCM patient registers. Of these children, 246 were children who were observed by the survey team and 298 were children who were seen by HEWs prior to the day of the survey visit and were not observed by the survey team. Table 3 shows the estimates of indicators of quality of care from RR for children who were observed and children not observed, the difference between the two estimates and the p-value of the test of difference. The estimates of correct performance were higher for observed children than children not observed for eight out of the 12 indicators. For the other four indicators, the estimate was higher for children not observed. The differences between the two estimates were relatively small for most of the indicators and the difference was borderline significant for only one indicator. For the summary indicator of correct management of major iCCM illnesses, the estimates were similar (66% of observed children compared to 68% for children not observed, p=0.639) for both groups of children.

4. Discussion

4.1. Recruitment of sick children

Mobilization of sick children by HEWs and recruitment by the survey team both provided more than twice as many sick children than did spontaneous consultations. Survey teams were able to contact HEWs using cellular phones or by passing the message through local administrators, and HEWs usually complied with the mobilization request. Active recruitment of sick children from the community also proved to be easier and more productive than we anticipated.

The highest proportion of children with severe illness was found in the children mobilized by the HEWs. One explanation may be that the HEWs are familiar with the households and children in their community, and they may have mobilized in households where they knew there were very ill children. Other observed differences in child characteristics may also be due to HEWs and/or survey teams introducing implicit selection criteria. These results suggest that mobilization by CHWs and recruitment of sick children by survey teams are feasible methods of obtaining relatively large samples of sick children, including children with severe illness. However, some differences were observed between the groups of children, which indicates the potential for bias associated with active mobilization or recruitment. The small sample sizes of children within each group make it difficult to assess these differences with confidence.

4.2. Validity of register review and DO

Our assessment of the validity of RR and DO, compared to DO with RE, found that sensitivity was high for the majority of indicators, but specificity was lower for both RR and DO. High sensitivity and low specificity indicate that RR and DO were generally good at identifying correct practices, but less useful for identifying errors in practice. The kappa statistics indicate that RR provided fair to moderate agreement for most indicators. DO provided fair, moderate, or substantial agreement for most indicators. Agreement was reasonably high for both methods (especially DO) for the summary indicator of correct management of major iCCM illnesses.

Given the feasibility and relative low cost of RR compared to DO with RE, these results may be good enough to encourage the use of RR for assessments of quality of care for routine program monitoring and evaluation. However, the results should be interpreted keeping in mind that the estimates may substantially underestimate the frequency of performance errors. Additionally, the fact that RR seems to be more useful for identifying correct performance than for identifying errors suggests that overall validity of RR may be lower in a situation where quality of care is lower. Register review may also be less useful in other developing country contexts where data quality and completeness in patient registers are lower than in Ethiopia. Our results are generally consistent with previous assessments of RR that showed low to moderate validity of RR.[4, 5, 17] The only previous assessment of RR in a CHW setting found that RR provided better estimates for management of diarrhea than for fast breathing and severe illness, which is also consistent with our findings.[17] On the other hand, our results diverge with those of another study in health facilities that found that RR was more useful for identifying performance errors than for identifying correct performance.[4] Our results are somewhat discouraging, given the unusual high quality of patient registers and the high level of completeness of registers in Ethiopia. However, given the advantages of RR over DO with RE with regards to feasibility and affordability, RR will continue to be an essential data collection method. More work is needed to determine how the quality of data in patient registers can be improved in a CHW setting.

Our results correspond with previous results that show that DO overestimates the proportion of cases correctly managed by CHWs by around 13-14%.[17] In contrast to those previous results, in our study DO did not overestimate performance for all indicators. We found that estimates of correct treatment of diarrhea and malnutrition were lower from DO than from DO with RE, likely because many children with diarrhea and malnutrition were misclassified by the HEWs, but were still treated correctly. This led to higher consistency between signs and symptoms and treatment than between classification and treatment. The results from DO are encouraging and suggest that further investigation should be conducted into this method. To further enhance the validity of results obtained through DO, future studies should collect data on the presence or absence of relevant signs and symptoms as determined by the observer. This would allow for a more accurate determination of quality of care, rather than just consistency between classification and treatment, which requires the dubious assumption that all classifications are correct. If validity were found to be reasonably high using this method, it could provide the advantage of measuring actual performance of health workers, while eliminating the need for multiple data collectors. DO, combined with the sick child recruitment techniques described above, could be conducted during routine supervision visits, potentially providing a valuable compromise between the need for a high degree of rigor and lower cost.

4.3. Hawthorne effect

The comparison of estimates of indicators of quality of care from RR for children who were observed by the survey team to estimates for children who were not observed found that most of the differences were small. Of the four indicators with larger differences (above 9 percentage points), estimates were higher for children who were observed. All but one of these differences was non-significant, but this may be due to small sample sizes. However, all of the indicators with relatively large sample sizes showed small, non-significant differences. These data suggest that the effect of observation in this setting was small.

Previous assessments of the effect of observation on quality of care in developing countries found that health workers performed substantially better when under observation. However, those studies often assessed the affect of observation using inconsistent methods (e.g. observation versus simulated client[11] or hospital-based observation versus RR in communities,[10] or observation versus exit interview[8]). It is not clear that differences seen in these studies are entirely due to the Hawthorne effect rather than inconsistencies in the data collection methods. By using RR to obtain estimates of performance for observed and not observed children, we attempted to eliminate bias caused by inconsistency of methods.

4.4. Limitations

These analyses have limitations. First, small sample sizes for some indicators limited our ability to assess management of malaria and measles and to detect statistically significant differences between groups. Second, it is possible there was misclassification regarding whether children were obtained through spontaneous consultations or HEW mobilization. Third, our assumption that missing information for a particular sign or symptom in the patient register meant the child did not have that sign or symptom may not have been accurate in all cases and could have led to an overestimation of correct care from RR. Finally, the failure to record presence or absence of signs and symptoms of sick children during direct observation limited usefulness of the estimates of indicators of quality of care from DO.

These analyses support the use of direct observation with re-examination for assessing quality of care of CHWs when possible. Samples of sick children can be obtained through mobilization by CHWs and recruitment of children by survey teams. Our assessment of the validity of RR and DO suggests that RR and DO are not an ideal proxies for DO with RE for research purposes. However, the estimates provided by these methods generally had fair or moderate agreement with DO with RE. Because DO with RE is too costly to be implemented as part of routine monitoring and evaluation activities, program implementers will need more affordable methods of assessing quality of care. The advantages in cost and feasibility and the fair to moderate validity of estimates from RR and DO encourage their continued use for routine data collection. The results from RR may be higher than would be found in other countries, as patient registers in the Ethiopia iCCM program are probably as good or better than in other community settings. Finally, our assessment of the Hawthorne effect showed little effect of observation on HEW performance.

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Box 1: Definitions of key terms

Community case management of childhood illness (CCM): Management of at least one common childhood illness by a community-based health worker.

Integrated community case management of childhood illness (iCCM): In general, iCCM refers to the concurrent management of more than one common childhood illness in the community. ICCM in Ethiopia is integrated management by an HEW at the community level of all of the following childhood illnesses: pneumonia, diarrhea (ORS and zinc), malaria, malnutrition, measles, anemia, and ear infection.

Quality of care: We assessed quality based on whether HEWs correctly assessed, classified, treated, and referred children with iCCM illnesses and provided counseling to caretakers based on Ethiopia iCCM clinical guidelines.

Correct classification: All HEW classifications matched gold standard classifications.

Correct treatment: All HEW treatments matched gold standard treatments including correct dose, duration, and frequency.

Correct management: All HEW treatments matched gold standard treatments including correct dose, duration, and frequency and HEW referral matched the gold standard classification for referral.

Eligible iCCM illness: Lethargy or unconsciousness, convulsions, not eating or drinking, fever/malaria, cough, fast/difficulty breathing, diarrhea, vomiting, ear problem, signs/history of measles, malnutrition, feeding problems, or anemia.

Severe illness: Any general danger sign (not able to drink/breastfeed, vomits everything, convulsions, lethargic or unconscious), severe pneumonia, diarrhea with severe dehydration, severe persistent diarrhea, persistent diarrhea, dysentery, very severe febrile disease, severe complicated measles, severe complicated malnutrition, or severe anemia.

Uncomplicated illness: Uncomplicated pneumonia, diarrhea, malaria, measles, malnutrition, eye infection, or anemia.

Major iCCM illnesses: Pneumonia, diarrhea, malaria, measles, malnutrition, and danger signs.

Validity: The degree to which a method is able to depict the technical quality of services accurately.

Box 1: Definitions of key terms, continued

Sensitivity: The proportion of children who are correctly managed or receive a given task according to the gold standard, who were categorized as having been correctly managed or having received the task according to RR.

Specificity: The proportion of children who were not correctly managed or did not receive a given task according to the gold standard, who were categorized as being incorrectly managed or not having received the task according to RR.

Kappa statistic: A measure of the level of agreement between DO with RE and RR that is beyond agreement due to chance.

Figure 1: Ethiopia iCCM Sick Child Register

INTEGRATED OPD REGISTER FOR THE SICK CHILD AGE 2 MONTH-5 YEARS

Date	Name	Age (month)	Weight	Presnting complaint	Circle on or write the signs found in the sick child							Immunization status /≤2 years/
S. No	Address Kebele/sub-kebele	Sex	Temperature		General Danger Signs	Cough or difficult breathing	Diarrhoea	Fever	Ear Problem	Malnutrition and anaemia	HIV/AIDS	
	Kebele: Sub-kebele:	Male Fmale			Yes No Unable to drink or breastfeed Vomiting everything History of convulsion Convulsing now Lethargic or unconscious	Yes No .... days Breathing ..../minute Fast breathing Chest indrawing Stridor	Yes No ____Days Blood in stool Lthargic or unconscious Restless/irritable Sunckrn eyes Weak to drink Eager/thrusty Skin pinch going back Slowly Ver slowly	Yes No Malaria Risk High Low None History of Travel to malarious area Days / it has been there daily for 7 days Measles in the last three months Stiff neck/Bulging fontanele Generalized rash of measles cough/ runny nose /red eyes mouth ulcer/ pus draining eyes/ corneal clouding RDT' Positive/ Negative/ Not done	Yes No Ear pain Ear discharge .... Days Ear discharge /Pus	< 6 months Pitting oedema of both feet Visible Severe wasting ≥ 6 Months Pitting oedema of both feet MUAC<11/ 11-12/ ≥ 12 cm Pneumonia/Fever Watery diarrhoea /dysntery/ measles Appetite test Pass / Fail Severe/ Some palmar pallor	Mother Positive Negative Unknown Child Positive Negative Unknown	Completed Up to date Not up to date Defaulted Not started
	Kebele: Sub-kebele:	Male Fmale			Yes No Unable to drink or breastfeed Vomiting everything History of convulsion Convulsing now Lethargic or unconscious	Yes No .... days Breathing ..../minute Fast breathing Chest indrawing Stridor	Yes No ____Days Blood in stool Lthargic or unconscious Restless/irritable Sunckrn eyes Weak to drink Eager/thrusty Skin pinch going back Slowly Ver slowly	Yes No Malaria Risk High Low None History of Travel to malarious area Days / it has been there daily for 7 days Measles in the last three months Stiff neck/Bulging fontanele Generalized rash of measles cough/ runny nose /red eyes mouth ulcer/ pus draining eyes/ corneal clouding RDT' Positive/ Negative/ Not done	Yes No Ear pain Ear discharge .... Days Ear discharge /Pus	< 6 months Pitting oedema of both feet Visible Severe wasting ≥ 6 Months Pitting oedema of both feet MUAC<11/ 11-12/ ≥ 12 cm Pneumonia/Fever Watery diarrhoea /dysntery/ measles Appetite test Pass / Fail Severe/ Some palmar pallor	Mother Positive Negative Unknown Child Positive Negative Unknown	Completed Up to date Not up to date Defaulted Not started

INTEGRATED OPD REGISTER FOR THE SICK CHILD AGE 2 MONTH-5 YEARS

Vitamin A /Age ≥6 Month/	Other Problems	Disease Clssification	Treatment given			Follow up date		Remark
Mebe/Albendazole /Age ≥2 Year/			Medicine	Counsel mother	If referred name of health facility	Follow up date /Shortest date/	Outcome	
within last 6 months Received Not received within last 6 months Received Not received				on feeding On fluids On when to return			Improved The same Worse Died Unknown	
within last 6 months Received Not received within last 6 months Received Not received				on feeding On fluids On when to return			Improved The same Worse Died Unknown	

Table 1: Characteristics of the sample of sick children by recruitment method in health posts implementing iCCM in Jimma and West Hararghe Zones, Ethiopia

Characteristic	Total n=257 % (95% CI)	Spontaneous n=45 % (95% CI)	Mobilized by HEWs n=96 % (95% CI)	Recruited by survey team n=116 % (95% CI)
Zone				
Jimma	59.1 (48.5-69.0)	71.1 (50.3-85.7)	40.6 (25.4-57.9)	69.8 (55.8-81.0)
W. Hararghe	40.9 (31.0-51.5)	28.9 (14.3-49.7)	59.4 (42.1-74.6)	30.2 (19.1-44.3)
Age				
2-11 months	36.6 (31.0-42.5)	37.8 (24.4-53.3)	35.4 (25.9-46.3)	37.1 (29.9-44.9)
12-23 months	35.8 (30.0-42.0)	37.8 (23.5-54.5)	35.4 (26.7-45.3)	35.3 (27.3-44.3)
24-35 months	15.2 (11.7-19.5)	11.1 (4.6-24.5)	21.9 (15.7-29.6)	11.2 (6.9-17.6)
36-47 months	8.6 (5.6-12.8)	11.1 (3.8-28.2)	4.2 (1.6-10.7)	11.2 (6.8-17.9)
48-59 months	3.9 (2.0-7.4)	2.2 (0.4-12.6)	3.1 (1.0-9.2)	5.2 (2.1-12.5)
Sex				
Male	50.2 (44.4-56.0)	37.8 (24.0-53.8)	53.1 (44.3-61.8)	52.6 (43.3-61.7)
Female	49.8 (44.0-55.6)	62.2 (46.2-76.0)	46.9 (38.2-55.7)	47.4 (38.3-56.7)
Disease classification				
Pneumonia	15.2 (11.2-20.3)	22.2 (11.4-38.8)	11.5 (6.6-19.3)	15.5 (9.8-23.8)
Diarrhea	65.8 (59.2-71.8)	53.3 (38.1-68.0)	76.0 (65.0-84.4)	62.1 (52.7-70.6)
Malaria	1.2 (0.3-5.0)	2.2 (0.3-14.9)	1.0 (0.1-7.2)	0.9 (0.1-6.0)
Measles	2.0 (0.7-5.4)	2.2 (0.3-14.9)	0.0	3.5 (1.0-10.8)
Malnutrition	12.5 (8.6-17.7)	11.1 (4.4-25.4)	19.8 (12.2-30.5)	6.9 (3.5-13.3)
>1 classification	28.6 (22.9-35.1)	21.1 (10.5-37.8)	41.5 (31.7-52.0)	20.4 (13.5-29.7)
Severe illness	14.8 (10.4-20.7)	11.1 (4.4-25.4)	27.1 (18.6-37.6)	6.0 (2.9-12.2)

Table 2: Point estimates, sensitivity, specificity and kappa statistics for indicators of quality of sick child care from register review and direct observation only compared to direct observation with re-examination in Jimma and West Hararghe Zones, Ethiopia

Indicator	DO with RE		RR					DO				
	N	% of children (95% CI)	N	% of children (95% CI)	Sens.	Spec.	Kappa	N	% of children (95% CI)	Sens.	Spec.	Kappa
Correct treatment of pneumonia	37	73.0 (56.6-84.8)	42	78.6 (58.1-90.7)	92.6	10.0	0.333	38	92.1 (76.8-97.6)	100.0	30.0	0.575
Correct treatment of diarrhea	163	78.5 (70.6-84.8)	160	73.8 (64.4-81.4)	84.4	68.6	0.501	163	71.8 (63.5-78.8)	89.8	91.4	0.741
Correct treatment of malnutrition	31	61.3 (41.7-77.8)	32	71.9 (51.2-86.2)	68.4	66.7	0.435	22	45.5 (22.8-70.2)	36.8	75.0	0.301
Correct management of major iCCM illnesses	246	63.4 (56.1-70.2)	246	65.9 (58.4-72.6)	83.3	64.4	0.485	246	76.42 (70.2-81.7))	96.8	58.9	0.602
Correct management of severe illness	37	32.4 (20.0-48.0)	40	32.5 (17.5-52.3)	50.0	44.0	0.116	34	41.2 (26.5-57.6)	83.3	48.0	0.383
Correct dose, duration and schedule for all treatments	165	92.1 (86.5-95.5)	167	91.6 (85.5-95.3)	94.1	38.5	0.339	246	94.7 (90.9-97.0)	100.0	100.0	1.0
Unnecessary antibiotic or antimalarial prescribed	246	5.3 (2.8-9.7)	246	3.7 (1.6-8.2)	38.5	98.3	0.43	246	2.4 (1.0-5.9)	38.5	99.6	0.51
Vitamin A supplement given when needed	64	18.8 (10.2-31.8)	49	20.4 (9.5-38.5)	75.0	51.9	0.277	56	23.2 (12.4-39.2)	91.7	55.8	0.375
Mebendazole given when needed	29	20.7 (9.3-39.9)	23	17.4 (6.2-40.3)	66.7	52.2	0.303	27	22.2 (9.3-44.2)	83.3	65.2	0.44

Correct referral when needed	61	52.5 (39.0-65.5)	50	66.0 (48.2-80.2)	75.0	31.0	0.31	44	81.8 (66.9-90.9)	93.8	13.8	0.377
Correct classification of major iCCM illnesses	6	52.9 (45.4-60.2)	46	67.9 (60.9-74.2)	86.2	52.6	0.394			N/A		
Immunization status checked[1]	8	97.7 (91.1-99.5)	8	95.5 (88.5-98.3)	93.0	0.0	-0.029			N/A		

Table 3: Estimates of indicators of quality of sick child care from register review for children observed by the survey team and children not observed by the survey team and differences in estimates and result of test of equality of proportions from the two groups of children in Jimma and West Hararghe Zones, Ethiopia

Indicator	Observed by survey team		Not observed by survey team		Difference (95% CI)	p-value
	N	% (95% CI)	N	% (95% CI)		
Correct classification of major iCCM illnesses	246	67.9 (60.9-74.2)	298	73.2 (66.4-79.0)	-5.3 (-13.0-2.4)	0.18
Correct treatment of pneumonia	42	78.6 (58.1-90.7)	52	84.6 (71.4-92.4)	-6.0 (-21.8-9.8)	0.45
Correct treatment of diarrhea	160	73.8 (64.4-81.4)	155	68.4 (59.0-76.5)	5.4 (-4.6-15.4)	0.29
Correct treatment of malnutrition	32	71.9 (51.2-86.2)	51	62.8 (43.5-78.6)	9.1 (-11.4-29.6)	0.39
Correct management of major iCCM illnesses	246	65.9 (58.4-72.6)	298	67.8 (60.9-74.0)	-1.9 (-9.9-6.1)	0.64
Correct management of severe illness	40	32.5 (17.5-52.3)	26	23.1 (10.9-42.4)	9.4 (-12.4-31.2)	0.41
Correct dose, duration and schedule for all treatments	167	91.6 (85.5-95.3)	210	89.5 (85.0-92.8)	2.1 (-3.8-8.0)	0.49
Unnecessary antibiotic or antimalarial prescribed	246	3.7 (1.6-8.2)	298	5.0 (2.9-8.6)	-1.3 (-4.7-2.1)	0.46
Immunization status checked[1]	88	95.5 (88.5-98.3)	89	97.8 (91.0-99.5)	-2.3 (-7.6-3.0)	0.4
Vitamin A supplement given when needed	49	20.4 (9.5-38.5)	59	15.3 (5.9-34.2)	5.1 (-9.4-19.6)	0.49
Mebendazole given when needed	23	17.4 (6.2-40.3)	36	2.8 (0.3-19.6)	14.6 (-1.8-31.0)	0.05
Correct referral when needed	50	66.0 (48.2-80.2)	32	56.3 (38.9-72.2)	9.7 (-11.9-31.3)	0.38

[1] Children under 12 months of age.

Paper 3: Associations between quality of care and interventions to improve Health Extension Worker performance in Ethiopia

1. Introduction

Approximately 6.9 million children younger than five years of age died in 2011, with the vast majority of these deaths occurring in low and middle-income countries.[1] Pneumonia, diarrhea and malaria are among the leading causes of under-five mortality, with malnutrition as an important underlying cause.[2] Most under-five deaths can be prevented with available and cost-effective interventions.[3] Antibiotic treatment for pneumonia,[4-6] oral rehydration salts and zinc for diarrhea,[6-8] and artemisin-based combination therapy for malaria[9, 10] are effective interventions for preventing child mortality. However, poor and inequitable access to primary health care[11-13] and low quality of care[14-17] are important barriers to reducing child mortality. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) developed the Integrated Management of Childhood Illness (IMCI) strategy to reduce child mortality in low-income countries by improving management of common childhood illnesses at first-level health facilities, in addition to strengthening health systems and family practices for better health.[18-20] Integrated community case management of childhood illness (iCCM) adapts IMCI algorithms for treatment of multiple childhood illnesses by community-based health workers (CHWs). Box 1 provides definitions of key terms as applied in this study. ICCM is increasingly promoted as a key strategy to rapidly increase coverage of appropriate treatments for childhood illnesses, to reduce child mortality and to improve equity in access to health services.[21, 22]

Ensuring high quality care is essential to achieving mortality reductions. Assessments of IMCI and iCCM suggest that quality of care is variable and depends on the strength of program implementation.[23-30] Program processes such as training, supervision and provision of essential drugs and supplies are presumed to lead to improved health worker performance, but, in practice, this is not always the case.[31-36] Most of the evidence available on the impact of program activities on quality of care pertains to health facility-based workers and is limited to formal training and supervision. Little is known about which iCCM program activities are associated with improved quality of care for CHWs.

Ethiopia has implemented community-based treatment of childhood pneumonia, diarrhea, malaria, malnutrition, measles and ear infection through female Health Extension Workers (HEWs) in most regions of the country. A description of the Ethiopia iCCM program activities is provided in Table 1. The program was designed to strengthen the capacity of HEWs to assess, classify and treat common childhood illnesses through training on iCCM, supportive supervision, provision of essential drugs and supplies and improved monitoring and evaluation. As part of an independent prospective evaluation of the impact of iCCM in Ethiopia, we conducted a survey to assess iCCM implementation strength and the quality of iCCM services provided to sick children. We used these data to assess the associations between key components of the iCCM program and quality of care.

2. Methods

Data on indicators of iCCM implementation strength and quality of care were obtained through a randomized cross-sectional survey of health posts (in which HEWs work) in Jimma and West Hararghe Zones of Oromia Region, Ethiopia. The survey was conducted as part of an independent prospective evaluation of the impact of iCCM in Ethiopia. We collected data in 103 randomly selected health posts that were implementing iCCM. Data were collected in May and June 2012, about one year after initiation of iCCM implementation in the intervention areas. Data collectors trained in iCCM observed HEWs' consultations with sick children, carried out 'gold standard' re-examinations, conducted caretaker exit interviews, inspected commodities and patient registers and interviewed HEWs. Within health posts, all HEWs providing clinical services were included in the study. Children 2-59 months of age presenting spontaneously at the health post, mobilized by HEWs or recruited by the survey team were also included. There were one to three HEWs per health post, with an average of 1.3. The mean number of children observed per health post was 2.5, and the number ranged from one to five. Data were entered directly into tablet computers using Open Data Kit (ODK)[37] as the data capture software and were stored in a Research Electronic Data Capture (REDCap) database.[38] Detailed survey methods are available elsewhere.[39] Ethical approval was obtained from the Institutional Review Boards of the Oromia Regional Health Bureau and the Johns Hopkins University Bloomberg School of Public Health.

