Original Research

Improving Maternal and Newborn Health Care Delivery in Rural Amhara and Oromiya Regions of Ethiopia Through the Maternal and Newborn Health in Ethiopia Partnership

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Introduction: In Ethiopia, rural residence and limited access to skilled providers and health services pose challenges for maternal and newborn survival. The Maternal Health in Ethiopia Partnership (MaNHEP) developed a community-based model of maternal and newborn health focusing on birth and the early postnatal period and positioned it for scale-up. MaNHEP's 3-pronged intervention included community- and facility-based community maternal and newborn health training, continuous quality improvement, and behavior change communications.

Methods: Evaluation included baseline and endline surveys conducted with random samples of health extension workers, community health development agents, traditional birth attendants (TBAs), and women who gave birth the year prior to the survey; pretraining, posttraining, and postintervention clinical skills assessments conducted with health extension workers, community health development agents, and traditional birth attendants; endline surveys conducted with quality improvement teams; and a perinatal verbal autopsy study.

Results: There were significant improvements in the completeness of maternal and newborn health care provided by the team of health extension workers, community health development agents, and TBAs in their demonstrated capacity and confidence to provide care and a sense of being part of a maternal and newborn health care team. There were also significant improvements in women's awareness of and trust in the ability of these team members to provide maternal and newborn health care, in the completeness of care that women received, and in the use of skilled providers and health extension workers for antenatal and postnatal care. In addition, a shift occurred toward the use of providers with a higher level of skills for birth care. Successful local solutions for pregnancy identification, antenatal care registration, labor-birth notification, and postnatal follow-up were adopted across 51 project communities. The number of days between perinatal deaths increased over the duration of the project.

Discussion: MaNHEP was associated with more, and more complete, coverage of maternal and newborn health care and improved perinatal outcomes. The model is adaptable and potentially scalable, as indicated by the pilot test of its integration into the Ethiopian Ministry of Health's newly revised Primary Health Care Unit and Health Extension Program structures.
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Keywords: community intervention, Ethiopia, maternal and newborn survival, quality improvement

INTRODUCTION

Ethiopia has great needs in the area of maternal and newborn health. The most recent maternal mortality ratio estimates for 2010 and 2011 range from 350 deaths[1] to 676 deaths[2] per 100,000 live births, depending on the source. Nearly half of pregnant women received antenatal care, yet only 10% of women gave birth with a skilled provider in attendance; more than 61% of women indicated that a health facility is not necessary for birth; and 7% received postnatal care within 2 days of birth.[2] While Ethiopia has made considerable progress in improving child survival between 2005 and 2011, the neonatal mortality rate only decreased from 39 to 37 deaths per 1000 live births.[2,3] Most maternal and newborn deaths occur at birth or within the early postnatal period.[4,5] Rural residence, timing of maternal and neonatal mortality, and limited access to skilled providers and health services create challenges and opportunities for improving maternal and newborn health outcomes using community-based strategies.[6–8]

In this article, we report the main findings of an evaluation of the Maternal Health in Ethiopia Partnership (MaNHEP), a project to develop a community-based model of maternal and newborn health in rural Ethiopia and to position it for scale-up.[9] We describe the extent to which the project's objectives were met and highlight implications for policy, programming, and research. Other articles in this supplement issue of the *Journal of Midwifery & Women's Health* provide more detailed descriptions and results of MaNHEP interventions.[10–17]

Maternal and Newborn Health in Ethiopia Partnership

MaNHEP was a 3.5-year (November 2009-May 2013) learning project funded by the Bill and Melinda Gates Foundation.[9] The project operated under the leadership of the Ethiopian Federal Ministry of Health and 2 regional health bureaus and was aligned with 3 key national policies: *Health Sector Development Plan IV* Ethiopian Fiscal Year 2004 (equivalent to 2011-2012)[18]; *National Reproductive Health Strategy 2006-2015*[19]; and *Road Map for Accelerating the Attainment of the Millennium Development Goals Related*

Quick Points

✦ The Maternal and Newborn Health in Ethiopia Partnership's (MaNHEP's) community-based model focused on maternal and newborn survival during the vulnerable birth and early postnatal period.

✦ The model improved capacity and confidence of health extension workers, community health development agents, and traditional birth attendants to provide maternal and newborn health care during birth and the early postnatal period.