2.1. Indicators

The primary indicators of implementation strength and quality of care were based on indicators from the the WHO Health Facility Survey tool[40] and the CCM Global Indicators.[41] The indicators were adapted to fit the Ethiopia HEW context and some indicators were added if they were not covered in the existing tools. See Table 2 for descriptions of the indicators considered for use in this study. The outcome of interest was the proportion of children correctly managed for major iCCM illnesses. This is a summary indicator that includes management of pneumonia, diarrhea, malaria, malnutrition, measles and danger signs. A child was considered correctly managed if: 1) the child received all recommended treatments and no unnecessary treatments, 2) the child was referred if and only if referral was indicated and 3) the HEW prescribed the correct dose, duration and schedule for all treatments. The predictors in our analysis were indicators of implementation strength that are expected to affect quality of care. These indicators represent three categories of program inputs: 1) training, 2) supportive supervision and 3) availability of medications, supplies and other commodities. Other indicators of program strength, such as population coverage of health workers and demand creation activities, are important for achieving population coverage of correct treatment and reductions in morbidity and mortality. However, these activities should not directly affect quality of care and are not specifically targeted by the Ethiopia iCCM program, so they were not included in this analysis. Enhanced monitoring and evaluation may lead to improved quality of care over time. However, because data collection for this survey occurred relatively soon after implementation of the program, monitoring data had not been collected and analyzed for most health posts and feedback had not been given to HEWs and supervisors. Thus, there was little reason to expect monitoring and evaluation activities to be important predictors of quality of care at the time of data collection. Child characteristics, such as age or severity of illness, may be important predictors of quality of care. However, because the objective of this analysis was to determine the relationships between the interventions to improve HEW performance and quality of care, we did not include child characteristics as predictors in the model.

2.2. Data analysis

All analyses were carried out in Stata 13.[42] Standard errors and associated 95% confidence intervals were calculated using the Taylor linearization method to account for clustering of HEWs and children within health posts.[43] An alpha level of 0.05 was used for tests of statistical significance. Logistic regression was used to analyze the associations between predictor variables and the dichotomous quality of care outcome.

We assessed potential confounders of the relationship between the interventions and quality of care. The potential confounders assessed were: zone, *woreda* (district), distance from the health post to the nearest referral health facility, malaria burden of the health post catchment area and the number of sick child consultations at the health post in the previous month (caseload). Other child and HEW-level variables may be important predictors of quality of care, but these were not expected to be associated with the iCCM interventions, therefore they would not be confounders of the associations of interest.

We first conducted bivariate logistic regressions of the outcome on potential confounding variables. Potential confounders with a p-value ≤ 0.25 were retained for further assessment. For these variables, we assessed differences in the coefficients of the predictors of interest between a null model with the predictors of interest, but without the potential confounder and a full model with the predictors of interest and the confounder. We also conducted likelihood ratio tests with the null and full models to assess model fit with and without the confounder. Variables that changed the coefficient of at least one predictor of interest by ≥10% and improved model fit were included in the final model. We also assessed for interactions between caseload and the predictors. We assessed the p-values of the interaction variable ($p \leq 0.05$ was considered statistically significant) in the full model and conducted likelihood ratio tests to assess whether model fit significantly improved with the interaction variable included. Interaction variables that were statistically significant and improved model fit were included in the final model. Once we assessed potential confounders and interactions, we assessed the need to include random effects to account for random variation in quality of care among health posts and among HEWs. We ran a two-level random intercept with child and health post levels and tested whether the intra-cluster correlation coefficient (ICC) was statistically different from zero. This was then repeated for a random intercept with child and HEW levels. The final model was assessed for goodness of fit using a Pearson chi-squared goodness-of-fit test. Finally, we performed multivariate logistic regression analysis to assess associations between the quality improvement interventions and quality of care. Variables in the final multivariate model were considered statistically significant if the p-value of the coefficient was ≤0.05.

3. Results

Enrollment results, sample characteristics and detailed results on iCCM implementation strength and quality of care are presented elsewhere.[39] Several predictor variables were removed from the analysis because of lack of variability or strong collinearity with other predictors. All HEWs had received the initial HEW training and the iCCM training, so these variables were not included in the analysis. Supervision on iCCM including register review or observation of consultations was nearly perfectly collinear with any supervision on iCCM, so the former variable was also removed. Cotrimoxazole antibiotic and job aids also were removed because of lack of variability.

3.1. Model Selection

Bivariate logistic regression analyses found that zone (p=0.033), *woreda* (p=0.087) and malaria risk of the health post catchment area (p=0.088) were associated with the outcome. Because zone and *woreda* were likely measuring a similar effect, we assessed a model with the outcome, zone and *woreda*. Both became non-significant in this model (zone p-value=0.174 and *woreda* p-value=0.765). Therefore, *woreda* was removed from the analysis. Zone was also significantly associated with a number of predictor variables (follow-up training, p<0.001, attendance at a performance review and clinical mentoring meeting [PRCM], p=0.022, supplies available, p=0.089). The likelihood ratio test comparing multivariate models with and without the zone variable included showed that model fit was not significantly improved by adding zone (p=0.261). However, because of the highly significant associations between zone and both the outcome and several predictors, zone seemed to be an important potential confounder. Furthermore, the iCCM program was implemented by different partner organizations in the two study zones and both the strength of implementation and quality of care were higher in Jimma Zone. Including the variable for zone allows us to control for factors related to the zone that may influence implementation of iCCM and quality of care. For example, the strength of zonal health officials or NGO partners may cause higher levels of iCCM implementation. Stronger zonal leadership and partners may also lead to greater quality of care due to higher quality trainings, more frequent feedback to HEWs or other unmeasured variables. Therefore, it was important to control for zone in the final model.

A likelihood ratio test showed that adding malaria risk of the catchment area did not significantly improve model fit (p=0.234). Because malaria risk was not seen as a probable confounder, did not substantially change the coefficients of predictor variables and did not improve model fit, this variable was excluded from the final model.

We hypothesized that there may be an interaction between caseload of a health post and the association between program interventions and quality of care. For example, training or supervision may have had a greater or smaller impact on quality of care depending on the caseload of the health post. We found that caseload had a significant interaction with PRCM (p=0.038) and adding the interaction term to the multivariate model significantly improved model fit (p=0.021). Therefore this interaction was added to the final model.

Next we assessed whether random effects should be included in our model to account for random variation in quality of care among health posts or among HEWs. The test of whether the two-level random intercept with child and health post levels was significantly different from zero had a p-value of 0.346. The test of significance for an intercept with child and HEW levels had a p-value of 0.498. Therefore, we determined that random intercepts were not necessary. The final multivariate model included the six main predictors of interest, plus covariates for zone, caseload and a term for the interaction between PRCM and caseload. The Pearson chi-squared goodness-of-fit test indicated that the final model had reasonably good fit (p=0.496).

3.2. Final Regression Results

The results of the multivariate logistic regression (Table 3) showed that several of the components of the iCCM program had significant associations with quality of care, controlling for other covariates. The largest association was with PRCM. Children who were managed by an HEW who had attended a PRCM meeting had 15 times the odds of being correctly managed, compared to children managed by an HEW who had not attended a PRCM meeting (p=0.004). The HEW receiving follow-up training (OR=2.14, p=0.032) and more drugs available at the health post (OR=1.48, p=0.013) also significantly increased the odds of correct management. Supervision on iCCM (OR=0.83, p=0.684) and the HEW receiving clinical instruction on iCCM at a health center in the previous three months (OR=1.01, p=0.954) did not significantly affect the odds of receiving correct care. The number of supplies available at the health post was significantly negatively associated with quality of care (OR=0.59, p=0.005). Caseload was also significantly positively associated with quality of care (OR=1.12, p=0.015). The interaction between PRCM and caseload was significantly negatively associated with quality of care (OR=0.9, p=0.021).

4. Discussion

Although the interventions we assessed were not randomly assigned and we did not have a comparison group, we do know that the program inputs happened prior to the measurement of quality of care (i.e. HEWs were trained, supervision occurred and drugs and supplies were provided prior to the consultations we observed). Therefore, for any observed associations, causality is likely to go from the predictors to the outcome, and not the other way around. However, as this is an observational study, we cannot rule out the effect of unmeasured confounders.

Because all of the HEWs surveyed had received the standardized iCCM training, we could not assess the impact of this intervention. However, we did find that some components of the iCCM program had strong and significant associations with quality of care, while other components had no association and one unexpectedly had a negative association. HEW attendance at a PRCM and follow-up training were both significantly associated with higher quality of care. PRCM meetings, in particular, had a very strong association. These are important findings, as these interventions are not typically included in quality improvement programs, yet they seem to have provided substantial benefit. However, the findings should be interpreted with caution, as there is the potential for confounding. It is possible that the HEWs who provided lower quality care were less motivated and did not attend a PRCM meeting. This would spuriously inflate the observed association between PRCM and quality of care. During the survey, a small number of HEWs (16) reported that they did not plan to continue working as an HEW through the coming year. As this variable may be related to HEW motivation, we assessed whether there may be a negative association with attending a PRCM meeting. In fact, all of the HEWs who reported an intention to leave their jobs as HEWs had attended a PRCM meeting. This is far from an ideal proxy for motivation, but does somewhat weaken the argument that HEW motivation confounded the relationship between quality of care and PRCM.

Routine supervision for iCCM and HEW visits to health centers were not associated with quality of care. This merits further investigation to examine why these interventions do not seem to be having the desired impact and how they can be improved. The iCCM supervision is, at least in theory, highly standardized and supervisors use standardized checklists to guide supervisions and to collect data. The checklist includes a section on register review and supervisors collect data on quality of care from register review. However, supervisors may focus more on data collection rather than providing feedback to HEWs and discussing the errors found in the review. Visits to health centers are an opportunity to provide additional clinical reinforcement to HEWs, but it seems that this opportunity is being missed. PRCM and follow-up training may have been effective because they are more strictly focused on case management guidelines and actively reviewing registers with HEWs. On the other hand, the observed lack of association between supervision and clinical training during health center visits and quality of care may reflect a lack of focused quality improvement during these visits. More investigation should be done into the specific actions carried out during supervision and health center visits to determine whether sufficient clinical reinforcement is being carried out.

The significant positive association between the number of drugs available and quality of care is not surprising, since availability of essential drugs is requisite for high quality care. The finding that availability of supplies was significantly negatively associated with quality of care is difficult to explain. Clearly, having a timer, thermometer, weighing scale, supplies for administering ORS, rapid diagnostic tests for malaria (RDT) and tape to measure mid-upper arm circumference can only improve quality of care. Therefore, there must be some unmeasured confounder at play. For example, it is possible that better-performing HEWs used these supplies more often (i.e. they were more likely to count respiratory rate, to weigh a child, to take a child's temperature, to use an RDT to diagnose malaria, etc.). If the supplies were used more, they were more likely to break (in the case of a timer, thermometer, scale, etc.) or to run out (in the case of RDTs). Since most of these supplies were provided once and not routinely replenished the way drugs were, once an item was broken or out of stock, the HEW may have had to continue managing children without that item. This could lead have led to a situation where a high-performing HEW was less likely to have supplies available.

The significant coefficient for the interaction between PRCM meeting and the number of sick child consultations at the health post in the previous month indicates that the association between PRCM and quality of care was modified by caseload. The strength of the association between PRCM and quality of care decreased as the caseload of the health post increased. PRCM seemed to have the largest effect on HEWs that worked in health posts that saw fewer sick children. This may be because HEWs that saw fewer children had fewer chances to practice and hone the skills they learned at the iCCM training, so the additional reinforcement from PRCM was especially needed.

Previous studies that looked at associations between program inputs and health worker quality of care in low-income countries have typically focused on training and supervision of health workers in health facilities. These studies have had mixed results,[31, 44] with some showing significant or near-significant associations between quality of care and training[45-51] and others showing no association. [33-35, 48] Similarly, supervision has been shown to improve health worker performance in some studies[52] and to have no effect in others.[34, 53, 54] Few studies have assessed the effect of quality improvement interventions on CHWs. The evidence from this small number of studies is also mixed. Some have found positive associations between quality of care and training[55, 56] and supervision,[56] while others show no associations with training[54, 57] or supervision.[57] Reviews of interventions to improve health worker performance found that quality improvement interventions with multifaceted interventions generally have a greater effect and that supervision with feedback is usually beneficial.[31, 44]

This study has several limitations. First, the observational design of the study limits the conclusions about causality that can be drawn. The absence of a comparison group makes it impossible to rule out unmeasured variables that may have confounded the observed associations between the interventions and quality of care. Second, the lack of variability of some indicators of iCCM implementation precluded any assessment of the effectiveness of these interventions. Third, health workers may have performed better under observation than they would under normal circumstances.[58, 59] Finally, data on some indicators, such as HEW training and supervision, were based on HEW recall, which may be biased. These biases may have led to overestimations of quality of care and of indicators of program implementation strength.

The results of this study, as well as large variation in impact from various quality improvement interventions in other studies, suggest that it may be the quality of implementation of interventions, rather than the inherent characteristics of the interventions, that determines their effectiveness. Training and supervising health workers, and even providing drugs and supplies, can lead to improvements in quality of care, but they do not necessarily do so. Efforts should be focused not only on achieving high coverage of interventions, but also on the content and quality of these interventions to ensure that they have the expected impact.

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Box 1: Definitions of key terms

Integrated community case management (iCCM): In general, iCCM refers to the concurrent management of more than one common childhood illness in the community. ICCM in Ethiopia is integrated management by an HEW at the community level of all of the following childhood illnesses: pneumonia, diarrhea (ORS and zinc), malaria, malnutrition, measles, anemia, and ear infection.

Implementation strength: This term refers to the quantity of effective program activities carried out to reduce child mortality. These activities include training, supportive supervision, and continued availability of essential iCCM commodities and supplies.

Quality of care: We assessed quality based on whether HEWs correctly assessed, classified, treated, and referred children with iCCM illnesses and provided counseling to caretakers based on Ethiopia iCCM clinical guidelines. The summary indicator of quality of care used in this study refers to: Proportion of sick children correctly managed for all major iCCM illnesses.

Danger signs: Able to drink/breastfeed, vomits everything, had convulsions, and lethargy.

Major iCCM illness: Pneumonia, diarrhea, malaria, measles, malnutrition, or danger signs

Table 1: Description of Ethiopia iCCM program interventions

Activity	Description
ICCM training	Six-day training on clinical management of childhood illnesses. The training covers iCCM clinical algorithms and includes case management practice with patients in health facilities.
Follow-up training	Refresher training in the health post within six weeks of the iCCM training.
Performance review and clinical mentoring meetings (PRCM)	Bi-annual meetings where HEWs meet with supervisors, woreda and zonal health officials and partner NGO officials. Facilitators review iCCM patient registers with HEWs and discuss clinical errors.
Supervision	Standardized supportive supervision on iCCM in the health post. Supervisors may be health center supervisors, woreda health officials or partner NGO officials. Supervisors use a standardized supervision checklist and are instructed to either observe the HEWs conducting sick child consultations or review iCCM patient registers with the HEWs and discuss clinical errors.
Clinical mentoring during visits to health centers	HEWs regularly visit their supervising health center for support. During these visits, the HEWs may receive instruction on iCCM from health center supervisors or other clinical staff.
Supply of commodities	Support for purchase and supply of drugs, supplies and other commodities by UNICEF and partners.
Monitoring and evaluation	Enhanced data collection during supervisions and PRCM meetings. Data management support by UNICEF

Table 2: Indicators of iCCM quality of care and implementation strength and their proportions (95% CI) or means (standard deviation), Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Variable	N	% or mean	95% CI or SD
Outcome			
Child correctly managed for iCCM illnesses	257	64.2	57.4-70.5
Predictors			
HEW received initial HEW training	137	100	-
HEW received iCCM training	137	97.8	93.3-99.3
HEW received follow-up training within six weeks of iCCM training	134[a]	46.3	36.7-56.1
HEW attended performance review and clinical mentoring meeting	137	89.1	82.1-93.5
HEW received clinical instruction on iCCM in health center in previous three months	137	57.7	48.8-66.0
Health post received at least one supervision on iCCM in the previous three months	100[b]	87.0	78.8-92.9
Health post received at least one supervision on iCCM that included that included register review or observation of consultations in the previous three months	100	85.0	76.5-91.4
Number of drugs[c] available on the day of data collection (0-7)	103	6.3	1.1
Number of supplies[d] available on the day of data collection (0-6)	103	3.1	0.9
Number of job aids[e] available on the day of data collection (0-3)	103	2.3	1.0

[a] Excludes HEWs that did not receive iCCM training.
[b] Three health posts excluded because HEWs reported not being present for majority of previous three months.
[c] ORS, zinc, vitamin A, ACT, chloroquine, amoxicillin, RUTF.
[d] Timer, thermometer, weighing scale, ORT corner supplies, RDT, MUAC tape.
[e] ICCM chart booklet, iCCM patient register, family health card.

Table 3: Results of multivariate analysis of associations between iCCM quality improvement interventions and selected covariates and correct management of major iCCM illnesses in children 2-59 months, Jimma and West Hararghe Zones, Oromia Region, Ethiopia

Variable	No. of children (N=257)	% children correctly treated	OR (95% CI)	P-value
Child managed by HEW who received follow-up training within 6 weeks of iCCM training				
Yes	116	74.1	2.14 (1.07-4.3)	0.032
No	141	56.0	Ref.	
Child managed by HEW who attended PRCM meeting				
Yes	233	68.2	15.12 (2.49-91.79)	0.004
No	24	25.0	Ref.	
Child managed in health post that received at least one supervision on iCCM in the previous three months				
Yes	225	65.3	0.83 (0.33-2.06)	0.684
No	29	62.1	Ref.	
Child managed by HEW who received clinical instruction on iCCM in health center in previous three months				
Yes	148	66.2	1.02 (0.52-2.02)	0.954
No	109	61.5	Ref.	
Number of drugs available on the day of data collection in health post where child was managed	257	6.3	1.48 (1.09-2.01)	0.013
Number of supplies available on the day of data collection in health post where child was managed	257	3.1	0.59 (0.41-0.85)	0.005
Zone				
Jimma	152	70.4	1.51 (0.72-3.17)	0.267
West Hararghe	105	55.2	Ref.	
Number of sick child consultations at health post in the previous month	257	16.5	1.12 (1.02-1.22)	0.015
Interaction between HEW attended PRCM meeting and number of sick child consultations	257	-	0.9 (0.01-1.37)	0.021

Conclusions

1. Summary of findings

The scale-up of iCCM in Ethiopia is a rare example of rapid large-scale implementation of iCCM covering the large majority of a country's population. Tremendous resources have been invested in the iCCM program with the goal of increasing access to life-saving medical care and reducing child mortality. This study provides valuable information on the implementation of iCCM as well as the capacity of HEWs to provide high quality care to sick children. As the number and scale of iCCM programs increase in sub-Saharan Africa, evidence on the strengths and weaknesses of existing programs is increasingly important. The results of this study are relevant not only for Ethiopia, but also for iCCM programs in other countries that face similar challenges. Although the Ethiopian context is unique, there are many commonalities with other rural sub-Saharan African settings. The potential pools of CHWs and the communities they serve have broadly comparable socio-economic backgrounds and many of the challenges of providing care to these populations are similar. As other countries plan for scale-up of iCCM, the lessons from Ethiopia may prove valuable.

This study demonstrates the ability of CHWs to effectively manage multiple childhood illnesses and highlights crucial limitations and challenges that must be addressed for an iCCM program to have a large impact on child mortality. We also provide information on which components of the Ethiopia iCCM program may be having the largest impact on quality of care and assess a number of methodological questions that will inform future assessments of quality of care in the challenging CHW context.

1.1. Paper 1

Training of HEWs in iCCM was virtually universal and a large majority of HEWs had participated in PRCM meetings. Supportive supervision on iCCM was also common and nearly all supervision included clinical reinforcement. Availability of iCCM commodities, supplies and job aids was also very good. This is in sharp contrast with comparison health posts, where nearly all measures of implementation strength were significantly lower. The results of the quality of care assessment show that most children received correct treatment for their illnesses. On the other hand, assessment of danger signs, management of children with severe illness, management of complicated malnutrition and provision of vitamin A and mebendazole are priority areas for improvement. Quality of care provided by HEWs compares favorably to that provided by community-based health workers in other countries as well as to higher-level health workers in Ethiopia. However, without a large increase in utilization of iCCM services, population coverage of effective treatments will likely remain low. The iCCM program is also failing to reach sick children under two months of age, who are precisely the children who are most vulnerable to preventable mortality.

1.2. Paper 2

In circumstances where low utilization of case management services makes it unlikely that a survey team will easily obtain an adequate sample of sick children from spontaneous consultations to assess quality of care, alternative methods of obtaining sick children are required. The results of this survey support the use of both mobilization by community health workers and recruitment of children by survey teams to obtain a larger sample of sick children. Both methods proved to be feasible and provided relatively large samples of sick children, including children with severe illness.

The assessment of the validity of alternative methods for assessing quality of care found that RR and DO provided estimates of indicators of quality of care that mostly had fair or moderate agreement with the gold standard method (DO with RE). RR and DO clearly have advantages in cost and feasibility and therefore will be commonly used for routine data collection. The limitations of these methods, including potential overestimation of correct performance, should be kept in mind. Finally, we found that observation of consultations had little effect on HEW performance.

1.3. Paper 3

Several components of the Ethiopia iCCM program were assessed for associations with quality of care. HEW attendance at a PRCM meeting had the strongest association with correct management of childhood illnesses. Children who were managed by HEWs who had received follow-up training and children who were managed in health posts that had more essential drugs available also had significantly higher odds of being correctly managed. On the other hand, routine supervision for iCCM, HEW visits to health centers and supplies available were not significantly positively associated with quality of care. These results suggest that some, but not all, of the interventions to increase HEW performance are having the intended effect.

2. Limitations & Strengths

This study has several limitations. First, direct observation of HEW consultations and re-examination of sick children were not conducted in comparison health posts. Therefore, we do not have measures of quality of care for the comparison areas. This limited our ability to compare the two study areas. However, because implementation strength for routine CCM was so low in comparison areas, it is reasonable to infer that quality of care was also low. Second, the single time point for data collection precludes an assessment of changes in implementation strength and quality of iCCM services over time. Third, sample size limitations in the comparison areas led to relatively imprecise estimates of some indicators. Small sample sizes for sub-groups in intervention and comparison areas also limited the conclusions that could be drawn from various analyses. Fourth, informing HEWs of upcoming visits by data collectors may have biased the results positively. Fifth, we relied on HEW recall to measure some indicators. We attempted to verify this information through review of documentation, but this was not always possible. These results may be subject to recall bias. These biases may have led to overestimates of quality of care and implementation strength. Sixth, the assessment of associations between quality of care and iCCM interventions is an observational study with no comparison group, thus there is the possibility that the observed associations were due to unmeasured confounders. For this reason, causal inferences should be made with caution. Seventh, the study results may be impacted by the season in which data collection is carried out. Jimma and West Hararghe Zones have a relatively low burden of malaria and the survey was conducted outside of the peak malaria season. There may be different patterns of utilization and quality of care in areas with a high burden of malaria or in the peak malaria season that we were not able to assess in this study. Finally, The evaluation areas may not be representative of entire country. As the assessment of implementation strength and quality of care was only conducted in the two zones designated as the evaluation areas, it is possible that implementation was stronger than in other regions and the results may not be entirely generalizable.