✦ The model increased demand for skilled maternal and newborn care and improved the self-care behaviors of women during labor and the early postnatal period.

✦ The model's lead *woreda* (district) approach improved identification of pregnant women, enrollment of pregnant women in antenatal care and in MaNHEP's Community Maternal and Newborn Health family meetings, labor and birth notification to health extension workers, and the timely postnatal care follow-up by health extension workers.

✦ Application of the model is associated with improved perinatal survival, as evidenced by an increase in the number of days between perinatal deaths over the course of the project.

to Maternal and Newborn Health in Ethiopia 2011-2015.[20] MaNHEP complemented and strengthened the Federal Ministry of Health's flagship Health Extension Program, which seeks to expand health care delivery to rural areas where 85% of Ethiopians reside by ensuring the delivery of a core package of community maternal and newborn health (CMNH) care (Table 1) to achieve Millennium Development Goals 4 and 5 to reduce child and maternal mortality. MaNHEP sought to strengthen district-wide administrative and health systems to support and continuously improve CMNH care. MaNHEP was led by Emory University, Atlanta, Georgia, in collaboration with JSI Research & Training Institute, Inc., Boston, MA; University Research Company LLC Bethesda, MD, and Addis Ababa University, Ethiopia. MaNHEP was implemented in the Amhara and Oromiya regions at the request of the Federal Ministry of Health.

The Ethiopian Health Extension Program is implemented through health extension workers, who are paid government employees, primarily young women. They have at least a 10th grade education and one year of training on a package of primary health care focusing on preventive and selected curative heath, including maternal and newborn health. Since 2005, the government has trained and deployed more than 33,000 health extension workers to cover rural communities at a ratio of one health extension worker per 2500 persons.[21, 22] Community outreach was supplemented through a network of community health development agents, who operated at a ratio of one per 30 to 50 households. These agents are women and men, who are somewhat older and have more years of education than the health extension workers. MaNHEP focused its efforts on health extension workers and community health development agents and on traditional birth attendants (TBAs) who, in Ethiopia, are older and have less formal education than the other 2 provider groups. The TBAs assist women at birth and during the early postnatal period. While some TBAs learned basic midwifery through short-term biomedical training, most acquire their skills through apprenticeship and experience.

The MaNHEP project design[9] rested on 4 assumptions. First, health extension workers are not likely to be present at birth. Family members and TBAs are most likely to provide care. Second, opportunity exists for entry of health extension workers into the home during birth and during the early post-

natal period, in addition to or in place of TBAs or other less skilled caregivers (eg, untrained family members). Third, this shift will be made more easily by establishing a team comprised of health extension workers, community health development agents, and TBAs—and by introducing a CMNH care package (Table 1) through these care providers. Fourth, an effective team can provide a platform for delivering additional health interventions at the local level.

The project's aim was to learn how best to ensure that the CMNH care package could be provided to "every woman, in time, every time." Toward this aim, MaNHEP pursued 3 objectives: 1) improve the capacity and performance of the team of health extension workers, community health development agents, and TBAs to provide the targeted CMNH care; 2) increase demand for the targeted CMNH care and improve self-care behaviors; and 3) develop and demonstrate the effectiveness of lead *woredas* (districts) to improve CMNH care and services. Lead *woredas* are model districts that are committed and able to continuously improve care and service delivery to meet the needs of childbearing families.

MaNHEP deployed a 3-pronged intervention to achieve its objectives and to influence both supply and demand for CMNH: 1) a CMNH training program, 2) continuous quality improvement, and 3) behavior change communications. The first intervention component, a community training program, aimed at objectives 1 and 2, worked with district health and community stakeholders to teach the CMNH care package. The training program, adapted from the American College of Nurse-Midwives' (ACNM's) Home Based Life Saving Skills program,[23] had 2 components. In a facility-based component, health extension workers were given refresher clinical training for safe, clean birth and postnatal care to build competence and confidence in providing the targeted care. In a community-based component, health extension workers, community health development agents, and TBAs shared their knowledge and expertise in week-long training sessions, acquiring new knowledge and skills to provide better care. After training, community health development agents and TBAs worked in pairs called *"guide teams"* to teach skills (eg, clean birth, safe use of misoprostol [Cytotec], uterine massage to reduce postpartum bleeding after delivery of the placenta, and newborn resuscitation) to women in their second and third trimester of pregnancy and their family caregivers,

who will be present at birth, during community CMNH family meetings.[24]

The second intervention component, continuous quality improvement, was aimed at objectives 2 and 3.[25,26] Quality improvement teams were comprised of community stakeholders including *kebele* (the smallest administrative unit of Ethiopia, similar to a village or neighborhood) council members, priests, agricultural association and women's association leaders, health extension workers, community health development agents, and TBAs. The quality improvement teams used participatory problem solving to generate and test ideas to improve pregnancy identification, antenatal care registration, CMNH family meeting attendance, labor and birth notification, and postnatal care follow-up within 48 hours of birth by a health extension worker. The quality improvement teams engaged in iterative cycles of idea generation and testing and met together 5 times over the course of the project to share their learning. The most successful ideas or solutions across the project's 51 kebeles, considered the best care-delivery processes, were compiled in a CMNH Change Package.[27] Intervention components 1 and 2 were designed to collectively build the capacity of the *woredas* to become lead *woredas*.

The third intervention component, behavior change communications, reinforced objectives 1 and 2. Through culturally appropriate, professionally produced films, radio and TV dramas, songs, and poetry contests, the project sought to influence community demand for improved care and services and to promote teamwork among the health extension workers, community health development agents, and TBAs for better service delivery.

METHODS

MaNHEP was implemented in 3 *woredas* (districts) in each of the 2 regions: North Achefer, South Achefer, and Mecha in the Amhara region, and Degem, Kuyu, and Warejarso in the Oromiya region. Results are presented by region. *Woreda* selection was based on need; population size and number of expected births; accessibility of health services; presence of health extension workers, community health development agents, and TBAs; and the absence of other development partners working on the same or similar issues. MaNHEP focused on a section of each *woreda* consisting of 2 health centers and their associated health posts and all pregnant or newly postpartum women and newborns within the health posts' catchment areas. Overall, MaNHEP implementation encompassed a population of about 350,000 residing in 51 *kebeles*, with about 12,000 births per year.

MaNHEP used an uncontrolled before/after study design, with data for evaluating project level indicators primarily collected from randomly selected respondents through surveys and skills assessments, as well as a quality improvement survey and a verbal autopsy study with a one-year open cohort of pregnant women. Monthly quality improvement monitoring complemented these methods and permitted a degree of data triangulation.

The results for objective 1 indicators are based on data obtained from a health care provider baseline and end-

Table I. Community Maternal and Newborn Health Care Package

Woman

Care Before Birth

Birth preparedness and complication readiness

Promotion of antenatal care

Promotion of CMNH family meeting

Care at Birth

Clean birth

Uterotonics (misoprostol [Cytotec])

Uterine massage

Care After Birth

Breast check

Bleeding check

Trauma check (fistula)

Fever check

Counseling

Breast care

Nutrition (especially fluids)

Personal hygiene

Rest

Uterine massage

Illness recognition and care-seeking

Newborn

Care at Birth

Immediate care (dry, stimulate, keep warm, delay cord clamping)

Color check

Activity check

Feeding check

Care After Birth

Color check

Activity check

Feeding check

Counseling

Promotion of immediate, exclusive

Breastfeeding

Thermal care, kangaroo mother care

Hand-washing

Clean cord care

Illness recognition and care seeking

Case management for pneumonia (where part of national policy)

Abbreviation: CMNH, community maternal and newborn health.

line survey[28,29] and data obtained from clinical skills assessment. The baseline survey was conducted from June through September 2010, and the endline survey was conducted from May through August 2012. The survey questionnaire, which focused on CMNH knowledge, practice, and coverage, was developed in English, translated to Amharic and Oromifa,

back-translated, pretested, and refined before use. It was conducted in the local language by MaNHEP-trained interviewers and involved individual face-to-face interviews with a stratified random sample of 266 (baseline) and 264 (endline) health extension workers, community health development agents, and TBAs. Individuals surveyed were asked which of the CMNH care elements they had provided at the last birth attended (yes or no). The proportion of care elements reported as having been provided, out of a total of 17 care elements, was calculated to measure individual completeness of care. The values were averaged across the individuals surveyed. Individuals surveyed were also asked to self-assess their level of confidence in the ability to provide pregnancy, birth, postpartum, and newborn care on a Likert-type scale (1 = not very confident, 10 = very confident). The values were averaged across the individuals surveyed. Finally, individuals surveyed were asked to self-assess whether they viewed themselves as part of a CMNH care team (yes or no). The proportion of individuals who saw themselves as part of a team, out of the individuals surveyed, was calculated.