Despite the limitations of this study, we applied rigorous assessment methods to add to the evidence base regarding implementation of iCCM. An important strength of this study is the randomized design of the larger iCCM evaluation. Because the *woredas* were randomized into intervention and comparison areas, we can feel reasonably confident that the *woredas* had similar levels of implementation strength and quality of services provided at baseline. Furthermore, the methods employed to assess quality of care, including direct observation with a gold standard clinician re-examination, are generally accepted as the most rigorous methods used in this setting. Data collectors received intensive training by highly qualified trainers with deep knowledge of the study design and tools. Training also included extensive practice, including field piloting. Study researchers from IIP-JHU and ABH carried out extensive field supervision and support, in addition to the daily supervision provided by team supervisors. Electronic data collection allowed for timely review of data quality and early feedback to survey teams. Study researchers thoroughly reviewed all data, and survey teams worked to rectify all missing or inconsistent data, which led to very little missing data. In all, we believe the data quality from this study was of high quality.

The data presented here provide insight into a number of understudied questions. This was the first study we are aware of that assessed actual performance of HEWs in delivering CCM/iCCM services. We have added to a limited evidence base that demonstrates the ability of CHWs to manage multiple childhood illnesses. This was also the first study to directly address mobilization and recruitment of sick children for observation in a context of low utilization of CCM services. It also assesses alternative methods for assessing CHW quality of care, for which little information was previously available.

3. Public Health Significance

A primary motivation for this research was to provide early feedback to the Ethiopian FMOH, the ORHB and implementing partners on the strength of program implementation, the quality of care provided to sick children and the utilization of iCCM services. The results have been widely disseminated to stakeholders in Ethiopia and have been well received. Our findings confirm data from routine monitoring that the iCCM program was implemented at a very high level and that HEWs are for the most part providing correct care. However, this study has highlighted some key concerns. First, mismanagement of children with severe illness is very concerning. Second the low levels of utilization of iCCM services threaten to nullify the achievements in implementation of the program. These findings have been accepted and their importance has been recognized by key stakeholders. In particular, the focus of attention has now shifted from implementation and scale-up of iCCM to efforts to increase utilization of services to achieve high coverage of treatments of childhood illnesses. The prioritization of the massive HDA is one example of this new focus.

The findings of this study have relevance beyond the Ethiopian context. For an international audience, evidence regarding the successes and limitations of the Ethiopia iCCM program is important. Several authors have highlighted the dearth of evidence on how to most effectively deliver proven interventions for child health and called for more research in this area.[1-4]

The Ethiopian HEP is often seen as a model for large-scale implementation of primary health care at the community level. It also provides one of the few examples of iCCM being implemented at a national scale (in a large country). As other African countries scale up iCCM, the lessons from Ethiopia can help improve implementation in other countries.

There are concerns about the ability of CHWs to provide high quality management of multiple illnesses.[5] The limited evidence on quality of care provided by CHWs managing multiple childhood illnesses suggests that performance is variable.[6-8] Previous findings that CHWs may have more difficulty with management of children with severe illness[9-11] were confirmed in our study and this challenge should be a key focus for future interventions. Furthermore, the issue of low utilization of CHWs is not unique to Ethiopia. It is critical that future iCCM programs consider demand creation to be a key component of the program from the beginning and efforts to promote utilization of services should be as intense as efforts to train health workers and provide drugs.

Another key motivation for this research was to provide information on intermediate outcomes for the prospective impact evaluation of iCCM in Ethiopia. With information on implementation of the iCCM program, quality of care and utilization of services, evaluators will be better able to interpret the evaluation results. The results of this study suggest that the Ethiopia iCCM program was implemented as planned and HEWs are capable of treating multiple childhood illnesses. However, the low level of utilization suggests that the impact of the program on coverage of treatments and child mortality will be negligible. Without the information from this survey, interpretation of the data from the household surveys would be more difficult and the messages transmitted to stakeholders both inside and outside of Ethiopia, would be less clear.

Finally, this study provided information on a number of methodological questions related to assessing the quality of care provided by CHWs. Low utilization of CHWs presents a serious challenge when conducting assessments of quality of care that include direct observation of consultations. We have shown that it is feasible to obtain sick children through mobilization by the CHW or through recruitment by the survey team on the day of data collection. This study has also provided evidence on the validity of alternative methods of assessing quality of care when DO with RE is considered too expensive or difficult. We also found that observation of consultations had little effect on HEWs' performance. These findings will help future researchers and program managers make more informed decisions regarding which assessment methods to employ.

4. Recommendations for future research

The most urgent follow-up research to this study is an examination of the reasons for low utilization of iCCM services. Qualitative research on barriers to care seeking, as well as quantitative research looking at factors associated with high or low utilization would be extremely useful and timely. This information is imperative for Ethiopia to increase the impact of the iCCM program and is important for other countries that are scaling up iCCM and will face similar issues.

Along the same lines, evaluations of interventions to create demand for iCCM services and increase utilization are needed to provide rigorous evidence on which interventions are most effective. The scale of the Ethiopian HDA and its apparent key role in increasing utilization of HEW services make it an excellent candidate for a rigorous effectiveness evaluation.

Mismanagement of children with severe illness has been a consistent finding in assessments of CHW quality of care.[9-11] Standard training and supervision interventions do not seem to be effectively addressing this crucial component of case management. Evaluations of interventions to improve management of severe illness by CHWs would be extremely useful.

To our knowledge, this was the first published report of the use of mobilization and on-the-spot recruitment of children for assessment of CHW quality of care. Thus, more evidence on the feasibility, productivity and biases of these methods from other settings is needed. The small sample sizes of children in some categories, such as those who arrived spontaneously, make it difficult to assess difference in child characteristics with good precision. Future studies should be designed to have adequate sample sizes of children in each recruitment category to allow for more precise comparisons.

There is also limited evidence on the validity of RR and DO for assessing CHW quality of care. DO performed fairly well in our assessment, but the strength of the results is limited by the fact that we did not collect information on children's signs and symptoms during the observation. Estimating correct management of illnesses by looking at consistency between signs and symptoms and treatment would be more meaningful than looking at consistency between classification and treatment like we did in this study. A more rigorous assessment, comparing DO and DO with RE, would provide valuable information on whether the addition of re-examination, with the extra time and cost, provides substantially different estimates than could be attained using DO only.

Finally, an assessment of the effects of different interventions in an iCCM program, but with a stronger randomized and/or pre-post design, with a comparison area, would be useful. This would shed more light on which components of the program are having the largest impact on CHW performance and which interventions need improvement.

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Appendix 1: Survey Questionnaires

Read the informed consent and obtain agreement from the HEWs.
Fill out one Health Post Questionnaire Panel per health post.

Health Post Questionnaire Panel

HP1.	Zone: ________________________________
HP2.	Woreda: ______________________________
HP3.	Kebele: ______________________________
HP4.	Health post: ______________________________
HP5.	Distance of health post from nearest referral health location: ______ km
HP6.	Malaria risk of kebele: (1) High (2) Low (3) No malaria
HP7.	Population of children under five in the health post catchment area: _______________

Date of visit: __ __ /__ __ /__ __ Data collector name: _______________ Result: ___

No. of observations of consultations: _____ No. of re-examinations: _____

Result codes:

1 = Completed
2 = Partially completed
3 = Health post closed / no HEW available
4 = Refused
5 = Health post could not be found
8 = Other, specify: ____

Supervisor	**Senior supervisor (quality check)**
Name __________________	Name __________________
Date__ __ /__ __ / __ __	Date__ __ / __ __ / __ _

Form 1. Observation Checklist – child (2 – 59 months)

Read informed consent and obtain agreement from child's caretaker.
Then fill out one Observation Checklist per sick child.

Unique child ID: | | | | | **Unique HEW ID**: | | | | Data collector: ………………

Zone: …………………. Woreda: …………………. Kebele: ………………….

Health post: ………………….

HEW number: …………………. HEW name: ………………….

Caretaker number: ……… Caretaker relationship: (1) Biological Mother (2) Father 8) Other: …..………..

Child name: …………………. Child number: ……….. Sex: (1) M (2) F

Age (completed months): ………

Consultation type: (1) Spontaneous (2) Mobilized by HEW (3) Recruited by survey team

Time of start of observation: ……… (Ethiopian time)

Interruption time 1: ……… Resumption time 1: ………

Interruption time 2: ……… Resumption time 2: ………

Interruption time 3: ……… Resumption time 3: ………

ASSESSMENT MODULE

Observe silently and do not interfere with the consultation. Record what you hear and see.

A1. What reasons does the caretaker give for bringing the child to the health post?
Circle all signs mentioned.

A.	Fast/difficult breathing	(1) mentioned	(2) not mentioned
B.	Cough	(1) mentioned	(2) not mentioned
C.	Pneumonia	(1) mentioned	(2) not mentioned
D.	Diarrhoea	(1) mentioned	(2) not mentioned
E.	Fever	(1) mentioned	(2) not mentioned
F.	Malaria	(1) mentioned	(2) not mentioned
G.	Convulsions	(1) mentioned	(2) not mentioned
H.	Difficulty drinking or breastfeeding	(1) mentioned	(2) not mentioned
I.	Vomiting	(1) mentioned	(2) not mentioned
J.	Ear problem	(1) mentioned	(2) not mentioned
K.	Other problem, specify:	(1) mentioned	(2) not mentioned
L.	Other problem, specify:	(1) mentioned	(2) not mentioned
M.	Other problem, specify:	(1) mentioned	(2) not mentioned

Does the health worker ask about the following signs and symptoms?

Note: "Avail." means the information was already available. Either the patient (or caretaker) spontaneously offers the information, or the patient has already given the information in response to a previous question, or the patient very obviously has the sign (e.g., convulsions, vomiting, etc.).

Note: The questions below refer to whether the child currently has or has had the given signs/symptoms during the illness episode.

Weight		
A2A.	Does the HEW weigh the child?	(1) Yes (2) No → ***Skip to A3A***
A2B.	What is the child's weight?	………..... kgs
Danger Signs		
A3A.	Does the HEW ask if the child is NOT able to drink or breastfeed ANYTHING?	(1) Yes (2) No (3) Avail.
A3B.	Does the HEW **check** if the child is able to drink or breastfeed (*by offering water or breastmilk*)?	(1) Yes (2) No (3) Avail.
A4.	Does the HEW ask if the child is vomiting EVERYTHING?	(1) Yes (2) No (3) Avail.
A5.	Does the HEW ask whether the child has convulsions?	(1) Yes (2) No (3) Avail.
A6.	Does the HEW check for lethargy or unconsciousness (try to wake up the child)?	(1) Yes (2) No (3) Avail.
Cough/Difficult Breathing		
A7A.	Does the HEW ask if the child has cough or difficult breathing?	(1) Yes (2) No → ***Skip to A8A*** (3) Avail.
A7B.	Does the child have cough or difficult breathing?	(1) Yes (2) No → ***Skip to A8A***
A7C.	Does the HEW ask how long the child has had cough or difficult breathing?	(1) Yes (2) No (3) Avail.
A7D.	Does the HEW count breaths in 1 minute?	(1) Yes (2) No → ***Skip to A7F***
A7E.	How many breaths does the HEW count in 1 minute?	………..... bpm
A7F.	Does the HEW look for chest indrawing?	(1) Yes (2) No (3) Avail.
A7G.	Does the HEW look and listen for stridor?	(1) Yes (2) No (3) Avail.
Diarrhoea		
A8A.	Does the HEW ask if the child has diarrhoea (loose stools)?	(1) Yes (2) No → ***Skip to A9A*** (3) Avail.
A8B.	Does the child have diarrhoea?	(1) Yes (2) No → ***Skip to A9A***

A8C.	Does the HEW ask how long the child has had diarrhoea?	(1) Yes (2) No (3) Avail.
A8D.	Does the HEW ask if there is blood in the stool?	(1) Yes (2) No (3) Avail.
A8E.	Does the HEW check if the child is restless or irritable?	(1) Yes (2) No (3) Avail.
A8F.	Does the HEW offer the child fluid?	(1) Yes (2) No (3) Avail.
A8G.	Does the HEW pinch the skin of the abdomen?	(1) Yes (2) No
Fever		
A9A.	Does the HEW ask or feel for fever (reported or now) or take the child's temperature?	(1) Yes (2) No → ***Skip to A10A*** (3) Avail.
A9B.	Does the HEW take the child's temperature?	(1) Yes (2) No → ***Skip to A9D***
A9C.	What is the child's temperature?	……... degrees
A9D.	Does the child have fever or history of fever (last 48 hours)?	(1) Yes (2) No → ***Skip to A10A***
A9E.	Does the HEW ask how long the child has had fever?	(1) Yes (2) No (3) Avail.
A9F.	Does the HEW ask if the fever has been present every day?	(1) Yes (2) No (3) Avail.
A9G.	Does the HEW check if the child has a stiff neck?	(1) Yes (2) No
A9H.	Does the HEW check if the child has bulged fontanel?	(1) Yes (2) No
A9I.	Does the HEW ask if the child has had measles in the last 3 months **or** check for signs of measles? *Note: Signs of measles defined as generalized rash and one of these: cough, runny nose, red eyes. Observe the child for runny nose and red eyes.*	(1) Yes (2) No → ***Skip to A9N*** (3) Avail.
A9J.	Does the HEW check for generalized rash?	(1) Yes (2) No (3) Avail.
A9K.	Does the child have history of measles in the last 3 months **or** signs of measles?	(1) Yes (2) No → ***Skip to A9N***
A9L.	Does the HEW check if the child has mouth ulcers?	(1) Yes (2) No
A9M.	Does the HEW look at the child's eyes for pus or clouding of the cornea?	(1) Yes (2) No (3) Avail.
A9N.	Does the HEW perform an RDT for the child?	(1) Yes (2) No → ***Skip to A10A***

A9O.	What is the result of the RDT?	(1) Pos. falciparum (2) Pos. vivax (3) Pos. falciparum & vivax (4) Neg (5) Invalid
A9P.	Is the RDT performed correctly?	(1) Yes (2) No
Ear Problem		
A10A.	Does the HEW ask if the child has an ear problem?	(1) Yes (2) No → ***Skip to A11A*** (3) Avail.
A10B.	Does the child have an ear problem?	(1) Yes (2) No → ***Skip to A11A***
A10C.	Does the HEW ask how long the child has had an ear problem?	(1) Yes (2) No (3) Avail.
A10D.	Does the HEW ask if there is ear pain?	(1) Yes (2) No (3) Avail.
A10E.	Does the HEW check if there is ear discharge/pus draining from the ear?	(1) Yes (2) No (3) Avail.
Malnutrition		
A11A.	Does the HEW press on both feet to look for swelling?	(1) Yes (2) No
A11B.	Does the HEW look for visible severe wasting?	(1) Yes (2) No (3) Avail.
A11C.	Does the HEW measure the child's MUAC?	(1) Yes (2) No → ***Skip to A11E***
A11D.	What is the child's MUAC measurement (in cm)?	(1) <11 (2)11-<12 (3) $\geq$12
A11E.	Does the HEW give the child an appetite test?	(1) Yes (2) No (3) Avail.
Anaemia		
A12.	Does the HEW look for palmar pallor?	(1) Yes (2) No
HIV		
A13A.	Does the HEW ask about the mother's HIV status?	(1) Yes (2) No (3) Avail. (9) NA
A13B.	Does the HEW ask about the child's HIV status?	(1) Yes (2) No (3) Avail.

Vaccination		
A14A.	Does the HEW ask to see the child's vaccination card?	(1) Yes (2) No → ***Skip to A14C*** (3) Avail.
A14B.	Is the child's vaccination card available?	(1) Yes (2) No
A14C.	Does the HEW ask the caretaker about the child's vaccination history?	(1) Yes (2) No (3) Avail.
Vitamin A		
A15.	Does the HEW ask if the child has received a dose of vitamin A in the previous 6 months?	(1) Yes (2) No (3) Avail.
Mebendazole/Albendazole		
A16.	Does the HEW ask if the child has received a dose of mebendazole/albendazole in the previous 6 months?	(1) Yes (2) No (3) Avail.
Other Problems		
A17.	Does the HEW ask if there are any other problems? Specify: …………………………… …………………………… ……………………………	(1) Yes (2) No (3) Avail.

CLASSIFICATION MODULE

Look at the iCCM registration book for the patient's classification. If the classification is not recorded in the registration book, ask the HEW what the child's classifications are. Ask "Any other classification?" until the health worker has stated all classifications. Do not ask for each specific classification.

C1. Does the HEW give one or more classifications for the child?

(1) Yes

(2) No → ***Skip to Treatment Module (T1)***

Observer record all classifications below:		
C2.	One or more general danger signs (unable to drink or breastfeed, vomits everything, convulsions, lethargic/unconscious)	(1) Yes (2) No
C3A.	Severe pneumonia/very severe disease	(1) Yes (2) No
C3B.	Pneumonia	(1) Yes (2) No
C3C.	No pneumonia: cough or cold	(1) Yes (2) No
C4A.	Diarrhoea, severe dehydration	(1) Yes (2) No
C4B.	Diarrhoea, some dehydration	(1) Yes (2) No
C4C.	Diarrhoea, no dehydration	(1) Yes (2) No
C4D.	Severe persistent diarrhoea	(1) Yes (2) No
C4E.	Persistent diarrhoea	(1) Yes (2) No
C4F.	Dysentery	(1) Yes (2) No
C5A.	Very severe febrile disease	(1) Yes (2) No
C5B.	Malaria	(1) Yes (2) No
C5C.	Fever, malaria unlikely	(1) Yes (2) No
C5D.	Fever, no malaria	(1) Yes (2) No
C6A.	Severe complicated measles	(1) Yes (2) No
C6B.	Measles with eye/mouth complications	(1) Yes (2) No
C6C.	Measles	(1) Yes (2) No
C7A.	Acute ear infection	(1) Yes (2) No
C7B.	Chronic ear infection	(1) Yes (2) No
C8A.	Severe complicated malnutrition	(1) Yes (2) No
C8B.	Severe uncomplicated malnutrition	(1) Yes (2) No
C8C.	Moderate acute malnutrition	(1) Yes (2) No
C9A.	Severe anaemia	(1) Yes (2) No
C9B.	Anaemia	(1) Yes (2) No
C10.	Vaccination status **not** up-to-date → Vaccine(s) needed …………………………………..	(1) Yes (2) No
C11.	Vitamin A status **not** up-to-date	(1) Yes (2) No
C12.	Mebendazole/albendazole supplementation status **not** up-to-date	(1) Yes (2) No
C13.	Other, specify………………	(1) Yes (2) No
C14.	Other, specify………………	(1) Yes (2) No
C15.	Other, specify………………	(1) Yes (2) No

TREATMENT MODULE

Note: If the HEW treats with one dose for a child being referred, record the one dose given (formulation and number of tablets/ml/sachets, etc.) and mark NA for frequency and total days.

T1.	Does the HEW administer or prescribe any treatment or vaccine?	(1) Yes (2) No → ***Skip to T16A***
Cotrimoxazole		
T2A.	Does the HEW give cotrimoxazole?	(1) Yes (2) No → ***Skip to T3A*** (3) Prescribed only
T2B.	What is the formulation of cotrimoxazole?	(1) Pediatric tablet (2) Adult tablet (3) Syrup → ***Skip to T2D*** (8) Other, specify _____________→ ***Skip to T2E*** (99) Not specified → ***Skip to T2E***
T2C.	How many cotrimoxazole tablets for each dose?	(1) ½ → ***Skip to T2E*** (2) 1 → ***Skip to T2E*** (3) 2 → ***Skip to T2E*** (4) 3 → ***Skip to T2E*** (8) Other, specify ______ → ***Skip to T2E*** (99) Not specified → ***Skip to T2E***
T2D.	How many ml of cotrimoxazole syrup for each dose?	(1) 2.5 (2) 5 (3) 7.5 (4) 10 (8) Other, specify ______ (99) Not specified
T2E.	How many times should cotrimoxazole be given per day?	(1) 1 (2) 2 (3) 3 (8) Other, specify ______ (9) NA (referred) (99) Not specified
T2F.	For how many days is cotrimoxazole prescribed?	(1) 3 (2) 5 (3) 7 (8) Other, specify ______ (9) NA (referred) (99) Not specified
T2G.	Does the HEW demonstrate how to administer cotrimoxazole?	(1) Yes (2) No
T2H.	Does the HEW ask the caretaker to repeat back how to administer cotrimoxazole?	(1) Yes (2) No
T2I.	Does the HEW give or ask the caretaker to give the first dose of cotrimoxazole before leaving the health post?	(1) Yes (2) No
ORS		
T3A.	Does the HEW give ORS?	(1) Yes (2) No → ***Skip to T3G*** (3) Prescribed only
T3B.	How many sachets of ORS are given?	(1) 1 (2) 2 (3) 3 (8) Other, specify ______ (99) Not specified
T3C.	Does the HEW recommend that the child stay in the health post after the consultation to receive ORS?	(1) Yes (2) No
T3D.	Does the HEW demonstrate how to administer ORS?	(1) Yes (2) No

T3E.	Does the HEW ask the caretaker to repeat back how to administer ORS?	(1) Yes (2) No
T3F.	Does the HEW give or ask the caretaker to give the first dose of ORS before leaving the health post?	(1) Yes (2) No
T3G.	Does the HEW prescribe home-based ORT?	(1) Yes (2) No
Zinc		
T4A.	Does the HEW give zinc?	(1) Yes (2) No → ***Skip to T5A*** (3) Prescribed only
T4B.	How many zinc tablets for each dose?	(1) 1/2 (2) 1 (3) 2 (8) Other, specify ______ (99) Not specified
T4C.	How many times should zinc be given per day?	(1) 1 (2) 2 (3) 3 (8) Other, specify ______ (9) NA (referred) (99) Not specified
T4D.	For how many days is zinc prescribed?	(1) 3 (2) 5 (3) 10 (8) Other, specify ______ (9) NA (referred) (99) Not specified
T4E.	Does the HEW demonstrate how to administer zinc?	(1) Yes (2) No
T4F.	Does the HEW ask the caretaker to repeat back how to administer zinc?	(1) Yes (2) No
T4G.	Does the HEW give or ask the caretaker to give the first dose of zinc before leaving the health post?	(1) Yes (2) No
Vitamin A		
T5A.	Does the HEW give vitamin A?	(1) Yes (2) No → ***Skip to T6A*** (3) Prescribed only
T5B.	What is the formulation of vitamin A?	(1) 50,000 IU capsule (2) 100,000 IU capsule (3) 200,000 IU capsule (8) Other, specify ________________ (99) Not specified
T5C.	How many vitamin A capsules does the HEW give?	(1) 1/2 (2) 1 (3) 2 (4) 3 (5) 4 (8) Other, specify ______ (99) Not specified
T5D.	How many doses of vitamin A does the HEW prescribe?	(1) 1 (2) 2 (3) 3 (8) Other, specify ______ (99) Not specified
T5E.	Does the HEW give or ask the caretaker to give vitamin A in the health post?	(1) Yes (2) No
T5F.	Does the HEW give vitamin A to be given at home?	(1) Yes (2) No → ***Skip to T6A***

T5G.	Does the HEW demonstrate how to administer vitamin A?	(1) Yes (2) No
T5H.	Does the HEW ask the caretaker to repeat back how to administer vitamin A?	(1) Yes (2) No
Coartem		
T6A.	Does the HEW give Coartem?	(1) Yes (2) No → ***Skip to T7A*** (3) Prescribed only
T6B.	How many Coartem tablets for each dose?	(1) 1 (2) 2 (3) 3 (4) 4 (8) Other, specify ______ (99) Not specified
T6C.	How many times should Coartem be given per day?	(1) 1 (2) 2 (3) 3 (8) Other, specify ______ (9) NA (referred) (99) Not specified
T6D.	For how many days is Coartem prescribed?	(1) 3 (2) 5 (3) 7 (8) Other, specify ______ (9) NA (referred) (99) Not specified
T6E.	Does the HEW demonstrate how to administer Coartem?	(1) Yes (2) No
T6F.	Does the HEW ask the caretaker to repeat back how to administer Coartem?	(1) Yes (2) No
T6G.	Does the HEW give or ask the caretaker to give the first dose of Coartem before leaving the health post?	(1) Yes (2) No
Chloroquine		
T7A.	Does the HEW give chloroquine?	(1) Yes (2) No → ***Skip to T8*** (3) Prescribed only
T7B.	What is the formulation of chloroquine?	(1) Tablet (2) Syrup → ***Skip to T7D*** (8) Other, specify ______________→***Skip to T7E*** (99) Not specified →***Skip to T7E***
T7C.	How many chloroquine tablets for each dose?	(1) ¼,¼, ¼ → ***Skip to T7E*** (2) ½, ½, ½ → ***Skip to T7E*** (3) 1, 1, ½ → ***Skip to T7E*** (4) 1,1,1 → ***Skip to T7E*** (5) 1½, 1½, 1 → ***Skip to T7E*** (6) 2½, 2½, 1 → ***Skip to T7E*** (7) 3, 3, 2→ ***Skip to T7E*** (7a) 4, 4, 2 → ***Skip to T7E*** (8) Other, specify _________ → ***Skip to T7E*** (99) Not specified →***Skip to T7E***
T7D.	How many ml of chloroquine syrup for each dose?	(1) 5, 5, 2.5 (2) 7.5, 7.5, 5 (3) 12.5, 12.5, 7.5 (4) 15, 15, 15 (5) 20, 20, 15 (8) Other, specify ______ (99) Not specified

T7E.	How many times should chloroquine be given per day?	(1) 1 (2) 2 (3) 3 (8) Other, specify _______ (9) NA (referred) (99) Not specified
T7F.	For how many days is chloroquine prescribed?	(1) 3 (2) 5 (3) 7 (8) Other, specify _______ (9) NA (referred) (99) Not specified
T7G.	Does the HEW demonstrate how to administer chloroquine?	(1) Yes (2) No
T7H.	Does the HEW ask the caretaker to repeat back how to administer chloroquine?	(1) Yes (2) No
T7I.	Does the HEW give or ask the caretaker to give the first dose of chloroquine before leaving the health post?	(1) Yes (2) No
Paracetamol		
T8.	Does the HEW give paracetamol?	(1) Yes (2) No (3) Prescribed only
Amoxicillin		
T9A.	Does the HEW give amoxicillin?	(1) Yes (2) No → ***Skip to T10A*** (3) Prescribed only
T9B.	What is the formulation of amoxicillin?	(1) Tablet (2) Syrup → ***Skip to T9D*** (8) Other, specify _______________→ ***Skip to T9F*** (99) Not specified → ***Skip to T9F***
T9C.	How many amoxicillin tablets for each dose?	(1) ½ → ***Skip to T9F*** (2) 1 → ***Skip to T9F*** (3) 2 → ***Skip to T9F*** (4) 3 → ***Skip to T9F*** (5) 4 → ***Skip to T9F*** (8) Other, specify _______ → ***Skip to T9F*** (99) Not specified → ***Skip to T9F***
T9D.	What is the strength of the amoxicillin syrup?	(1) 125mg per 5ml (2) 250mg per 5ml (8) Other, specify _______ (99) Not specified
T9E.	How many ml of amoxicillin syrup for each dose?	(1) 2.5 (2) 5 (3) 10 (4) 15 (5) 20 (6) 30 (7) 40 (8) Other, specify _______ (99) Not specified
T9F.	How many times should amoxicillin be given per day?	(1) 1 (2) 2 (3) 3 (8) Other, specify _______ (9) NA (referred) (99) Not specified

T9G.	For how many days is amoxicillin prescribed?	(1) 3 (2) 5 (3) 7 (8) Other, specify ______ (9) NA (referred) (99) Not specified
T9H.	Does the HEW demonstrate how to administer amoxicillin?	(1) Yes (2) No
T9I.	Does the HEW ask the caretaker to repeat back how to administer amoxicillin?	(1) Yes (2) No
T9J.	Does the HEW give or ask the caretaker to give the first dose of amoxicillin before leaving the health post?	(1) Yes (2) No
RUTF		
T10A.	Does the HEW give RUTF (Plumpy Nut or BP 100)?	(1) Yes (2) No → ***Skip to T11*** (3) Prescribed only
T10B.	What is the formulation of RUTF?	(1) Plumpy Nut (2) BP 100 → ***Skip to T10D*** (8) Other, specify ____________→ ***Skip to T10E*** (99) Not specified → ***Skip to T10E***
T10C.	How many sachets of Plumpy Nut per day?	(1) 1¼ → ***Skip to T10E*** (2) 1½ → ***Skip to T10E*** (3) 2 → ***Skip to T10E*** (4) 3 → ***Skip to T10E*** (5) 4 → ***Skip to T10E*** (6) 5 → ***Skip to T10E*** (8) Other, specify ______ → ***Skip to T10E*** (9) NA (referred) → ***Skip to T10E*** (99) Not specified → ***Skip to T10E***
T10D.	How many bars of BP 100 per day?	(1) 2 (2) 2½ (3) 4 (4) 5 (5) 7 (6) 9 (8) Other, specify ______ (9) NA (referred) (99) Not specified
T10E.	For how many days is RUTF prescribed?	______ (99) NA (referred) (999) Not specified
T10F.	Does the HEW give or ask the caretaker to give RUTF before leaving the health post?	(1) Yes (2) No
Folic Acid		
T11.	Does the HEW give folic acid?	(1) Yes (2) No (3) Prescribed only
Mebendazole/Albendazole		
T12A.	Does the HEW give mebendazole or albendazole?	(1) Yes (2) No → ***Skip to T13*** (3) Prescribed only
T12B.	What is the formulation of mebendazole/ albendazole?	(1) Mebendazole 100 mg tablet (2) Mebendazole 500 mg tablet (3) Albendazole 400 mg tablet (8) Other, specify __________________ (99) Not specified

T12C.	How many tablets of mebendazole/albendazole does the HEW give?	(1) 1 (2) 2 (3) 3 (4) 4 (5) 5 (8) Other, specify ______ (99) Not specified
Tetracycline		
T13.	Does the HEW give tetracycline ointment?	(1) Yes (2) No (3) Prescribed only
Other Treatments		
T14.	Does the HEW give other treatments? Specify: ………………………… ………………………… …………………………	(1) Yes (2) No (3) Prescribed only
Vaccines		
T15.	Does the HEW give vaccines? Specify: ……………………… ……………………… ………………………	(1) Yes (2) No (3) Prescribed only
Referral		
T16A.	Does the HEW refer the child to a health facility?	(1) Yes (2) No → ***Skip to T17A***
T16B.	Does the caretaker accept referral for the child?	(1) Yes (2) No, specify reason ………………………………
T16C.	What was the reason for referral?	(1) Severe illness (2) Drug stock-out (8) Other, specify reason ……………………………
T16D.	Does the HEW explain the need for referral?	(1) Yes (2) No
T16E.	Does the HEW write a referral note?	(1) Yes (2) No
T16F.	Does the HEW arrange transportation?	(1) Yes (2) No
Advising on Home Care		
T17A.	Does the HEW advise on home care?	(1) Yes (2) No → ***Skip to T18A***
T17B.	Does the HEW advise to go to health facility/return if the child cannot drink or breastfeed?	(1) Yes (2) No
T17C.	Does the HEW advise to go to health facility/return if child becomes sicker?	(1) Yes (2) No
T17D.	Does the HEW advise caregiver to increase fluids?	(1) Yes (2) No
T17E.	Does the HEW advise caregiver to continue feeding?	(1) Yes (2) No
T17F.	Does the HEW advise to continue breastfeeding and/or breastfeed more frequently?	(1) Yes (2) No
T17G.	Does the HEW advise on when to return for follow-up?	(1) Yes (2) No
Job Aids		
T18A.	Does the HEW use the iCCM chart booklet at any time during the encounter with the child?	(1) Yes (2) No
T18B.	Does the HEW use the iCCM registration book at any time during the encounter with the child?	(1) Yes (2) No

Note: After the consultation, if the treatment is not clear, ask the health worker what treatments were given or prescribed to the patient. Ask "Any other treatments?" until the health worker has stated all treatments given/prescribed. Do not ask for each specific treatment.

Time of end of observation: …………..

Calculate total time of observation: ……… minutes

END OF OBSERVATION

Form 2. Caretaker Exit Interview – child (2–59 months)

Fill out one Exit Interview per sick child observed

Unique child ID: ☐☐☐☐ **Unique HEW ID**: ☐☐☐

Data collector name: ………………

Zone: …………………. Woreda: …………………. Kebele: ………………….

Health post: ………………….

HEW number: …………………. HEW name: ………………….

Child name: …………………. Child number: ……….. Caretaker number: ………………….

EX1. Did the HEW give you or prescribe any medicines for <CHILD> today?
HEF hara'a daa'imaaf dawaa/goricha keenitee ykn ajajjeettii?
→ *Note: 'Medicines' excludes ORS. See EX7 for ORS*
→ *Note: Medicines prescribed include only those received by or prescribed to the caretaker for home care.*

(1) Yes
(2) No → ***Skip to EX7A***
(3) Referred → ***Skip to RE1 (Re-examination Form)***

EX2A. What was the FIRST medicine prescribed or given?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Cotrimoxazole
(2) Zinc
(3) Vitamin A
(4) Coartem
(5) Chloroquine
(6) Paracetamol
(7) Amoxicillin
(8) Plumpy Nut
(9) BP 100
(10) Folic acid
(11) Mebendazole
(12) Albendazole
(88) Other, specify …………………………………….

EX2B. What was the formulation?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Tablet
(2) Syrup
(3) Capsule
(4) Sachet
(5) Bar
(8) Other, specify …………………………………….

EX2C. How much will you give <CHILD> each time?
Daa'imaaf si'a tokkotti hagam kenniitaa?

………………………………………

(999) Don't know

EX2D. How many times will you give it to <CHILD> each day?
Guyyaatti si'a meeqa kenniitaa?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(8) Other, specify ………
(9) Don't know

EX2E. How many days will you give the medicine to <CHILD>?
Daa'immaf Dawaa/goricha guyyaa meeqaaf kennitta?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6
(7) 7
(8) Other, specify ………
(9) Don't know

EX3A. Was a SECOND medicine prescribed or given?
Dawaan/gorichi lammataa kennamee ykn ajajameeraa?

(1) Yes
(2) No → ***Skip to EX7A***

EX3B. What was the SECOND medicine prescribed or given?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Cotrimoxazole
(2) Zinc
(3) Vitamin A
(4) Coartem
(5) Chloroquine
(6) Paracetamol
(7) Amoxicillin
(8) Plumpy Nut
(9) BP 100
(10) Folic acid
(11) Mebendazole
(12) Albendazole
(88) Other, specify …………………………………….

EX3C. What was the formulation?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Tablet
(2) Syrup
(3) Capsule
(4) Sachet
(5) Bar
(8) Other, specify …………………………………….

EX3D. How much will you give <CHILD> each time?
Daa'imaaf si'a tokkotti hagam kenniitaa?

………………………………………

(999) Don't know

EX3E. How many times will you give it to <CHILD> each day?
Guyyaatti si'a meeqa kenniitaa?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(8) Other, specify ………
(9) Don't know

EX3F. How many days will you give the medicine to <CHILD>?
Daa'immaf Dawaa/goricha guyyaa meeqaaf kennitta?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6
(7) 7
(8) Other, specify ………
(9) Don't know

EX4A. Was a THIRD medicine prescribed or given?
Dawaan/gorichi sadafaa kennamee ykn ajajameeraa?

(1) Yes
(2) No → ***Skip to EX7A***

EX4B. What was the THIRD medicine prescribed or given?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Cotrimoxazole
(2) Zinc
(3) Vitamin A
(4) Coartem
(5) Chloroquine
(6) Paracetamol
(7) Amoxicillin
(8) Plumpy Nut
(9) BP 100
(10) Folic acid
(11) Mebendazole
(12) Albendazole
(88) Other, specify …………………………………….

EX4C. What was the formulation?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Tablet
(2) Syrup
(3) Capsule
(4) Sachet
(5) Bar
(8) Other, specify …………………………………….

EX4D. How much will you give <CHILD> each time?
Daa'imaaf si'a tokkotti hagam kenniitaa?

………………………………………

(999) Don't know

EX4E. How many times will you give it to <CHILD> each day?
Guyyaatti si'a meeqa kenniitaa?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(8) Other, specify ………
(9) Don't know

EX4F. How many days will you give the medicine to <CHILD>?
Daa'immaf Dawaa/goricha guyyaa meeqaaf kennitta?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6
(7) 7
(8) Other, specify ………
(9) Don't know

EX5A. Was a FOURTH medicine prescribed or given?
Dawaan/gorichi afuraffaa ajajameeraa ykn kennameeraa?

(1) Yes
(2) No → ***Skip to EX7A***

EX5B. What was the FOURTH medicine prescribed or given?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Cotrimoxazole
(2) Zinc
(3) Vitamin A
(4) Coartem
(5) Chloroquine
(6) Paracetamol
(7) Amoxicillin
(8) Plumpy Nut
(9) BP 100
(10) Folic acid
(11) Mebendazole
(12) Albendazole
(88) Other, specify …………………………………….

EX5C. What was the formulation?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Tablet
(2) Syrup
(3) Capsule
(4) Sachet
(5) Bar
(8) Other, specify …………………………………….

EX5D. How much will you give <CHILD> each time?
Daa'imaaf si'a tokkotti hagam kenniitaa?

………………………………………

(999) Don't know

EX5E. How many times will you give it to <CHILD> each day?
Guyyaatti si'a meeqa kenniitaa?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(8) Other, specify ………
(9) Don't know

EX5F. How many days will you give the medicine to <CHILD>?
Daa'immaf Dawaa/goricha guyyaa meeqaaf kennitta?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6
(7) 7
(8) Other, specify ………
(9) Don't know

EX6A. Was a FIFTH medicine prescribed or given?
Dawaan/gorichi Shanafaa kennameeraa ykn ajajameeraa?

(1) Yes
(2) No → ***Skip to EX7A***

EX6B. What was the FIFTH medicine prescribed or given?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Cotrimoxazole
(2) Zinc
(3) Vitamin A
(4) Coartem
(5) Chloroquine
(6) Paracetamol
(7) Amoxicillin
(8) Plumpy Nut
(9) BP 100
(10) Folic acid
(11) Mebendazole
(12) Albendazole
(88) Other, specify …………………………………….

EX6C. What was the formulation?
→ *Copy the information from the caretaker's medication or prescription:*

(1) Tablet
(2) Syrup
(3) Capsule
(4) Sachet
(5) Bar
(8) Other, specify …………………………………….

EX6D. How much will you give <CHILD> each time?
Daa'imaaf si'a tokkotti hagam kenniitaa?

………………………………………

(999) Don't know

EX6E. How many times will you give it to <CHILD> each day?
Guyyaatti si'a meeqa kenniitaa?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(8) Other, specify ………
(9) Don't know

EX6F. How many days will you give the medicine to <CHILD>?
Daa'immaf Dawaa/goricha guyyaa meeqaaf kennitta?

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6
(7) 7
(8) Other, specify ………
(9) Don't know

EX7A. Was ORS prescribed or given?

(1) Yes
(2) No → ***Skip to EX8***

EX7B. How much water will you mix with one ORS packet?
Paakeetii ORS tokko bishaan hagamiin bulbulta?

…………… liters

(999) Don't know

EX8. Did the HEW give you a specific day when to come back to the health post?
HEF guyyaa gara kellaa fayyaa itti deebitanii dhuftan isiniitti himteettii?

(1) Yes → In how many days? ………. days
(2) No
(9) Don't know

END OF EXIT INTERVIEW

Thank the caretaker for answering your questions and ask if he/she has any questions. Be sure that the caretaker knows how to prepare ORS for a child with diarrhoea, when to return for vaccination, how to give the prescribed medications, and when to return if the child becomes worse at home.

Form 3. Re-examination Form – child (2 – 59 months)

Fill out one Re-examination Form per sick child observed

Unique child ID: ☐☐☐☐ **Unique HEW ID**: ☐☐☐ Data collector name: ………………

Zone: …………………. Woreda: …………………. Kebele: ………………….

Health post: ………………….

HEW number: …………………. HEW name: ………………….

Caretaker number: ………………….

Child name: …………………. Child number: ………. Child's age (completed months): …………..

RE1. Ask what the child's problems are.
Circle all signs mentioned.

A.	Fast/difficult breathing	(1) mentioned	(2) not mentioned
B.	Cough	(1) mentioned	(2) not mentioned
C.	Pneumonia	(1) mentioned	(2) not mentioned
D.	Diarrhoea	(1) mentioned	(2) not mentioned
E.	Fever	(1) mentioned	(2) not mentioned
F.	Malaria	(1) mentioned	(2) not mentioned
G.	Convulsions	(1) mentioned	(2) not mentioned
H.	Difficulty drinking or breastfeeding	(1) mentioned	(2) not mentioned
I.	Vomiting	(1) mentioned	(2) not mentioned
J.	Ear problem	(1) mentioned	(2) not mentioned
K.	Other problem, specify:	(1) mentioned	(2) not mentioned
L.	Other problem, specify:	(1) mentioned	(2) not mentioned
M.	Other problem, specify:	(1) mentioned	(2) not mentioned

Assess			**Classify**	
Take the child's temperature and weight				
RE2A.	Temperature: ……....			
RE2B.	Weight: ……....			
Check for general danger signs			RE3E.	**General danger sign present?** (1) Yes (2) No *Note: Remember to use danger sign when selecting classifications*
RE3A.	Is the child **unable** to drink or breastfeed? *Daa'imni harma hodhuu ykn waa dhuguu hindanda'uu?*	(1) Yes (2) No		
RE3B.	Does the child vomit EVERYTHING? Daa'imn*i waa hunda hooqqisaa?*	(1) Yes (2) No		
RE3C.	Has the child had convulsions? *Daa'imni ni gagaba/ni urgufamaa?*	(1) Yes (2) No		
RE3D.	Is the child lethargic or unconscious? *Daa'imni of wallaalaa?*	(1) Yes (2) No		
Check for pneumonia			RE4F.	**Pneumonia classification:** (1) Severe pneumonia/ very severe disease (2) Pneumonia (3) No pneumonia:
RE4A.	Does the child have cough or difficult breathing? *Daa'imni qufaa ykn rakkoo argansuu afuuraa qabaa?*	(1) Yes (2) No → ***Skip to RE5A***		
RE4B.	How long has the child had cough or difficult breathing? *Qufaan ykn rakkoon argansuu afuuraa hagam irrati ture?*	.... days		

RE4C.	How many breaths does the child have in 1 minute?	…....... bpm		cough or cold
RE4D.	Does the child have chest indrawing?	(1) Yes (2) No		
RE4E.	Does the child have stridor?	(1) Yes (2) No		
Check for diarrhoea and dehydration			RE5J.	**Diarrhoea classification:** (1) Diarrhoea, severe dehydration (2) Diarrhoea, some dehydration (3) Diarrhoea, no dehydration (4) Severe persistent diarrhoea (5) Persistent diarrhoea (6) Dysentery
RE5A.	Does the child have diarrhoea? *Daa'imni garaa kaasaa qabaa?*	(1) Yes (2) No → ***Skip to RE6A***		
RE5B.	How long has the child had diarrhoea? *Garaa kaasaan daa'ima irra yeroo hagam ture?*	.... days		
RE5C.	Is there blood in the stool? *Boolii isaa keessa dhiigni nijirra?*	(1) Yes (2) No		
RE5D.	Is the child restless or irritable? *Daa'imni ni aaraa ykn jijiraa amalaa niqabaa?*	(1) Yes (2) No		
RE5E.	Does the child have sunken eyes?	(1) Yes (2) No		
RE5F.	Is the child **not** able to drink or drinking poorly? *Daa'imni dhuguu hindanda'uu moo ykn xiino dhugaa?*	(1) Yes (2) No		
RE5G.	Is the child drinking eagerly, thirsty? *(Offer the child water to drink)*	(1) Yes (2) No		
RE5H.	Does the abdomen skin pinch go back slowly (less than 2 seconds)?	(1) Yes (2) No		
RE5I.	Does the abdomen skin pinch go back very slowly (longer than 2 seconds)?	(1) Yes (2) No		
Check for malaria			RE6J.	**Malaria classification:** (1) Very severe febrile disease (2) Malaria (3) Fever: malaria unlikely (4) Fever: no malaria
RE6A.	Does the child have fever or history of fever (last 48 hrs)? *Daa'imni gubaa qaamaa qabaa ykn sa'atii 48 darban keessatti qabaa?*	(1) Yes (2) No → ***Skip to RE8A***		
RE6B.	How long has the child had fever? *Gubaan qaama hagam irra ture?*	.... days → ***If less than 8 days, skip to RE6D***		
RE6C.	Was the fever present every day? *Gubaan qaama guyyaa guyyaan isa mudataa?*	(1) Yes (2) No		
RE6D.	Was an RDT performed for the child by the HEW?	(1) Yes → ***Skip to RE6F*** (2) No (3) Yes, but incorrectly		
RE6E.	Was an RDT performed for the child by the re-examiner? *Note: RDT should be performed in low or high malaria area or if child has traveled to a malarious area in the 2 weeks before the illness began.*	(1) Yes (2) No → ***Skip to RE6G***		
RE6F.	What is the child's RDT result?	(1) Positive falciparum (2) Positive vivax (3) Positive falc. & vivax (4) Negative		
RE6G.	Does the child have a stiff neck?	(1) Yes (2) No		
RE6H.	If child is **less than 1 year**, does the child have bulged fontanel?	(1) Yes (2) No (9) NA		