The clinical skills assessment focused on labor, birth, and early postnatal care. The assessment was conducted by trained MaNHEP CMNH specialists and involved direct observation using skills checklists. Each health extension worker, community health development agent, and TBA was given a scenario and the appropriate props and was asked to demonstrate how to care for a woman and newborn (eg, helping a newborn breathe using a special resuscitation doll). The skills checklists, part of ACNM's Home-Based Life Saving Skills program,[23] have been used successfully in more than 15 countries, including in the initial field tests of that program in Ethiopia from 2001 to 2004. The baseline pre- and immediate posttraining skills assessment included all 808 health extension workers, community health development agents, and TBAs trained by MaNHEP. The endline postintervention assessment included a stratified random sample of 359 of these workers. Individuals were tested to determine if they could correctly demonstrate the CMNH care steps. The proportion of CMNH care steps correctly demonstrated, among all the care steps in the skills checklist, was calculated for each individual observed to yield a test score. These scores were averaged across the individuals tested.

The results for objective 2 indicators are based on information obtained from a women's baseline and endline survey.[28,29] This survey was comparable to the health care provider survey in content and was conducted by the MaNHEP-trained interviewers during the same time frame. The baseline and endline surveys involved face-to-face interviews with systematic random samples of 1027 and 1019 women, respectively, who gave birth during the year before the survey. Each woman surveyed was asked whether she knew the health extension workers, community health development agents, and TBAs in her own *kebele* (yes or no). The proportion of individuals who knew each provider group, out of the individuals surveyed, was calculated. Each woman surveyed was asked whether she had received each of 17 CMNH care elements at her last birth (yes or no). The proportion of care elements reported as having been received, out of the 17 care elements, was calculated to measure individual completeness

of care. These values were averaged across the women surveyed. Each woman surveyed was asked to self-assess her level of trust in each group to provide CMNH care on a Likert-type scale (1 = least trust, 5 = most trust). The values were averaged across the individuals surveyed. Finally, each woman surveyed was asked whether she had received antenatal care, birth care, and postnatal care (yes or no). For each care component received, she was asked who had provided the care (skilled provider [physician, midwife, or nurse], health extension worker, community health development agent, TBA, unskilled family, friend, or no one), when she received the care (time in relation to pregnancy or birth), and in the case of antenatal care, how often (the number of visits).

The results for objective 3 indicators are derived from data obtained through a variety of sources. The first source was an endline quality improvement survey[30] conducted in October 2012. The CMNH Change Package[27] of successful solutions provided the content of the survey. This survey questionnaire was translated, back-translated, pretested, and finalized before use. A MaNHEP-trained interviewer administered the survey to 51 original quality-improvement teams and 39 new quality-improvement teams, one team per *kebele*. For each area of emphasis, quality improvement teams surveyed were asked if their *kebele* had adopted each improvement idea or solution (yes or no). The proportion of solutions that each *kebele* adopted, out of the number of successful solutions, was calculated. These values were averaged across 51 original *kebeles* and 39 new *kebeles*.

The second data source was a verbal autopsy study conducted by a team of trained interviewers from Addis Ababa University. Verbal autopsy is a research method that uses interviews to determine probable social and medical cause of death when an autopsy is not done, medical records are unavailable or nonexistent, or the person who died received no medical attention. In this study, the mothers and others present at birth (if available) were interviewed using the World Health Organization's 2007 standard verbal autopsy questionnaire,[31] an instrument that had been adapted by others for use in Ethiopia. Relevant to objective 3, this team identified and enrolled a cohort of approximately 9500 pregnant women from March 1, 2011, through February 28, 2012, and followed them through birth. The verbal autopsy data included the dates of birth and death for 175 perinatal deaths among this cohort.[32]