RE6I.	Does the child have runny nose?	(1) Yes (2) No		
Check for measles			RE7E.	**Measles classification:** (1) Severe complicated measles (2) Measles with eye or mouth complications (3) Measles
RE7A.	Has the child had measles in the last 3 months or does the child have signs of measles (generalized rash and one of these: cough, runny nose, red eyes)? *Baatii sadan darban keessatti daa'imni gifirri/ shiftoon ykn mallattoon gifiraa irratti mul'ateeraa?*	(1) Yes (2) No → ***Skip to RE8A***		
RE7B.	Does the child have mouth ulcers?	(1) Yes (2) No		
RE7C.	Does the child have pus draining from the eye?	(1) Yes (2) No		
RE7D.	Does the child have clouding of the cornea?	(1) Yes (2) No		
Check for ear infection			RE8E.	**Ear infection classification:** (1) Acute ear infection (2) Chronic ear infection (3) No ear infection
RE8A.	Does the child have an ear problem? *Daa'imni rakkoo gurraa qabaa?*	(1) Yes (2) No → ***Skip to RE9A***		
RE8B.	Is there ear pain? *Gurra ni dhukkubaa?*	(1) Yes (2) No		
RE8C.	Is there ear discharge? *Gurri ni malaa'aa?*	(1) Yes (2) No → ***Skip to RE8E***		
RE8D.	How long has the child had ear discharge? *Gurri mala'uu erga jalqabee hagam ta'eera?*	.... days		
Check for malnutrition			RE9F.	**Malnutrition classification:** (1) Severe complicated malnutrition (2) Severe uncomplicated malnutrition (3) Moderate acute malnutrition (4) No acute malnutrition
RE9A.	Does child have pitting edema of both feet?	(1) Yes (2) No		
RE9B.	If **younger than 6 months**, does child have visible severe wasting?	(1) Yes (2) No (9) NA		
RE9C.	If **6 months or older**, what is the child's MUAC measurement?	(1) <11 cm (2) 11-<12 cm (3) ≥12 cm (9) NA		
RE9D.	If **6 months or older** AND MUAC < 11cm OR bilateral oedema, did the child pass an appetite test?	(1) Yes (2) No (9) NA		
RE9E.	If **6 months or older**, does the child have any complicating condition? (pneumonia, watery diarrhoea, dysentery, fever/low temperature)	(1) Yes (2) No (9) NA		
Check for anaemia			RE10C.	**Anaemia classification:** (1) Severe anaemia (2) Anaemia (3) No anaemia
RE10A.	Does the child have severe palmar pallor?	(1) Yes (2) No		
RE10B.	Does the child have moderate palmar pallor?	(1) Yes (2) No		
Check immunization status *Review the child's immunization card. If the card is not available, probe the caretaker using the immunization questions provided to obtain as much information as possible regarding the child's vaccines.*			RE11C.	**Immunization classification:** (1) Vaccination status up-to-date (2) Vaccination status **not** up-to-date (3) Completed
RE11A.	If the child is **under 24 months**, has the child received all appropriate vaccines?	(1) Yes→ ***Skip to RE11C*** (2) No (9) NA→ ***Skip to RE12A***		

RE11B.	*Circle needed vaccines* **Birth** — BCG, OPV-0 **6 weeks** — Penta-1, Pneumoc.-1, OPV-1 **10 weeks** — Penta-2, Pneumoc.-2, OPV-2 **14 weeks** — Penta-3, Pneumoc.-3, OPV-3 **9 months** — Measles *Note: Keep an interval of 4 weeks between Penta and OPV doses. Do not recommend OPV-0 if the child is 14 days old or more.*			(4) Not started
Check vitamin A supplementation status			RE12B.	**Vitamin A classification:** (1) Vitamin A supplementation status up-to-date (2) Vitamin A supplementation status **not** up-to-date
RE12A.	If **<u>6 months or older</u>**, has the child received a vitamin A supplementation in the previous 6 months? *Yoo daa'imni Ji'a 6 ykn sanaa ol ta'e: ji'ottan jahan darban keessatti daa'imni qooricha Vitaamina A fudhateeraa?*	(1) Yes (2) No (9) NA → ***Skip to RE13A***		
Check mebendazole/albendazole status			RE13B.	**Mebendazole/ albendazole classification:** (1) Mebendazole/ albendazole status up-to-date (2) Mebendazole/ albendazole status **not** up-to-date
RE13A.	If **<u>24 months or older</u>**, has the child received mebendazole/albendazole in the previous 6 months? *Yoo daa'imni Ji'a 24 ykn sanaa ol ta'e; baatii 6 haan darban keessatti mebendazolii/albendazolii yokin qoricha rammoo garaa fudhateeraa?*	(1) Yes (2) No (9) NA → ***End re-examination***		

Once the re-examination is finished, ask the child and caretaker to wait. Write down the treatments needed for the child according to the iCCM guidelines. Then check the treatment given or prescribed by the HEW. If there is any discrepancy between the HEW's treatments and the re-examiner's treatments, discuss this discrepancy with the HEW and ensure that the child receives the correct treatments.

END OF RE-EXAMINATION FORM

Form 4. Equipment, Supplies & Support Checklist

Fill out one Equipment, Supplies & Support Checklist per health post

Zone: …………………. Woreda: …………………. Kebele: ………………….

Health post: …………………. Data collector: ………………

DRUGS & SUPPLIES MODULE

Ask the HEW to show you around where she works. Check the drug stocks and other supplies. Answer the following questions based on what you ***see****.*

D1. Does the health post have the following (unexpired) drugs/diagnostics available the day of visit?

A.	Cotrimoxazole	(1) Yes	Amount in stock: ……….. tablets
		(2) No	Amount in stock: ……….. bottles syrup
B.	ORS	(1) Yes	Amount in stock: ……….. sachets
		(2) No	
C.	Zinc	(1) Yes	Amount in stock: ……….. tablets
		(2) No	
D.	Vitamin A	(1) Yes	Amount in stock: ……….. capsules
		(2) No	
E.	Coartem	(1) Yes	Amount in stock: ……….. tablets
		(2) No	
F.	Chloroquine	(1) Yes	Amount in stock: ……….. tablets
		(2) No	Amount in stock: ……….. bottles syrup
G.	Paracetamol	(1) Yes	Amount in stock: ……….. tablets
		(2) No	Amount in stock: ……….. bottles syrup
H.	Amoxicillin	(1) Yes	Amount in stock: ……….. tablets
		(2) No	Amount in stock: ……….. bottles syrup
I.	Plumpy Nut	(1) Yes	Amount in stock: ……….. sachets
		(2) No	
J.	BP 100	(1) Yes	Amount in stock: ……….. bars
		(2) No	
K.	Folic Acid	(1) Yes	Amount in stock: ……….. tablets
		(2) No	
L.	Mebendazole/albendazole	(1) Yes	Amount in stock: ……….. tablets
		(2) No	
M.	Tetracycline ointment	(1) Yes	Amount in stock: ……….. tubes
		(2) No	
N.	Vitamin K	(1) Yes	Amount in stock: ……….. ampules
		(2) No	
O.	RDT	(1) Yes	Amount in stock: ……….. tests
		(2) No	

D2. Does the health post have the following <u>EXPIRED</u> drugs/diagnostics on the day of visit?

A.	Cotrimoxazole	(1) Yes	Amount expired: ………… tablets
		(2) No	Amount expired: ………… bottles syrup
B.	ORS	(1) Yes	Amount expired: ………… sachets
		(2) No	
C.	Zinc	(1) Yes	Amount expired: ………… tablets
		(2) No	
D.	Vitamin A	(1) Yes	Amount expired: ………… capsules
		(2) No	
E.	Coartem	(1) Yes	Amount expired: ………… tablets
		(2) No	
F.	Chloroquine	(1) Yes	Amount expired: ………… tablets
		(2) No	Amount expired: ………… bottles syrup
G.	Paracetamol	(1) Yes	Amount expired: ………… tablets
		(2) No	Amount expired: ………… bottles syrup
H.	Amoxicillin	(1) Yes	Amount expired: ………… tablets
		(2) No	Amount expired: ………… bottles syrup
I.	Plumpy Nut	(1) Yes	Amount expired: ………… sachets
		(2) No	
J.	BP 100	(1) Yes	Amount expired: ………… bars
		(2) No	
K.	Folic Acid	(1) Yes	Amount expired: ………… tablets
		(2) No	
L.	Mebendazole/albendazole	(1) Yes	Amount expired: ………… tablets
		(2) No	
M.	Tetracycline ointment	(1) Yes	Amount in stock: ………… tubes
		(2) No	
N.	Vitamin K	(1) Yes	Amount in stock: ………… ampules
		(2) No	
O.	RDT	(1) Yes	Amount expired: ………… tests
		(2) No	

D3. Does the health post have the following equipment and supplies?

A.	Functional timer (that can accurately count a minute)	(1) Yes	(2) No
B.	Functional thermometer	(1) Yes	(2) No
C.	Functional scale	(1) Yes	(2) No
D.	1 liter measuring container	(1) Yes	(2) No
E.	Clean water in a container	(1) Yes	(2) No
F.	Cup for ORS	(1) Yes	(2) No
G.	Spoon for ORS	(1) Yes	(2) No
H.	Tray for ORT corner	(1) Yes	(2) No
I.	Cloth for ORT corner	(1) Yes	(2) No
J.	MUAC tape	(1) Yes	(2) No
K.	Ambu bag	(1) Yes	(2) No

D4. Does the health post have the following job aids available the day of visit?

A.	iCCM chart booklet	(1) Yes	(2) No
B.	iCCM registration book (both age groups)	(1) Yes	(2) No
C.	Family health card	(1) Yes	(2) No
D.	OTP card	(1) Yes	(2) No

Ask the following questions to the HEW. Use any documentation available (e.g. drug stock cards) to help determine this information.

D5. Have you experienced a stock-out in the last three months of any of the following? If yes, what was the longest number of consecutive days without that item?

A.	Cotrimoxazole	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
B.	ORS	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
C.	Zinc	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
D.	Vitamin A	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
E.	Coartem	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
F.	Chloroquine	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
G.	Paracetamol	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
H.	Amoxicillin	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
I.	RUTF	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
J.	Folic acid	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
K.	Mebendazole/ albendazole	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
L.	Tetracycline ointment	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
M.	Vitamin K	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days
N.	RDT	(1) Yes (2) No (3) never rcvd.	Duration of stock-out ……… days

SERVICES & SUPPORT MODULE

S1. How many hours was the health post open last week (Monday-Friday)?
Torban darbe kellaan fayyaa sa'atii meeqaaf banaa ture (Wiixata – Jimaataa)?

…………… hours (999) Don't know

S2. How many volunteer community health workers (VCHWs) are there in the health post catchment area?
Keellaa fayyaa kana jala hojjettoota fedhii hawaasaa meeqatu jira?

…………… VCHWs (999) Don't know

S3. Which of the following community education/mobilization activities focused on iCCM were carried out by HEWs or VCHWs in the last month?
Read list to HEW

A.	Health education during Idir	(1) Yes (2) No (999) DK	Number reported ………	People reported ……….	Number documented ………	People documented ……….
B.	Community conversation enhancement	(1) Yes (2) No (999) DK	Number reported ………	People reported ……….	Number documented ………	People documented ……….
C.	Community leader meeting	(1) Yes (2) No (999) DK	Number reported ………	People reported ……….	Number documented ………	People documented ……….
D.	Outreach community mobilization	(1) Yes (2) No (999) DK	Number reported ………	People reported ……….	Number documented ………	People documented ……….
E.	Growth monitoring and promotion	(1) Yes (2) No (999) DK	Number reported ………	People reported ……….	Number documented ………	People documented ……….
F.	Other, specify …………………… …………	(1) Yes (2) No (999) DK	Number reported ………	People reported ……….	Number documented ………	People documented ……….
G.	Other, specify …………………… …………	(1) Yes (2) No (999) DK	Number reported ………	People reported ……….	Number documented ………	People documented ……….

S4. How many times during the last <u>three months</u> did you receive a supervisory visit that included supervision of iCCM activities?
Daawwannaa (supparviziniii) sochii ICCM dabalatee, Ji'a sadan darban keessatti si'a meeqa siif godhame?
Probe the HEW to ensure that the HEW understands that this refers to supervision visits where the supervisor comes to talk about iCCM and the HEWs' management of sick children.

…………… times → ***<u>if 0 times, skip to S7</u>***

(99) NA (HEWs not present in HP majority of last 3 months) →***skip to S7***

(999) Don't know →***skip to S7***

S5. At these supervision visits in the last <u>three months</u> that included supervision of iCCM activities, who visited you?
Baatiiwwan sadan darban keessatti sochii ICCM dabalatee, qaamni isin daawwate eenyufaadha.
Circle all responses given, do not read list

A. Supervisor from the supporting health center
B. Woreda supervisor
C. NGO supervisor
D. Other, specify ……………………………………..

S6. At any of these visits, did the supervisor(s) do the following?
Yeroo daawwannaa kana keessatti supparvaayizarootni waan kanaa gadii hojjetaniiru?
Read list to HEW

A. Observe you managing a sick child *Yeroo ati daa'ima dhibamaa wal'aantu si ilaalaniiru?*	(1) Yes	(2) No	(9) Don't know
B. Use a supervision checklist *Cheekliistii supparviizyirii fayyadamaniiru*	(1) Yes	(2) No	(9) Don't know
C. Review the iCCM registration book *Galmee ICCM ni ilaaluu*	(1) Yes	(2) No	(9) Don't know
D. Provide verbal feedback *Dub deebii Afaanii sii kennaniiruu*	(1) Yes	(2) No	(9) Don't know
E. Provide written feedback *Dub deebii barreeffamaan sii kennaniiruu*	(1) Yes	(2) No	(9) Don't know

S7. Where do you refer children with danger signs?
Daa'imman mallattoo hamaa irratti agarte eessatti ergita (riifarii) goota?

(1) Health center, specify name: ………………………

(2) Hospital, specify name: ……………………………

(8) Other, specify: ………………………………………

S8. How long does it usually take for a patient to get to the nearest referral location (using the most common means of transport)?
Bakka dhaabbata fayyaa ergite (riifarii goote) ga'uuf dhibamaa hagam itti fudhata.(hagam fagaata?)

…………hours ………mins (999) Don't know

HEALTH POST RECORDS MODULE

*Ask if you can look at the health post iCCM registers. Use the **iCCM registration books** to answer the questions below. Use the last completed month. Do not rely on the HEWs' monthly report. Go through the cases in the register to add up the numbers.*

R1. Is there an iCCM registration book available in the health post?

(1) Yes

(2) No → ***Skip to R11***

R2. What is the number of initial consultations for children 0 – 59 months recorded in the register for the previous month by sex?

A. Female …………

B. Male …………

C. Unspecified …………

R3. How many of these initial consultations were for children between the ages of 0 days – 2 months in the previous month?

Initial consultations for children 0 days – 2 months: …………

R4. How many sick children (0 – 59 months) were referred in the previous month?

Children referred: …………

R5. In the previous month, how many children (0 – 59 months) were classified as having:

A. Pneumonia? …………

B. Diarrhoea? …………

C. Malaria? …………

D. Ear infection? …………

E. Acute malnutrition? …………

F. Anaemia? …………

R6. In the previous month, how many children (0 – 59 months) received:

A. Antibiotic for pneumonia? …………

B. ORS for diarrhoea? …………

C. Zinc for diarrhoea? …………

D. ACT for malaria? …………

E. Chloroquine for malaria? …………

F. RUTF for acute malnutrition? …………

G. Antibiotic for acute malnutrition? …………

R7. Are there any sick children 0 days – 2 months registered in the iCCM register?

(1) Yes

(2) No → ***Skip to R9***

R8. Record the following information for the past 10 cases of sick children with iCCM illness <u>0 days – 2 months</u> with an iCCM illness.

Include patients receiving initial consultation and having at least one iCCM-related symptom.

	Date Seen	**Age** (weeks) **& Sex**	**Weight & Temperature**	**Signs & Symptoms** (Select from list of complaints)	**Disease Classification** (Select from list of classifications)	**Treatment Given** (drug, dose, schedule, duration)	**Referred?**	**Outcome Registered?**
R8A.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N
R8B.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N
R8C.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N
R8D.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N
R8E.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N

R8F.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N
R8G.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N
R8H.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N
R8I.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N
R8J.	…../…../…..	Age: M F	Weight: Temp:				Y N	Y N

R9. Are there any sick children 2 – 59 months registered in the iCCM register?

(1) Yes

(2) No → ***Skip to R11***

R10. Record the following information for the past 10 cases of sick children <u>2 – 59 months</u> with an iCCM illness.
Include patients receiving initial consultation and having at least one iCCM-related symptom.

	Date Seen	**Age** (months) **& Sex**	**Weight & Temperature**	**Signs & Symptoms** (Select from list of complaints)	**RDT**	**Disease Classification** (Select from list of classifications)	**Treatment Given** (drug, dose, schedule, duration)	**Referred?**	**Outcome Registered?**
R10A.	…../…../…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N
R10B.	…../…../…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N
R10C.	…../…../…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N
R10D.	…../…../…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N
R10E.	…../…../…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N

R10F.	…../..…/…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N
R10G.	…../..…/…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N
R10H.	…../..…/…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N
R10I.	…../..…/…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N
R10J.	…../..…/…..	Age: M F	Weight: Temp:		Pos falc. Pos viv. Pos falc. & viv. Neg No RDT			Y N	Y N

Ask the HEWs to answer the following questions.

R11. In the previous month, have any children been treated by the HEWs that are not recorded in the iCCM registration book?
Ji'a dabre keeysati Tajaajila qindoomina qabu sadarkaa hawaasaati kennamuun daa'imni hojjatuu Ekisteenshinii fayyaatiin gargaarsa argate fi galmee irrati kan hingalmaa'in Jira?

(1) Yes

(2) No → **Skip to HEW Questionnaire (H1)**

R12. In the previous month, how many children have been treated by the HEWs that are not recorded in the iCCM registration book?
Ji'a dabre keeyssati daa'imman meeqatuu HEFtiin tajaajila qindoomina argatanii galmee Tajaajilaa ICCM irrati hingalmoofne?

………… children (999) Don't know

R13. Why were these children not recorded in the iCCM registration book?
Maaliif daa'imman tajaajila qindoomina qabu argatan kun galmee tajaajilaa irratti galmaa'uu dhaban?

A. Treated in the community, not registered	(1) mentioned	(2) not mentioned
B. Treated in the community, other register	(1) mentioned	(2) not mentioned
C. Forgot	(1) mentioned	(2) not mentioned
D. Other, specify ……………………………………..	(1) mentioned	(2) not mentioned

END OF EQUIPMENT, SUPPLIES & SUPPORT CHECKLIST

Form 5. HEW Questionnaire

Fill out one HEW Questionnaire per HEW

Zone: …………………. Woreda: …………………. Kebele: …………………. Health post: ………………….

Data collector: ……………… **Unique HEW ID:** | | | | HEW name: ……………………

Ask the HEW the following questions:

H1. Age: ………. years

H2. What is your marital status?
Haalli ga'ela keetii maali?

(1) Married (4) Widowed

(2) Single (8) Other, specify …………………

(3) Separated/divorced

H3. In what month and year did you complete the initial 1-year HEW training?
Leenjii bu'uraa HEFf kennamu bara kamii fi ji'a kam keessa xumurte?

.... month ………..year

(99) Didn't complete training

H4. In what month and year did you complete the iCCM training?
Leenjii Tajaajila qindoomina Wa'ansa da'imma sadarkaa hawaasaati yoom fudhate?

.... month ………..year

(99) Didn't complete training → ***If iCCM training not completed, skip to H6.***

H5. Did you receive a follow-up from training visit within six weeks after you received the iCCM training?
Leenjiin booda torbe 6 keessati hordoffiin siif taasifame jiraa erga leenjii tajaajila qindoomina qabu fudhate booda?

(1) Yes

(2) No

(9) Don't know

(99) NA

H6. Do you plan to continue working as an HEW through the coming year?
Bara dhufuus hojjatuu E. Fayyaa taatee hojjachuuf karoora qabdaa

(1) Yes → ***Skip to H8***

(2) No

(9) Don't know → ***Skip to H8***

H7. Why do you expect to stop working as an HEW?
Hojjatuu Ekisteenshinii fayyaa taatee hojjachuu maaliif dhaabuu yaade?

A.	Salary too low	(1) mentioned	(2) not mentioned
B.	Don't like work	(1) mentioned	(2) not mentioned
C.	Have another opportunity	(1) mentioned	(2) not mentioned
D.	Hope to receive training and move to higher level	(1) mentioned	(2) not mentioned
E.	Other, specify …………………	(1) mentioned	(2) not mentioned

H8. Where do you live now?
Amma eessa jiraatta?

(1) This kebele

(2) Other kebele → **Skip to H10**

H9. How long have you lived in this community?
Hawaasa kana keessati hammam turte?

………. months ………. years

(88) My whole life

(99) I don't live in this community

H10. How many hours did you spend doing the following activities yesterday (or last working day)?
Guyyaa kaleessaa hojiiwwan kanati aanan raawwachuuf sa'aa meeqa sijalaa fixe?
Ask the HEW to describe her activities during the day starting with when she began work.

A. Providing/offering clinical services in the health post __________

B. Providing/offering clinical services in the community __________

C. Community education/mobilization, disease prevention __________

D. Traveling outside the kebele __________

E. Other health-related activities, specify ……………………………… __________

F. Other non-health-related activities, specify ………………………… __________

G. Total work-related activities __________

H11. How many times did you visit a health center in the last 3 months?
Ji'oota 3n dabran keessa yeroo meeqa buufata fayyaa deemte?

………… times → ***if 0 times, skip to question H14***

H12. During <u>any</u> of these visits in the last three months, did you discuss your iCCM work with a supervisor at the health center?
Buufata fayyaa yemmuu deemtu ji'oota sadeen darban kana keessati waa'ee tajaajila qindoomina qabuu fi sadarkaa hawaasaati kennamu ilaalchisee supparvaayzara kee waliin mari'atee jirtaa?

(1) Yes

(2) No → ***skip to H14***

H13. During <u>any</u> of these visits, did the supervisor do the following?
Daawwannaa kee kamuu keessati supparvaayzarri kee qabxiiwwan kanati aanan raawwateeraa?
Read list to HEW

A. Give you iCCM supplies (1) Yes (2) No (9) Don't know
Meeshaalee Tajaajila wal'aansaa qindoomina qabuuf (iCCM) oolan siif kennuu

B. Instruct you on iCCM clinical issues (1) Yes (2) No (9) Don't know
Kenniinsa tajaajila qindoomina qabu (iCCM) ilaalchisee qajeelfama ogummaa kiliinikaa siif kennuu

C. Observe you managing a sick child (1) Yes (2) No (9) Don't know
Daa'ima dhukkubsateef yemmuu tajaajila kennitu silaaluu

D. Demonstrate how to care for a sick child (1) Yes (2) No (9) Don't know
Daa'ima dhukkubsate akkamiiti akka gargaaran sigarsiisuu

E. Review clinical case scenarios (1) Yes (2) No (9) Don't know
Akkamitti akka addaan baastanii fi akka yaaltan gamaggamuu.

F. Provide verbal feedback on iCCM issues (1) Yes (2) No (9) Don't know
Dhimmoota iCCM irratti afaaniin duubdeebii siif kennuu

G. Provide written feedback on iCCM issues (1) Yes (2) No (9) Don't know
Dhimmoota iCCM irratti barreefamaan duubdeebii siif kennuu

H14. Have you ever attended an iCCM performance review and clinical mentoring meeting?

(1) Yes

(2) No

H15. What are the main reasons that caretakers refuse referral for severely ill children?
Kununisitooni tajaajila kennan daa'ima baay'ee dhukkubsate riifarii kan didaan sababoonni saan maalfaadha?

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H16. What are the main reasons that caretakers don't bring their sick children to the health post for treatment?
Daa'ima dhukkubsate kununsiitun gara kellaa fayyaa waan hinfindneef sababni guddaan maali?

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END OF HEW QUESTIONNAIRE

Thank the HEWs for answering your questions.

Appendix 2: Supplemental Tables and Figures

Table 1A: Characteristics of the sample of health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 103		**Jimma N = 57**		**W. Hararghe N = 47**	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Distance from referral facility (km)	11.8	0-72	13.8	0-72	9.3	0.1-36
	N	**%**	**n**	**%**	**n**	**%**
<5km	16	16	6	11	10	22
5-<10km	37	36	17	30	20	44
10-<15km	18	18	14	25	4	9
15-<20km	16	16	10	18	6	13
≥20km (max 72km)	16	16	10	18	6	13
Malaria risk of kebele						
High	29	28	25	44	4	9
Low	46	45	21	37	25	54
No malaria	28	27	11	19	17	37
Health posts in priority high-malnutrition woredas	61	59	14	25	47	100
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Children <5 in HP catchment area	744	203-1626	807	203-1626	665	225-1487

Table 2A: Characteristics of the sample of health posts in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 46		Jimma N = 25		W. Hararghe N = 21	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Distance from referral facility (km)	8.7	0.3-35	10.8	0.5-35	6.2	0.3-18
	n	**%**	**n**	**%**	**n**	**%**
<5km	11	24	3	12	8	38
5-<10km	18	39	10	40	8	38
10-<15km	8	17	5	20	3	14
15-<20km	6	13	4	16	2	10
≥20km (max 72km)	3	7	3	12	0	0
Malaria risk of kebele						
High	11	24	9	36	2	10
Low	23	50	7	28	16	76
No malaria	12	26	9	36	3	14
Health posts in priority high-malnutrition woredas	21	46	0	0	21	100
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Children <5 in HP catchment area	733	191-1468	729	191-1375	739	335-1468

Table 3A: Characteristics of the sample of HEWs in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 137		Jimma N = 79		W. Hararghe N = 58	
	n	**%**	**n**	**%**	**n**	**%**
Age						
18-20	13	10	6	8	7	12
21-23	83	61	47	60	36	74
24-26	35	26	22	28	13	22
27-29	4	3	3	4	1	2
30-32	2	2	1	1	1	2
Marital status						
Married	80	58	40	51	40	69
Single	56	41	38	48	18	31
Separated/divorced	1	1	1	1	0	0
HEW lives in same kebele as health post	125	91	68	86	57	98
HEW lived in kebele one year prior to completing HEW training	16	12	16	20	0	0
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Years of experience as an HEW	4.3	0.7-7.7	4.3	0.7-7.7	4.2	0.8-7.6

Table 4A: Characteristics of the sample of HEWs in health posts in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 64		Jimma N = 33		W. Hararghe N = 31	
	n	%	n	%	n	%
Age						
18-20	9	14	6	18	3	10
21-23	35	55	20	61	15	48
24-26	18	28	6	18	12	39
27-29	1	2	0	0	1	3
30-32	1	2	1	3	0	0
Marital status						
Married	39	61	24	73	15	48
Single	25	39	9	27	16	52
Separated/divorced	0	0	0	0	0.0	0
HEW lives in same kebele as health post	55	86	29	88	26	84
HEW lived in kebele one year prior to completing HEW training	4	6	4	12	0	0
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Years of experience as an HEW	4.3	0.8-10.7	4.2	0.9-6.7	4.3	0.8-10.7

Table 5A: Characteristics of the sample of sick children in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 257		Jimma N = 152		W. Hararghe N = 105	
	n	%	n	%	n	%
Method of recruitment						
Spontaneous	45	18	32	21	13	12
Mobilized by HEWs	96	37	39	27	57	54
Recruited by survey team	116	45	81	53	35	33
Age						
2-11 months	94	37	57	38	37	35
12-23 months	92	36	55	36	37	35
24-35 months	39	15	21	14	18	17
36-47 months	22	9	12	8	10	10
48-59 months	10	4	7	5	3	3
Sex						
Male	129	50	75	49	54	51
Female	128	50	77	51	51	49
Gold standard disease classifications						
Pneumonia	39	15	34	22	5	5
Diarrhea	169	66	87	57	82	78
Malaria/Sev. febrile disease	3	1	2	1	1	1
Measles[a]	5	2	4	3	1	1
Malnutrition	32	13	15	10	17	16
Ear infection	30	12	11	7	19	18
Anemia	11	4	6	4	5	5
Severe illness[b]	38	15	15	10	23	22
Needs referral[c]	63	25	25	17	38	36

[a] Current or in the last three months.

[b] Danger signs; severe pneumonia or very severe disease; diarrhea, severe dehydration; severe persistent diarrhea; persistent diarrhea; dysentery; very severe febrile disease; severe complicated measles; severe complicated malnutrition; severe anemia.

[c] Includes referral for acute ear infection and anemia, which are not considered severe illnesses.

Table 6A: Gold standard disease classifications among surveyed children with severe illness in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 38		Jimma N = 15		W. Hararghe N = 23	
	n	%	n	%	n	%
Severe pneumonia	3	8	2	13	1	4
Persistent/severe persistent diarrhea	11	29	3	20	8	35
Dysentery	17	45	5	33	12	52
Severe febrile disease	1	3	0	0	1	4
Severe complicated malnutrition	12	32	7	47	5	22

Table 7A: Gold standard disease classifications of surveyed children by recruitment method in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	N	%	N	%	N	%
Spontaneous consultation						
Severe illness	45	11	32	6	13	23
Pneumonia	45	22	32	31	13	0
Diarrhea	45	53	32	38	13	92
Malaria/Sev. febrile disease	45	2	32	3	13	0
Measles	45	2	32	3	13	0
Malnutrition	45	11	32	6	13	23
Ear infection	45	13	32	13	13	15
Anemia	45	2	32	0	13	8
Mobilized by HEWs						
Severe illness	96	27	39	18	57	33
Pneumonia	96	12	39	21	57	5
Diarrhea	96	76	39	62	57	86
Malaria/Sev. febrile disease	96	1	39	0	57	2
Measles	96	0	39	0	57	0
Malnutrition	96	20	39	13	57	25
Ear infection	96	14	39	5	57	19
Anemia	96	7	39	8	57	7
Recruited by survey team						
Severe illness	116	6	81	7	35	3
Pneumonia	116	16	81	20	35	6
Diarrhea	116	62	81	63	35	60
Malaria/Sev. febrile disease	116	1	81	1	35	0
Measles	116	4	81	4	35	3
Malnutrition	116	7	81	10	35	0
Ear infection	116	10	81	6	35	17
Anemia	116	3	81	4	35	0

Table 8A: Gold standard disease classifications of surveyed children by age in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	N	%	N	%	N	%
2-11 months						
Severe illness	94	15	57	11	37	22
Pneumonia	94	18	57	26	37	5
Diarrhea	94	56	57	49	37	68
Malaria/Sev. febrile disease	94	1	57	0	37	3
Measles	94	2	57	4	37	0
Malnutrition	94	16	57	12	37	22
Ear infection	94	12	57	9	37	16
Anemia	94	3	57	4	37	3
12-23 months						
Severe illness	92	13	55	9	37	19
Pneumonia	92	16	55	27	37	0
Diarrhea	92	79	55	73	37	89
Malaria/Sev. febrile disease	92	0	55	0	37	0
Measles	92	1	55	2	37	0
Malnutrition	92	8	55	6	37	11
Ear infection	92	14	55	9	37	22
Anemia	92	7	55	6	37	8
24-35 months						
Severe illness	39	15	21	5	18	28
Pneumonia	39	10	21	10	18	11
Diarrhea	39	62	21	43	18	83
Malaria/Sev. febrile disease	39	3	21	5	18	0
Measles	39	3	21	0	18	6
Malnutrition	39	13	21	14	18	11
Ear infection	39	8	21	5	18	11
Anemia	39	0	21	0	18	0
36-47 months						
Severe illness	22	23	12	25	10	20
Pneumonia	22	14	12	17	10	10
Diarrhea	22	64	12	58	10	70
Malaria/Sev. febrile disease	22	5	12	8	10	0
Measles	22	5	12	8	10	0
Malnutrition	22	14	12	8	10	20
Ear infection	22	5	12	0	10	10
Anemia	22	9	12	8	10	10
48-59 months						
Severe illness	10	10	7	0	3	33
Pneumonia	10	0	7	0	3	0

Diarrhea	5/10	50	3/7	43	2/3	67
Malaria/Sev. febrile disease	0/10	0	0/7	0	0/3	0
Measles	0/10	0	0/7	0	0/3	0
Malnutrition	2/10	20	1/7	14	1/3	33
Ear infection	2/10	20	0/7	0	2/3	67
Anemia	0/10	0	0/7	0	0/3	0

Table 9A: Mean number of sick child consultations in the previous month by distance from referral facility in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Intervention N=103		Comparison N=46	
	Mean (95% CI)	**Range**	**Mean (95% CI)**	**Range**
<5km	11.4 (7.0-15.8)	0-31	2.9 (0.0-5.7)	0-12
5-<10km	17.9 (13.3-22.5)	0-63	6.4 (0.7-12.0)	0-32
10-<15km	21.5 (11.1-31.9)	1-95	5.2 (1.5-8.8)	0-11
15-<20km	12.0 (6.3-17.7)	0-43	7.0 (0.0-15.2)	0-17
≥20km	14.0 (10.0-18.0)	1-34	0.0 -	0

Table 10A: HEWs that plan to continue working as an HEW for the coming year in health posts in intervention and comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	n/N	% (95% CI)	n/N	% (95% CI)	n/N	% (95% CI)
Intervention area HEWs	130/137	95 (90-98)	75/79	95 (87-98)	55/58	95 (85-98)
Comparison area HEWs	58/64	91 (76-97)	33/33	100 -	25/31	81 (57-93)

Table 11A: Duration of HEW consultations with surveyed children in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N=257		Jimma N=152		W. Hararghe N=105	
	Mean (95% CI)	Range	Mean (95% CI)	Range	Mean (95% CI)	Range
Consultation time	27.3 (25.7-28.9)	8-60	30.3 (28.4-32.2)	8-60	22.9 (20.9-25.0)	8-48

Table 12A: Training and supervision received by HEWs in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
HEW received initial one-year training	137	100 -	79	100 -	58	100 -
HEW trained in iCCM	137[a]	98 (93-99)	79	100 -	58	95 (85-98)
HEW received follow-up training within six weeks of iCCM training	134[b]	46 (37-56)	79	65 (52-76)	55	20 (11-33)
HEW has attended iCCM performance review and clinical mentoring meeting	137	89 (82-94)	79	99 (91-100)	58	76 (63-85)
Health post received supervision on iCCM in the previous three months	100[c]	87 (79-93)	56	91 (80-97)	44	82 (67-92)
Health post received supervision on iCCM that included register review or observation of consultations in the previous three months	100	85 (77-91)	56	91 (80-97)	44	77 (62-89)
HEW received instruction in iCCM clinical practice at a health center in the previous three months	137	58 (49-66)	79	61 (49-71)	58	54 (40-67)

[a] The three HEWs that were not trained in iCCM were not providing clinical services.
[b] Excludes HEWs that did not receive iCCM training.
[c] Three health posts excluded because HEWs reported not being present for majority of previous three months.

Table 13A: Training and supervision received by HEWs in health posts in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
HEW received initial one-year training	64	100 -	33	100 -	31	100 -
HEW trained in iCCM	64	0 -	33	0 -	31	0 -
HEW has attended iCCM/CCM performance review and clinical mentoring meeting	64	3 (1-12)	33	6 (1-23)	31	0 -
Health post received supervision on CCM in the previous three months	42[a]	43 (28-59)	25	52 (31-72)	21	29 (10-56)
Health post received supervision on CCM that included register review or observation of consultations in the previous three months	42	19 (9-34)	25	32 (15-54)	21	0 -
HEW received instruction in CCM clinical practice at a health center in the previous three months	64	8 (3-18)	33	15 (6-33)	31	0 -

[a] Four health posts excluded because HEWs reported not being present for majority of previous three months.

Table 14A: Availability of essential iCCM commodities on the day of data collection and over the last three months in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Available on day of data collection						No stockout of more than 7 days in last 3 months					
	Total N = 103		Jimma N = 57		W. Hararghe N = 46		Total N = 103		Jimma N = 57		W. Hararghe N = 46	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
All essential iCCM commodities[a]	71	69 (59-78)	41	72 (59-83)	30	65 (50-79)	53	51 (41-61)	33	58 (44-71)	20	44 (29-59)
Cotrimoxazole	102	99 (95-100)	57	100	45	98 (89-100)	102	99 (95-100)	57	100	45	98 (89 -100)
ORS	100	97 (92-99)	56	98 (91-100)	44	96 (85-100)	93	90 (83-95)	56	98 (91-100)	37	80 (66-91)
Zinc	99	96 (90-99)	56	98 (91-100)	43	94 (82-99)	83	81(72-88)	50	88 (76-95)	33	72 (57-84)
ACT	91	88 (81-94)	49	86 (74-94)	42	91 (79-98)	90	87 (79-93)	48	84 (72-93)	42	91 (79-98)
Chloroquine	92	89 (82-95)	52	91 (81-97)	40	87 (74-95)	91	88 (81-94)	52	91 (81-97)	39	85 (71-94)
RUTF	82	80 (71-87)	47	83 (70-91)	35	76 (61-87)	80	78 (68-85)	42	74 (60-85)	38	83 (69-92)
RDT	92	89 (82-95)	50	88 (76-95)	42	91 (79-98)	91	88 (81-94)	50	88 (76-95)	41	89 (76-96)
Vitamin A	84	82 (73-89)	45	79 (66-89)	39	85 (71-94)	87	85 (76-91)	46	81 (68-90)	41	89 (76-96)
Amoxicillin	97	94 (88-98)	54	95 (85-99)	43	94 (82-99)	90	87 (79-93)	49	86 (74-94)	41	89 (76-96)
Folic acid	92	89 (82-95)	54	95 (85-99)	38	83 (69-92)	82	80 (71-87)	49	86 (74-94)	33	72 (57-84)
Mebendazole	93	90 (83-95)	53	93 (83-98)	40	87 (74-95)	90	87 (79-93)	53	93 (83-98)	37	80 (66-91)
Tetracycline ointment	90	87 (89-93)	49	86 (74-94)	41	89 (76-96)	81	79 (70-86)	46	81 (68-90)	35	76 (61-87)
Paracetamol	97	94 (88-98)	55	97 (98-100)	42	91 (79-98)	89	86 (78-92)	52	91 (81-97)	37	80 (66-91)

[a] Cotrimoxazole, ORS, zinc, ACT, chloroquine, RUTF, RDT.

Table 15A: Availability of essential iCCM commodities on the day of data collection and over the last three months in health posts in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Available on day of data collection						No stockout of more than 7 days in last 3 months					
	Total N = 46		Jimma N = 25		W. Hararghe N = 21		Total N = 46		Jimma N = 25		W. Hararghe N = 21	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
All essential CCM commodities[a]	2	4 (1-15)	0	0	2	10 (1-30)	0	0	0	0	0	0
Cotrimoxazole	1	2 (0-12)	0	0	1	5 (0-24)	2	4 (1-15)	0	0	2	10 (1-30)
ORS	28	61 (45-75)	17	68 (47-85)	11	52 (30-74)	28	61 (45-75)	17	68 (47-85)	11	52 (30-74)
Zinc	0	0	0	0	0	0	0	0	0	0	0	0
ACT	23	50 (35-65)	10	40 (21-61)	13	62 (38-82)	26	57 (41-71)	12	48 (29-69)	14	67 (43-85)
Chloroquine	17	37 (23-53)	12	48 (28-69)	5	24 (8-47)	18	39 (25-55)	13	52 (31-72)	5	24 (8-47)
RUTF	16	35 (21-50)	0	0 (0-14)	16	76 (53-92)	14	30 (18-46)	0	0	14	67 (43-85)
RDT	29	63 (48-77)	11	44 (24-65)	18	86 (64-97)	29	63 (48-77)	14	56 (35-76)	15	71 (48-89)
Vitamin A	29	63 (48-77)	11	44 (24-65)	18	86 (64-97)	29	63 (48-77)	11	44 (24-65)	18	86 (64-97)
Amoxicillin	16	35 (21-50)	0	0	16	76 (53-92)	14	30 (18-46)	0	0	14	67 (43-85)
Folic acid	3	7 (1-18)	0	0	3	14 (3-36)	5	11 (4-24)	0	0	5	24 (8-47)
Mebendazole	18	39 (25-55)	5	20 (7-41)	13	62 (38-82)	19	41 (27-57)	5	20 (7-41)	14	67 (43-85)
Tetracycline ointment	8	17 (8-31)	4	16 (5-36)	4	19 (5-42)	10	22 (11-36)	5	20 (7-41)	5	23 (8-47)
Paracetamol	21	46 (31-61)	12	48 (28-69)	9	43 (22-66)	21	46 (31-61)	10	40 (21-61)	11	52 (30-74)

[a] ORS, ACT, chloroquine, RUTF, RDT.

Table 16A: Index of essential iCCM commodity availability on day of data collection in health posts in intervention and comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	Mean (95% CI)	**Range**	**Mean (95% CI)**	**Range**	**Mean (95% CI)**	**Range**
Essential iCCM commodities available in intervention health posts	6.4/7 (6.2-6.6)	0-7	6.4/7 (6.2-6.7)	3-7	6.3/7 (6.0-6.7)	0-7
Essential routine CCM commodities available in comparison health posts	2.5/5 (2.1-2.9)	0-5	2.0/5 (1.5-2.5)	0-4	3.0/5 (2.5-3.6)	0-5

Table 17A: Health posts with no expired essential iCCM commodities on the day of data collection in health posts in intervention and comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	N	**% (95% CI)**	**N**	**% (95% CI)**	**N**	**% (95% CI)**
Intervention health posts	103	40 (30-50)	57	23 (13-36)	46	61 (45-75)
Comparison health posts	46	24 (13-39)	25	16 (5-36)	21	33 (15-57)

Table 18A: Availability of ICCM supplies and job aids on the day of data collection in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 103		Jimma N = 57		W. Hararghe N = 46	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
All essential supplies and job aids for iCCM[a]	40	46 (36-56)	31	54 (41-68)	16	35 (21-50)
Functional timer	94	91 (84-96)	53	93 (83-98)	41	89 (76-96)
Thermometer	82	80 (71-87)	41	72 (59-83)	41	89 (76-96)
Weighing scale	79	77 (67-85)	39	68 (55-80)	40	87 (74-95)
MUAC tape	102	99 (95-100)	56	98 (91-100)	46	100 -
Clean water	74	72 (63-81)	53	93 (83-98)	21	46 (31-61)
Supplies to mix ORS (cup & spoon)	77	75 (65-83)	56	98 (91-100)	21	46 (31-61)
ICCM chart booklet	103	100 -	57	100 -	46	100 -
ICCM patient register	103	100 -	57	100 -	46	100 -
Family health card	88	85 (77-92)	44	77 (64-87)	44	96 (85-100)
OTP card	41	40 (30-50)	2	4 (0-12)	39	85 (71-94)

[a] Functional timer, thermometer, weighing scale, clean water, MUAC, supplies to mix ORS, iCCM chart booklet, iCCM patient register.

Table 19A: Availability of routine CCM supplies and job aids on the day of data collection in health posts in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 46		Jimma N = 25		W. Hararghe N = 21	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
All essential supplies and job aids for CCM[a]	0	0 -	0	0 -	0	0 -
Functional timer	5	11 (4-24)	4	16 (5-36)	1	5 (0-24)
Thermometer	30	65 (50-79)	14	56 (35-76)	16	76 (53-92)
Weighing scale	37	80 (66-91)	17	68 (47-85)	20	95 (76-100)
MUAC tape	41	89 (76-96)	20	80 (59-93)	21	100 -
Clean water	3	7 (1-18)	3	12 (3-31)	0	0 -
Supplies to mix ORS (cup & spoon)	0	0 -	0	0 -	0	0 -
CCM chart booklet	0	0 -	0	0 -	0	0 -
CCM register	7	15 (6-29)	7	28 (12-49)	0	0 -
Family health card	39	85 (71-94)	18	72 (51-88)	21	100 -
OTP card	19	41 (27-57)	0	0 -	19	91 (70-99)

[a] Functional timer, thermometer, weighing scale, clean water, MUAC, supplies to mix ORS, patient register.

Table 20A: Indicators of quality of assessment of sick children by HEWs in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Child assessed for 4 general danger signs (able to drink/breastfeed, vomits everything, had convulsions, lethargy)	257	62 (53-70)	152	74 (62-83)	105	45 (31-59)
Child checked for presence of cough, diarrhea, fever and malnutrition	257	81 (74-86)	152	93 (89-96)	105	62 (50-72)
Child's vaccination status checked (children under 12 months)	94	98 (92-100)	57	98 (88-100)	37	97 (82-100)
Child with fever who needed an RDT for whom RDT was correctly performed	94	63 (51-73)	63	70 (54-82)	31	48 (30-67)
Child's respiratory rate recorded by HEW within five breaths of gold standard respiratory rate	130	70 (61-78)	93	69 (57-78)	37	73 (58-84)
Child's MUAC measurement by HEW matched gold standard MUAC measurement	225	94 (90-96)	137	97 (92-99)	88	89 (81-93)
Child's mother was asked about her HIV status	238	95 (90-98)	139	100 -	99	88 (77-94)
Child's caretaker was asked about child's HIV status	257	88 (81-93)	152	99 (95-100)	105	72 (60-82)
HEW used iCCM chart booklet and iCCM register during the child's consultation	257	100 -	152	100 -	105	100 -

Table 21A: Indicators of quality of classification of sick children by HEWs in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Child correctly classified for all iCCM illnesses[a]	257	53 (46-60)	152	63 (54-72)	105	38 (27-50)
Child with danger signs correctly classified for danger signs	0	0 -	0	0 -	0	0 -
Child with pneumonia correctly classified for pneumonia	39	74 (59-86)	34	74 (57-85)	5	80 (30-97)
Child with diarrhea correctly classified for diarrhea	169	75 (67-82)	87	87 (78-93)	82	62 (50-73)
Child with malaria correctly classified for malaria	3	67 (2-100)	2	100 -	1	0 -
Child with measles correctly classified for measles	5	20 (0-95)	4	25 (3-81)	1	0 -
Child with malnutrition correctly classified for malnutrition	32	53 (33-72)	15	87 (58-97)	17	24 (7-54)
Child not up-to-date on immunizations classified as not up-to-date	77	36 (26-48)	53	34 (23-47)	24	42 (21-65)
Child not up-to-date on vitamin A supplementation classified as not up-to-date	66	62 (49-74)	30	53 (37-69)	36	69 (50-84)
Child not up-to-date on mebendazole classified as not up-to-date	30	67 (46-83)	15	60 (30-83)	15	73 (46-90)
Child with fever who received an RDT classified in accordance with RDT result	61	100 -	45	100	16	100

[a] Danger signs, respiratory illness, diarrhea, malaria, measles, malnutrition.

Table 22A: Indicators of quality of management of sick children by HEWs in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total		Jimma		W. Hararghe	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Child correctly managed for all iCCM illnesses[a]	257	64 (57-71)	152	68 (59-75)	105	59 (48-69)
Child with severe illness correctly managed	38	34.2 (21-49)	15	26.7 (9-56)	23	39.1 (25-55)
Child needing referral correctly referred	63	54 (41-67)	25	72 (51-86)	38	42 (27-59)
Child with pneumonia correctly managed for pneumonia	39	72 (56-84)	34	74 (57-85)	5	60 (19-90)
Child with diarrhea correctly managed for diarrhea	169	79 (72-85)	87	86 (76-92)	82	72 (60-82)
Child with malaria correctly managed for malaria	3	67 (2-100)	2	100 -	1	0 -
Child with measles correctly managed for measles	5	20 (0-95)	4	25 (3-81)	1	100 -
Child with malnutrition correctly managed for malnutrition	32	59 (40-76)	15	47 (23-73)	17	71 (45-87)
Child received first dose of all needed treatments in presence of HEW[b]	153	14 (9-22)	92	19 (11-30)	61	8 (4-18)
Child received an antibiotic that wasn't needed	257	6 (3-10)	152	6 (3-11)	105	5 (2-14)
Child received an antimalarial that wasn't needed	257	0 -	152	0 -	105	0 -
Child needing vitamin A supplementation received vitamin A	66	18 (10-31)	30	27 (13-46)	36	11 (4-30)
Child needing mebendazole received mebendazole	30	20 (9-39)	15	33 (15-59)	15	7 (1-36)
Caretaker of referred child received referral note	44	75 (56-87)	24	83 (62-94)	20	65 (36-86)
Caretaker of referred child received transportation assistance from the HEW	44	0 -	24	0 -	20	0 -

[a] Includes danger signs, respiratory illness, diarrhea, febrile illness, measles, malnutrition.

[b] Includes cotrimoxazole, ORS, zinc, vitamin A, ACT, chloroquine and amoxicillin. Excludes children who were referred.

Table 23A: Indicators of quality of counseling of caretakers of sick children by HEWs in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia[a]

	Total		Jimma		W. Hararghe	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Caretaker received demonstration of how to administer all treatments by HEW[b]	154	77 (67-85)	89	88 (73-95)	65	63 (47-77)
Caretaker asked by HEW to repeat back how to administer treatment[c]	149	30 (21-41)	88	38 (26-51)	61	20 (9-37)
Caretaker correctly described how to give all treatments	158	83 (75-89)	90	87 (76-93)	68	78 (65-87)
Caretaker advised to give extra fluids and continued feeding for diarrhea	140	85 (78-90)	74	87 (76-93)	66	83 (72-91)
Caretaker advised to return Immediately if child cannot drink/breastfeed or becomes sicker[d]	213	36 (27-46)	12 8	56 (42-68)	85	7 (3-16)
Caretaker advised on when to return for follow-up[e]	213	93 (88-97)	12 8	94 (86-97)	85	93 (84-97)

[a] Denominators are caretakers of children who received a given treatment from the HEW, rather than children who needed a treatment according to the gold standard classification.

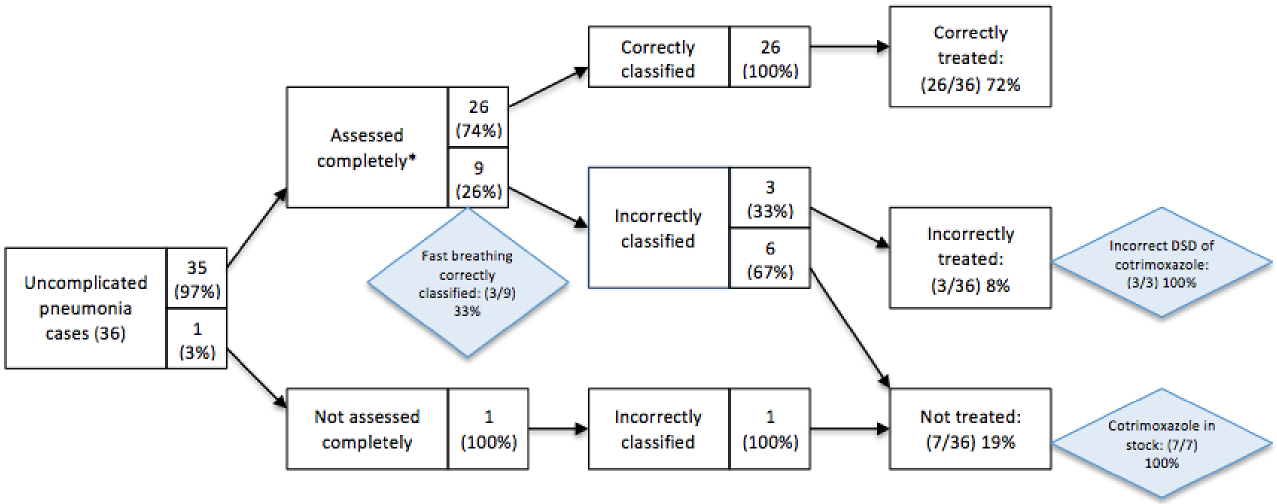
[b] Includes cotrimoxazole, ORS, zinc, vitamin A, ACT, chloroquine and amoxicillin. Excludes children who were referred.

[c] Includes cotrimoxazole, ORS, zinc, vitamin A, ACT, chloroquine and amoxicillin. Excludes children who were referred.

[d] Excludes children that were referred.

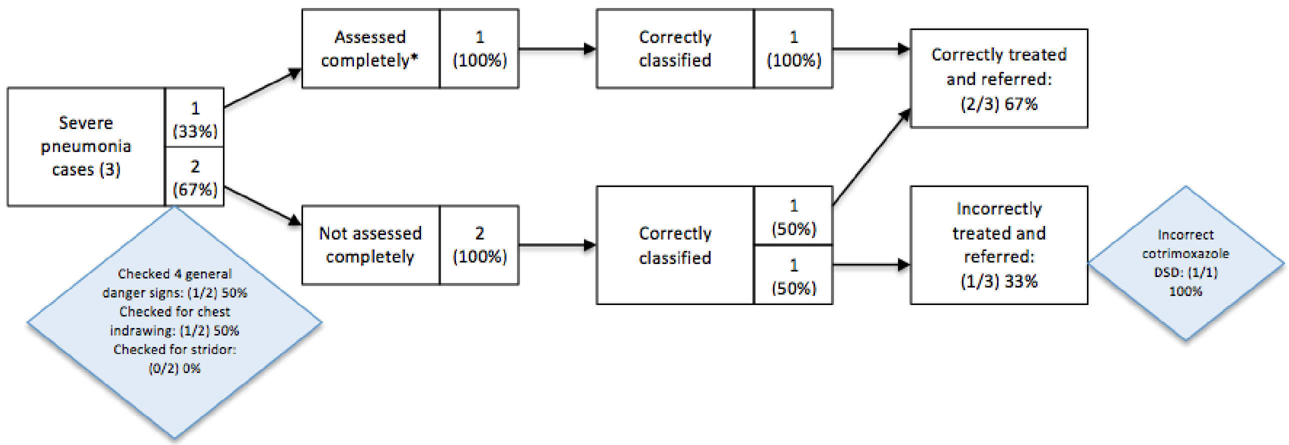
[e] Excludes children that were referred.

Figure 1A: Clinical errors analysis for children with non-severe pneumonia according to the gold standard classification in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia



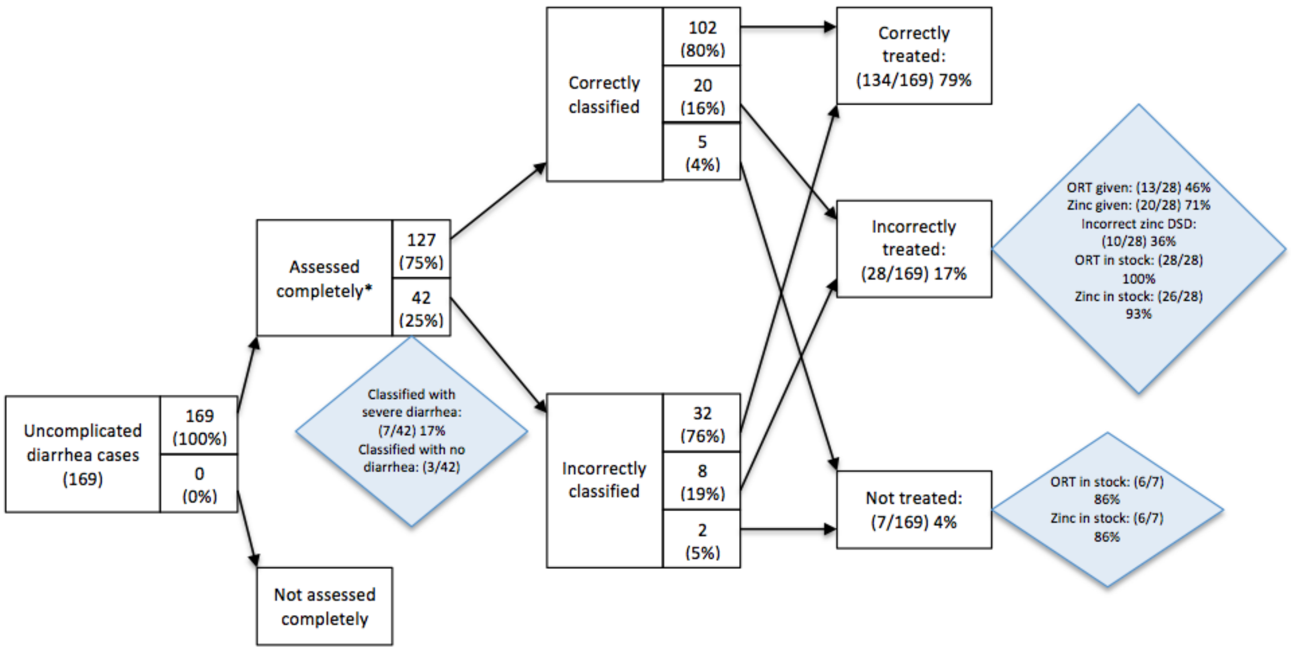
*Assessed completely defined as: HEW asked/checked for cough/difficult breathing and counted respiratory rate with a functional timer.

Figure 2A: Clinical errors analysis for children with severe pneumonia according to the gold standard classification in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia



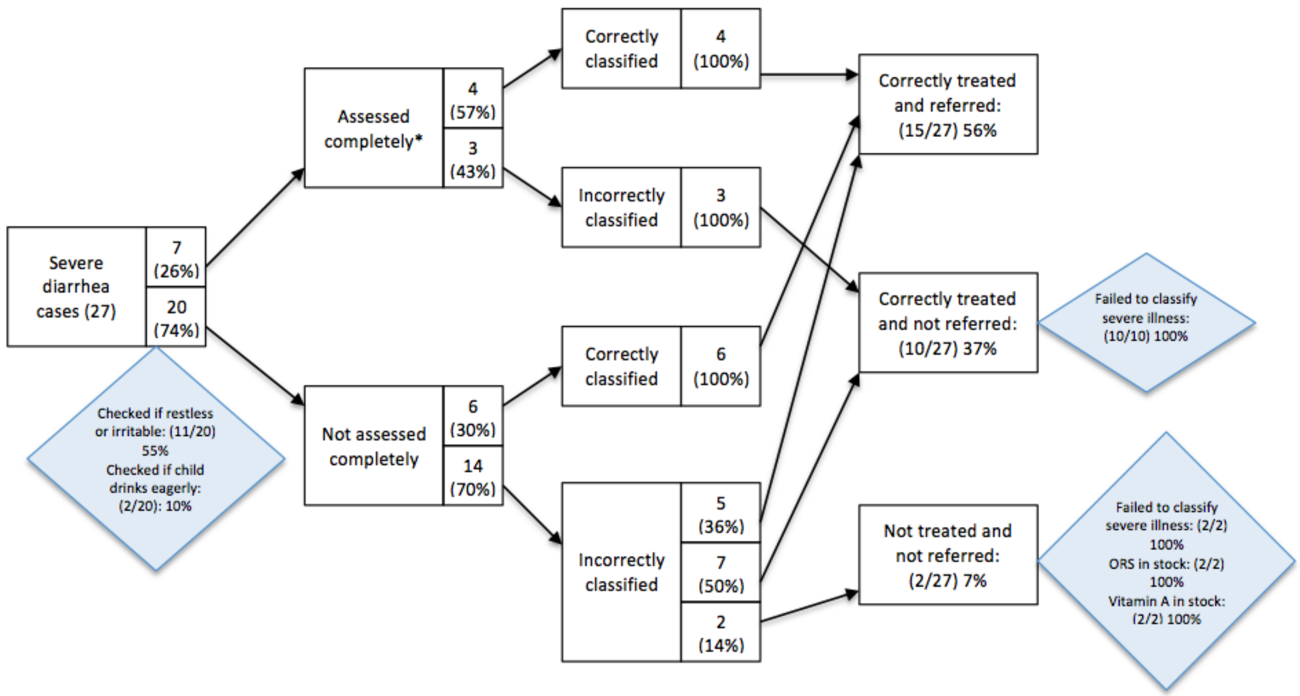
*Assessed completely defined as: HEW asked/checked for cough and difficult breathing, checked for all four general danger signs (not able to drink/breastfeed anything, vomits everything, convulsions, lethargy), looked for chest indrawing and listened for stridor.

Figure 3A: Clinical errors analysis for children with non-severe diarrhea according to the gold standard classification in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia



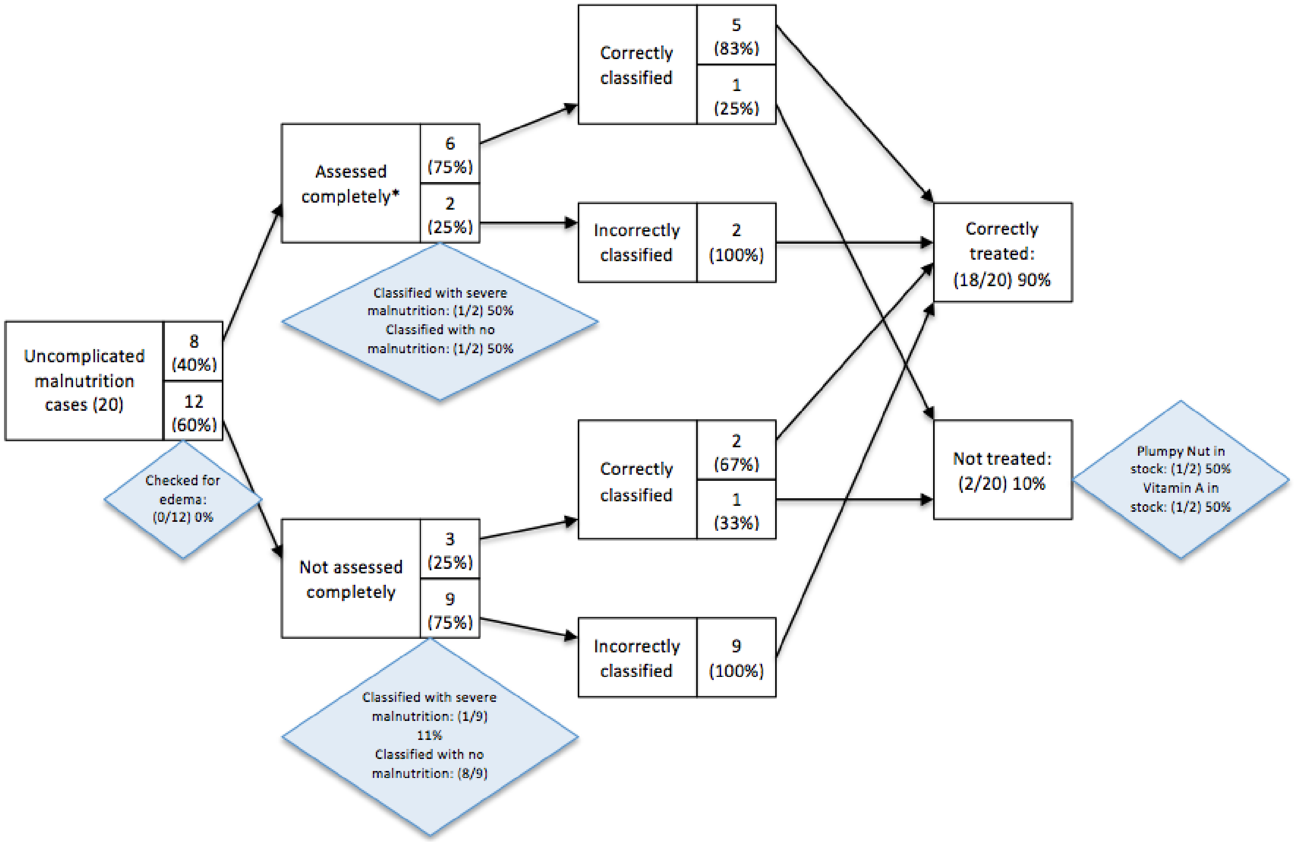
*Assessed completely defined as: asked for diarrhea.

Figure 4A: Clinical errors analysis for children with severe diarrhea according to the gold standard classification in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia



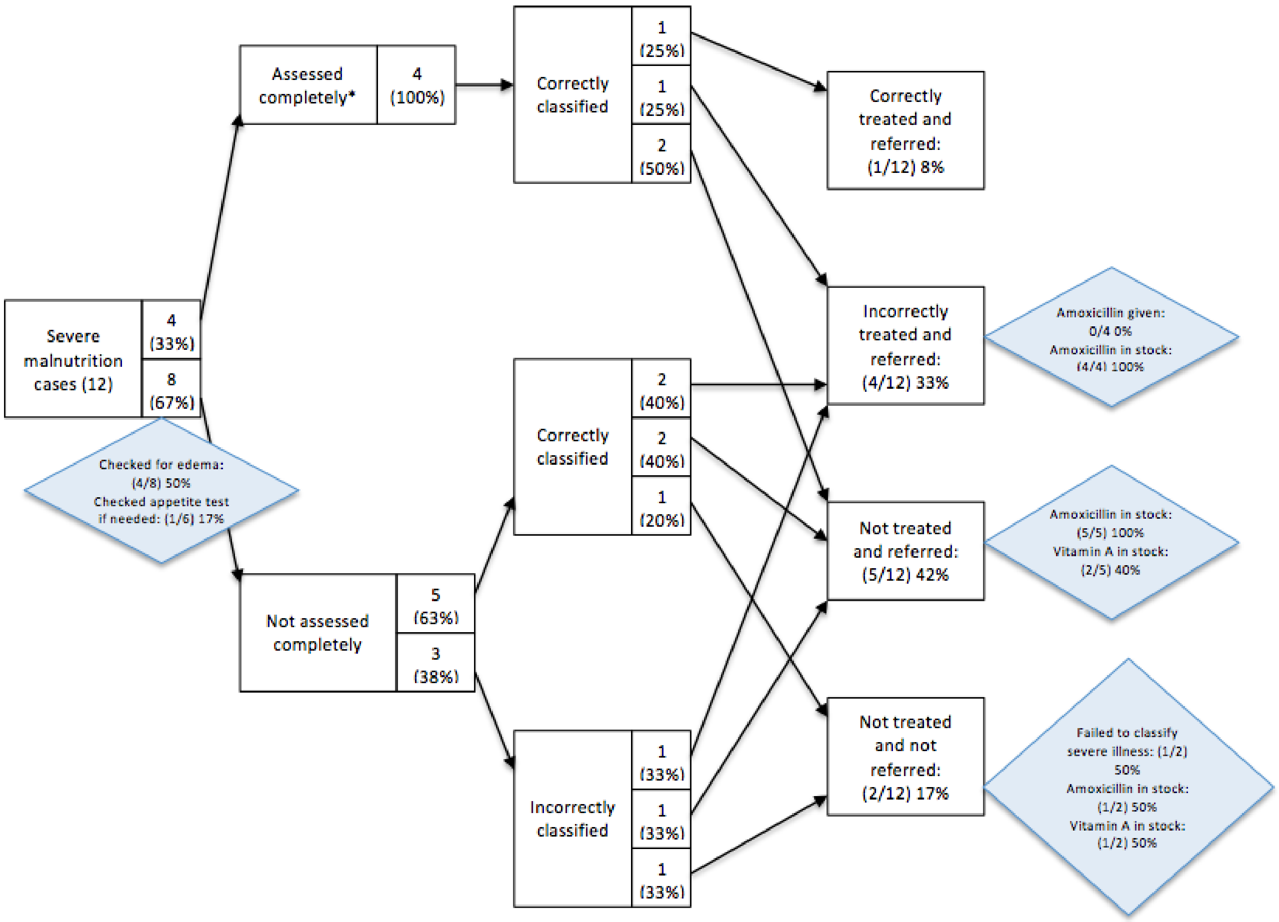
*Assessed completely defined as: asked for diarrhea, asked how long child had diarrhea, asked about blood in stool, checked for restlessness/irritability, checked if child drinks eagerly, did skin pinch.

Figure 5A: Clinical errors analysis for children with uncomplicated malnutrition according to the gold standard classification in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia



*Assessed completely defined as: checked for bipedal edema and measured MUAC (children six months or older) or looked for visible severe wasting (children under six months).

Figure 6A: Clinical errors analysis for children with complicated malnutrition according to the gold standard classification in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia



*Assessed completely defined as: checked for bipedal edema, measured MUAC (children six months or older) or looked for visible severe wasting (children under six months), gave appetite test (children six months or older and MUAC less than 11cm or edema and no medical complication).

Table 24A: Mean number and range of sick child consultations in the previous month in health posts in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N=103		Jimma N=57		W. Hararghe N=46	
	Mean (95% CI)	Range	Mean (95% CI)	Range	Mean (95% CI)	Range
Total	16.0 (13.2-18.8)	0-95	17.4 (13.1-21.7)	0-95	14.3 (11.0-17.7)	0-51
Age						
<2 months	0.3 (0.1-0.5)	0-9	0.4 (0.0-0.7)	0-9	0.2 (0.1-0.4)	0-2
2-59 months	15.7 (13.0-18.4)	0-94	17.0 (12.9-21.1)	0-94	14.1 (10.8-17.4)	0-50
Sex						
Female	8.0 (6.6-9.5)	0-40	8.7 (6.4-10.9)	0-40	7.3 (5.5-9.1)	0-28
Male[a]	7.9 (6.4-9.4)	0-57	8.7 (6.4-11.0)	0-57	6.9 (5.3-8.6)	0-20
Disease classifications						
Pneumonia	4.0 (3.1-5.0)	0-31	5.4 (3.9-6.9)	0-31	2.4 (1.3-3.5)	0-20
Diarrhea	6.4 (5.3-7.6)	0-28	6.3 (4.7-7.9)	0-28	6.6 (4.9-8.2)	0-20
Malaria	1.6 (1.1-2.1)	0-13	2.4 (1.6-3.2)	0-13	0.6 (0.1-1.1)	0-9
Malnutrition	1.1 (0.6-1.5)	0-12	0.2 (0.0-0.4)	0-4	2.1 (1.2-2.9)	0-12
Anemia	0.1 (0.0-0.1)	0-2	0.1 (0.0-0.2)	0-2	0.1 (0.0-0.2)	0-2
Ear infection	0.3 (0.1-0.5)	0-7	0.1 (0.0-0.2)	0-2	0.6 (0.2-1.0)	0-7
Referred	1.0 (0.7-1.3)	0-8	1.1 (0.6-1.5)	0-8	1.0 (0.5-1.5)	0-8

[a] 0.1 children per health post were missing information on sex.

Table 25A: Mean number and range of sick child consultations in the previous month in health posts in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 46		Jimma N = 25		W. Hararghe N = 21	
	Mean (95% CI)	Range	Mean (95% CI)	Range	Mean (95% CI)	Range
Total	5.0 (2.3-7.7)	0-32	4.8 (1.6-8.0)	0-32	5.5 (2.8-10.6)	0-29
Age						
<2 months	0.03 (0.0-0.1)	0-1	0.04 (0.0-0.1)	0-1	0.0 -	0
2-59 months	5.0 (2.4-7.6)	0-31	4.8 (1.7-7.9)	0-31	5.5 (0.3-10.6)	0-29
Sex						
Female	2.3 (0.7-3.9)	0-19	1.9 (0.1-3.7)	0-19	3.2 (0.0-6.6)	0-19
Male[a]	2.4 (1.2-3.7)	0-13	2.5 (0.9-4.1)	0-13	2.3 (3.1-4.2)	0-10
Disease classifications						
Pneumonia	0.0 -	0	0.0 -	0	0.0 -	0
Diarrhea	1.9 (0.4-3.4)	0-20	2.4 (0.3-4.5)	0-20	0.9 (0.0-2.0)	0-5
Malaria	1.0 (0.3-1.8)	0-10	1.2 (0.1-2.2)	0-10	0.7 (0.0-1.6)	0-4
Malnutrition	0.3 (0.0-0.5)	0-3	0.0 -	0	0.8 (0.1-1.5)	0-3
Anemia	0.0 -	0	0.0 -	0	0.0 -	0
Ear infection	0.0 -	0	0.0 -	0	0.0 -	0
Referred	0.3 (0.0-0.7)	0-7	0.4 (0.0-1.0)	0-7	0.1 (0.0-0.3)	0-1

[a] 0.2 children per health post were missing information on sex.

Table 26A: Reasons given by HEWs for why caretakers do not bring sick children to the health post in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	n N=137	%
Not aware of case management services	41	30
Distance from home to health post	32	23
Want injectable drugs	18	13
Health post not always open	15	11

Table 27A: Reasons given by HEWs for why caretakers do not bring sick children to the health post in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	n N=64	%
Lack of drugs in health post	37	58
Not aware of case management services	19	30
Poor service by HEWs/lack of training	12	19
Distance from home to health post	7	11

Table 28A: Mean number of hours health post was open in the previous week and mean number of hours spent by HEWs on work-related activities the previous day in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N=103		Jimma N=57		W. Hararghe N=46	
	Mean (95% CI)	**Range**	**Mean (95% CI)**	**Range**	**Mean (95% CI)**	**Range**
Hours health post was open in previous week	23.3 (21.0-25.5)	0-40	21.1 (18.8-23.4)	0-40	26.0 (21.9-30.1)	0-40
Hours spent by HEW in the previous day						
Providing clinical services in the health post	4.0 (3.5-4.5)	0-10	3.9 (3.3-4.6)	0-9	4.1 (3.3-5.0)	0-10
Providing clinical services in the community	0.5 (0.3-0.6)	0-7.5	0.5 (0.3-0.8)	0-7.5	0.4 (0.2-0.6)	0-4
Community education/mobilization, disease prevention	0.9 (0.6-1.1)	0-8	0.8 (0.6-1.1)	0-6	0.9 (0.4-1.3)	0-8
Other health-related activities	0.8 (0.5-1.1)	0-8	0.6 (0.4-0.9)	0-6	1.0 (0.4-1.6)	0-8
Other non health-related activities	0.2 (0.1-0.4)	0-8	0.3 (0.1-0.6)	0-8	0.1 (0.0-0.1)	0-2
Travel outside kebele	0.7 (0.3-1.2)	0-12	0.7 (0.2-1.2)	0-12	0.8 (0.0-1.6)	0-12
Total work-related activities	6.1 (5.6-6.6)	0-11	5.9 (5.3-6.5)	0-11	6.4 (5.7-7.1)	0-10

Table 29A: Mean number of hours health post was open in the previous week and mean number of hours spent by HEWs on work-related activities the previous day in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N = 46		Jimma N = 25		W. Hararghe N = 21	
	Mean (95% CI)	Range	Mean (95% CI)	Range	Mean (95% CI)	Range
Hours health post was open in previous week	20.2 (17.0-23.5)	0-40	12.2 (10.5-13.8)	0-17	29.9 (26.2-33.5)	16-40
Hours spent by HEW in the previous day						
Providing clinical services in the health post	1.8 (1.1-2.5)	0-8	0.9 (0.4-1.4)	0-6	2.8 (1.6-4.0)	0-8
Providing clinical services in the community	0.8 (0.3-1.2)	0-5	0.5 (0.2-0.8)	0-3	1.1 (0.2-1.9)	0-5
Community education/mobilization, disease prevention	1.5 (0.9-2.2)	0-8	1.9 (1.0-2.7)	0-7.5	1.2 (0.3-2.1)	0-8
Other health-related activities	1.4 (0.7-2.1)	0-8	1.8 (0.8-2.8)	0-8	1.0 (0.1-1.9)	0-8
Other non health-related activities	0.4 (0.1-0.8)	0-7	0.5 (0.2-0.9)	0-4	0.4 (0.0-0.9)	0-7
Travel outside kebele	0.5 (0.1-0.9)	0-8	0.3 (0.0-0.7)	0-6	0.8 (0.1-1.5)	0-8
Total work-related activities	5.5 (4.9-6.2)	0-9	5.1 (4.0-6.1)	0-9	6.1 (5.2-7.0)	0-8

Table 30A: Mean number of health promotion activities focused on iCCM illnesses carried out by HEWs or VCHWs and people attending iCCM-related health promotion activities in the previous month in health post catchment areas in intervention areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

	Total N=103		Jimma N=57		W. Hararghe N=46	
	Mean (95% CI)	#/1,000 children <5	Mean (95% CI)	#/1,000 children <5	Mean (95% CI)	#/1,000 children <5
Volunteer community health workers in the health post catchment area	20.5 (17.2-23.8)	30.4 (26.0-34.8)	23.7 (18.2-29.3)	32.5 (25.4-39.5)	16.4 (14.2-18.6)	27.7 (23.2-32.1)
Reported[a] community education/mobilization activities	9.2 (7.9-10.6)	15.4 (12.3-18.5)	11.7 (10.1-13.3)	19.4 (14.9-23.9)	6.1 (4.2-8.0)	10.5 (6.9-14.0)
Documented[b] community education/ mobilization activities	2.5 (1.6-3.4)	3.9 (2.4-5.3)	1.6 (0.9-2.2)	2.0 (1.1-2.9)	3.7 (1.9-5.5)	6.2 (3.2-9.1)
Reported people attending community education/mobilization activities	347 (266-428)	-	366 (300-432)	-	323 (160-485)	-
Documented people attending community education/mobilization activities	138 (62-215)	-	56 (32-81)	-	240 (75-405)	-

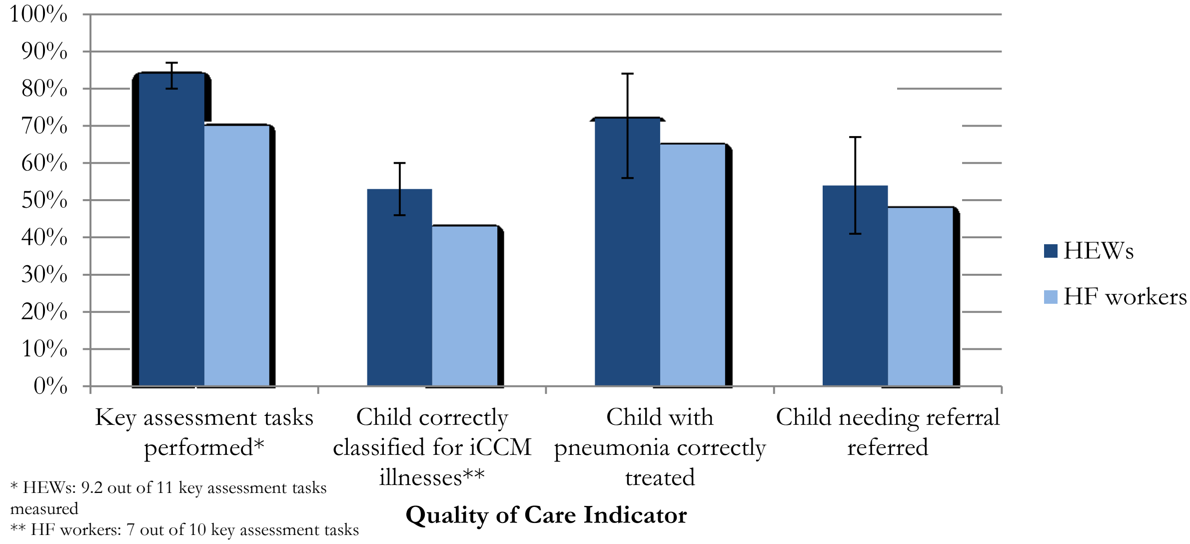
[a] Self-reported by the HEWs.

[b] Documented in written activity reports.

Table 31A: Mean number of health promotion activities focused on iCCM illnesses carried out by HEWs or VCHWs and people attending iCCM-related health promotion activities in the previous month in health post catchment areas in comparison areas in Jimma and West Hararghe Zones, Oromia Region, Ethiopia

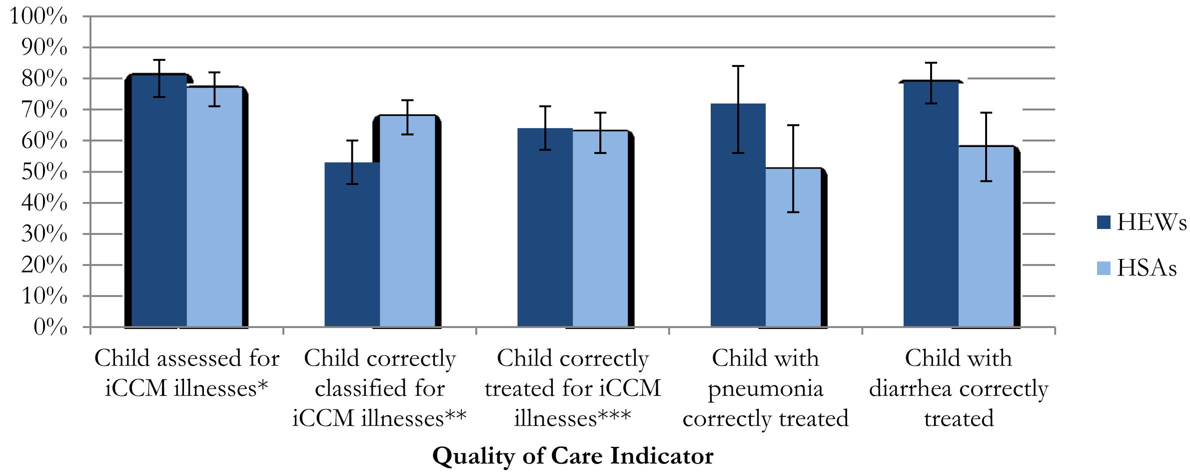
	Total N = 46		Jimma N = 25		W. Hararghe N = 21	
	Mean (95% CI)	**#/1,000 children <5**	**Mean (95% CI)**	**#/1,000 children <5**	**Mean (95% CI)**	**#/1,000 children <5**
Volunteer community health workers in the health post catchment area	19.7 (15.5-23.9)	28.6 (22.1-35.1)	24.5 (17.7-31.3)	35.9 (25.3-46.5)	14.0 (11.2-16.7)	20.0 (15.5-24.6)
Reported community education/mobilization activities	6.6 (4.7-8.5)	11.3 (6.1-16.5)	9.5 (6.9-12.1)	17.1 (8.5-25.6)	3.2 (1.2-5.2)	4.4 (1.2-7.6)
Documented community education/ mobilization	2.3 (1.5-3.2)	3.3 (2.0-4.6)	2.2 (1.2-3.1)	3.1 (1.8-4.5)	2.5 (1.0-4.1)	3.4 (1.0-5.8)
Reported people attending community education/mobilization activities	223 (140-306)	-	266 (164-368)	-	172 (36-307)	-
Documented people attending community education/mobilization activities	111 (48-174)	-	76 (37-115)	-	152 (23-282)	-

Figure 7A: Comparison of quality of care indicators for HEWs and higher-level health workers in Ethiopia



* HEWs: 9.2 out of 11 key assessment tasks measured
** HF workers: 7 out of 10 key assessment tasks

Figure 8A: Comparison of quality of care indicators for Ethiopian HEWs and Malawian HSAs



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Winch PJ, Gilroy KE, Wolfheim C, Starbuck ES, Young MW, Walker LD, et al. Intervention models for the management of children with signs of pneumonia or malaria by community health workers. Health Policy Plan. 2005; **20**(4): 199-212.

Winch PJ, Leban K, Casazza L, Walker L, Pearcy K. An implementation framework for household and community integrated management of childhood illness. Health Policy Plan. 2002; **17**(4): 345-53.

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Yeboah-Antwi K, Pilingana P, Macleod WB, Semrau K, Siazeele K, Kalesha P, et al. Community case management of fever due to malaria and pneumonia in children under five in Zambia: a cluster randomized controlled trial. PLoS medicine. 2010; **7**(9): e1000340.

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Management: An Equity-Focused Strategy to Improve Access to Essential Treatment Services for Children. The American journal of tropical medicine and hygiene. 2012; **87**(5 Suppl): 6-10.

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Zurovac D, Rowe AK. Quality of treatment for febrile illness among children at outpatient facilities in sub-Saharan Africa. Ann Trop Med Parasitol. 2006; **100**(4): 283-96.

Zurovac D, Rowe AK, Ochola SA, Noor AM, Midia B, English M, et al. Predictors of the quality of health worker treatment practices for uncomplicated malaria at government health facilities in Kenya. International journal of epidemiology. 2004; **33**(5): 1080-91.

Curriculum Vitae

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PROFESSIONAL PROFILE

Public health professional specializing in child survival and control of malaria and other infectious diseases. Eight years experience as an international public health program director and manager, consultant, and researcher. Extensive experience in program design and management, monitoring and evaluation, operational research, health systems strengthening, improvement of quality of health care delivery, development of health policy, disease surveillance, capacity building, and community mobilization and education. Doctoral and master's-level studies in public health, epidemiology, and international development.

EXPERIENCE

Research Fellow, Johns Hopkins Bloomberg School of Public Health, Department of International Health

Addis Ababa, Ethiopia and Baltimore, USA; July 2010-present

- Worked with the Institute for International Programs at the Johns Hopkins Bloomberg School of Public Health in Ethiopia on a multi-country evaluation of the Catalytic Initiative, a UNICEF-led initiative to scale-up integrated community case management of common childhood illnesses and reduce child mortality.
- Provided technical assistance in the completion of two household randomized cluster survey (11,000 households and 28,000 households) to measure child mortality and coverage of effective treatment for childhood illnesses.
- Led a randomized survey to measure the quality of case management of childhood illnesses provided by Health Extension Workers.

PMI Advisor, U.S. Agency for International Development (USAID)

Cotonou, Benin; Feb-July 2009

- Served as interim technical advisor for the U.S. President's Malaria Initiative in Benin.
- Provided technical assistance to USAID, the National Malaria Control Program (NMCP), and partner organizations in development, planning, implementation, and monitoring and evaluation of malaria control activities.
- Carried out supervision and evaluation of implementing partner activities—including indoor residual spraying, improving malaria diagnostics, development of sentinel

surveillance sites, malaria drug quality control, and pharmaceutical management—to ensure adherance to best practice standards.

Consultant, The World Bank
Jan-April 2009

- Contributing writer for the World Bank's "YouThink!" website (www.youthink.worldbank.org).

Country Director, The MENTOR Initiative
Yangon & Ayeyarwady Delta, Myanmar; July-October 2008

- Directed MENTOR's emergency response to cyclone Nargis.
- Provided training and technical support on malaria and dengue control, as well as medical and prevention supplies to relief agencies.
- Responsible for technical activities, representation, logistics, administration, finance, human resources, budget management, security, donor reporting, and fund raising.

Program Director, The MENTOR Initiative
Logone Oriental and Moyen Chari districts, Chad; Feb-July 2008

- Directed the MENTOR humanitarian relief program in southern Chad.
- Planned and directed the following activities: training and intensive supervision of government and NGO health workers, provision of anti-malarial drugs and rapid diagnostic tests (RDTs), distribution of long lasting insecticide-treated bed nets (LLINs), indoor residual spraying (IRS), and community education.
- Responsible for the overall direction and management of program activities in two districts, including technical activities, representation, logistics, administration, finance, human resources, budget management, security, donor reporting, and proposal writing.
- This program was the only large-scale intervention to control malaria, which is the leading cause of morbidity and mortality in the region, among refugees from the Central African Republic in 5 refugee camps and the Chadian host communities, and was critical in avoiding a health crisis among highly vulnerable communities.

Program Manager, The MENTOR Initiative
Huambo & Zaire provinces, Angola; April 2006-Feb 2008

- Managed the MENTOR malaria control program in two provinces.
- In collaboration with the NMCP, the National Essential Drugs Program (EDP), and the WHO, led the first large-scale implementation of artemisinin combination therapy (ACT) and RDTs in Angola.
- Designed and directed a broad range of malaria control interventions, including: large-scale training of health workers on malaria case management, provision of malaria control supplies, improving pharmaceutical management, and community

education campaigns in two provinces.

- This program was the pilot for implementing broad changes in the country's malaria control policies and activities. The program's success led to it being used as a model for expansion to the rest of the country.

Consultant, United Nations Population Fund (UNFPA)
Haiti; Aug-Sept 2007

- Carried out qualitative research—through focus groups, participatory rural appraisal (PRA) activities, and key informant interviews—for UNFPA and the UN peacekeeping mission in Haiti (MINUSTAH) on interactions and relations between MINUSTAH and communities and on community perceptions and knowledge regarding HIV/AIDS.

Research Assistant, Columbia University Mailman School of Public Health
New York, USA; Sept-Dec 2005

- Studied limitations and potential opportunities for scaling up the use of ACT for the treatment of malaria and assisted with the graduate course "Health Consequences of Forced Migration".

Consultant, The MENTOR Initiative
Huambo, Angola; June-Sept 2005

- Provided support to MENTOR's malaria control program, including supervision of an IRS campaign, a bed net retreatment campaign, training of health workers on malaria case management and malaria in pregnancy.
- Carried out the first field evaluation of insecticide-treated wall lining as a new malaria prevention tool.

Consultant, Save the Children USA
Maputo, Mozambique; May-June 2005

- Mapped out support services provided to children orphaned by AIDS in Mozambique and produced a concept paper detailing gaps in programming and priority areas of intervention.

Consultant, The International Rescue Committee (IRC)
New York, USA; Timor-Leste; Nov 2004-May 2005

- Carried out an evaluation of the IRC's gender-based violence (GBV) program in East Timor.
- Conducted interviews and focus groups with former staff and beneficiaries to identify strengths and shortcomings in programming and strategy, and to assess whether capacities of local partner NGOs had been successfully improved.

Consultant, International Organization for Migration (IOM)
Timor-Leste; May-Aug 2004

- Conducted an evaluation of IOM's community stabilization/environmental health program using quantitative and qualitative research methods.

EDUCATION

Doctor of Philosophy (PhD) candidate in Global Disease Epidemiology & Control
Johns Hopkins University Bloomberg School of Public Health, Baltimore, USA; 2009 – present.
Thesis: Integrated community case management of childhood illness in Ethiopia: Quality of care and implementation strength.
Advisor: Robert Black

Master of Public Health (MPH) in Forced Migration and Health
Columbia University Mailman School of Public Health, New York, USA. Graduated 2006 (with honors)
Advisor: Ronald Waldman

Master of International Affairs (MIA) in Economic & Political Development
Columbia University School of International & Public Affairs (SIPA), New York, USA. Graduated 2006 (with honors)

Bachelor of Business Administration (BBA) in International Business
New Mexico State University, Las Cruces, New Mexico, USA. Graduated 1999 (with honors).

LANGUAGES

Native English; fluent spoken and written Spanish, Portuguese, and French.

PROFESSIONAL AFFILIATIONS

Senior Associate, **Columbia Group for Children in Adversity, LLC**
2009 – Present

Associate, **Humanitas Global Development**
2009 – Present

Associate Member, Global Health Council
2011 – Present

Member, American Society of Tropical Medicine and Hygiene
2013-Present

PUBLICATIONS

Peer-Reviewed Journal Articles

Messenger LA, Miller NP, Adeogun AO, Awolola T, Rowland M. *The development of insecticide-treated durable wall lining for malaria control: insights from rural and urban populations in Angola and Nigeria*. Malaria Journal 2012, 11:332.

Rowe A, Ponce de León G, Mihigo J, Santelli AC, Miller NP, Van-Dunem P. *Quality of Malaria Case Management at Outpatient Health Facilities in Angola*. Malaria Journal 2009, 8:275.

Technical Reports

Miller NP, Amouzou A, Bryce J, Victora C, Hazel E, Black RE. Assessment of iCCM implementation strength and quality of care in Oromia, Ethiopia. Baltimore, USA and Addis Ababa, Ethiopia: Institute for International Programs, Johns Hopkins Bloomberg School of Public Health; 2013.

Bryce J, Amouzou A, Hazel E, Miller N, Johns B, Gilroy K, Munos M, and Victora C. Measuring the strength of implementation of community case management of childhood illness within the Catalytic Initiative to Save a Million Lives. Baltimore, USA: Institute for International Programs, Johns Hopkins Bloomberg School of Public Health; 2011

Byron MJ, Cook M, Fakhouri T, Hoe C, Jain K, Miller N, and Nakigozi G. Perspectives on Healthy Bodies, Healthy Souls: Qualitative Midterm Evaluation of a Church-Based Diabetes Intervention in Baltimore City. Baltimore, USA: Johns Hopkins Bloomberg School of Public Health; 2011

Stark L, Miller N. Community Perceptions of Peacekeeping in Haiti. Port-au-Prince, Haiti: United Nations Population Fund; 2008.

Miller N. Avaliação da Distribuição de Mosquiteiros por UNICEF na Província de Huambo, Angola. Huambo, Angola: The MENTOR Initiative; 2007.

Miller N. Evaluation of Feasibility and Acceptability of Insecticide Treated Wall Linings. Huambo, Angola: The MENTOR Initiative; 2005.

Evans J, Kee J, Lietz K, Miller N, Ravon L, Ullmann M. Capacity Building in East Timor: An Assessment of the IRC's Gender Based Violence Capacity Building Program. Dili, Timor-Leste: The International Rescue Committee and the Columbia University School of International and Public Affairs; 2005.

Miller N. Making the Transition from Relief to Sustainable Development. Dili, Timor-Leste: The International Organization for Migration; 2004.

Poster Presentations

Messenger LA, Arnez AM, Stiles-Ocran JB, Coulibaly MB, Larsen ML, Miller NP, Adeogun AO, Mulder CEG, Le H, Kleinschmidt I, Rowland M. *Insecticide-treated durable wall lining for malaria control: multicentre studies from Africa and South-East Asia*. Malaria Journal 2012, 11(Suppl 1):P121

Media

Miller, Nate. "My flight crashed in my own front yard." The Financial Times Magazine. 4 October 2008. http://www.ft.com/cms/s/2/62314ee0-8dcb-11dd-974f-0000779fd18c.html

AWARDS

National Institutes of Health Training Grant in International Maternal & Child Health, 2009-2011

Robert D. and Helen S. Wright Fellowship in International Health, 2011

Julie J. Kidd Fellowship in Conflict Resolution, 2004

PHOTOGRAPHY

Photos published on various websites and in literature by international organizations, NGOs, universities, and media, including: the Financial Times Magazine, USAID, Columbia University, Brandeis University, Population Services International, The MENTOR Initiative, and CORE Group.

Honorable mentions in HIV/AIDS and malaria categories; Johns Hopkins Center for Communication Programs 2010 International Photoshare Photo Contest.

Photographs included in the published photography book: Africa Through 100 Eyes: Portraits of Beauty and Hope.

SKILLS & ACTIVITIES

- Regular trainer on surveys, surveillance, and operational research for The MENTOR Initiative intensive malaria training workshops.
- Founding advisory board member and contributing writer and photographer for the HELO Humanitarian Reporting Project.
- Software proficiency: Microsoft Office, MS Access, Epi Info, Stata, Atlas.ti, Anthropac, Spectrum, and the Lives Saved Tool (LiST).
- Knowledge of Sphere standards for humanitarian health programs.
- Trained in UN and RedR field security procedures.
- Experience with field communications tools (satellite phones, HF radio, VHF radio).
- Traveled to over 60 countries and lived in 12 countries in Africa, Asia, Latin America, the Caribbean, and Europe.