For survey and clinical skills assessment data, simple univariate statistics were used to describe each indicator (proportion, mean, and standard deviation), and bivariate statistical tests, appropriate to level of measurement, to assess regional differences in the indicators. To measure the impact of the program on perinatal mortality (stillbirths and early neonatal deaths), the change in mortality pattern was assessed and documented using a quality assurance analysis referred to as a *statistical control process analysis*, specifically a G-chart that is designed to produce an estimate of units that occur between rare events or of nonconforming incidents (in this case, the number of days between perinatal deaths).[33,34] The G-chart presents the data in terms of mean, standard deviation (sigma 1 and 2), and upper control limit and gives a picture of deaths over time.

RESULTS

Objective 1: Improve Capability and Performance of the Health Extension Worker, Community Health Development Agent, and Traditional Birth Attendant Team to Provide Targeted Community Maternal and Newborn Health Care Services

Almost all health extension workers were aged between 20 and 34 years and on average had 9 to 11 years of education. Most community health development agents and TBAs were older and had more years of education than the health extension workers. More than 90% of the 3 provider groups in each region had some type of MaNHEP training. The level of their participation in training and subsequent activities varied by region. In the Amhara region, of those who had participated in any MaNHEP training, almost all (98%) had taken CMNH training. Some health extension workers (29%) had also participated in the facility-based clinical update. Most health extension workers were involved in conducting CMNH family meetings (96%), and a substantial number were quality improvement team members (72%). Most community health development agents and TBAs were guide team members (79%) and conducted CMNH family meetings (84%). Fewer community health development agents (28%) and TBAs (10%) were involved in a quality improvement team than a guide team.

In the Oromiya region, of those who had participated in any MaNHEP training, most had taken CMNH training (84%). Of note, health extension worker participation in the facility-based clinical update was double that of their Amhara counterparts (62% vs 29%). Many health extension workers were involved in conducting CMNH family meetings (67%). However, fewer reported that they were quality improvement team members (29% vs 72%). Moreover, community health development agent and TBA guide team membership was less than half that of their Amhara counterparts (community health development agents 34% vs 72%, TBAs 31% vs 86%); thus, fewer were involved in CMNH family meetings (community health development agents 43% vs 93%, TBAs 49% vs 82%). At the same time, more community health development agents and TBAs were quality improvement team members compared with their Amhara counterparts (community health development agents 46% vs 28%, TBAs 51% vs 10%).

Indicator 1.1. Community Maternal and Newborn Health Care Steps That Health Extension Workers, Community Health Development Agents, and Traditional Birth Attendants Demonstrated Correctly

There were significant increases in the mean immediate post-training scores over pretraining scores for preventing problems before and after birth (Table 2). Combining the 2 skill sets, the mean pretraining scores for health extension workers, community health development agents, and TBAs ranged from 16% to 27%, while the mean immediate posttraining scores ranged from 78% to 82%.

Importantly, there was no significant degradation in skills at endline assessment. Mean postintervention scores for health extension workers, community health development agents, and TBAs were 72% to 80% and greater than pretraining scores (all $P < .001$). There were small, significant increases in the mean postintervention score for Oromiya health extension workers and TBAs (Table 2).

Indicator 1.2. Community Maternal and Newborn Heath Care Package Elements That Health Extension Workers, Community Health Development Agents, and Traditional Birth Attendants Provided at the Last Birth Attended

There were significant increases in the mean proportion of care elements reported for each provider group from baseline to endline (Table 3). At endline, health extension workers, community health development agents, and TBAs reported that they had provided most CMNH care package elements (97%, 83%, and 91%, respectively).

Indicator 1.3. Health Extension Worker, Community Health Development Agent, and Traditional Birth Attendant Level of Confidence in Ability to Provide Community Maternal and Newborn Health Care

With few exceptions, there were significant increases in the health extension workers', community health development agents', and TBAs' self-assessed level of confidence in their ability to provide the components of CMNH care from baseline to endline (Table 3). At endline, health extension workers, community health development agents, and TBAs had mean self-ratings of 8.8, 8.0, and 8.7 for the combined care components, respectively. Interestingly, unlike endline self-ratings of confidence, the baseline confidence levels were high compared with the actual baseline pretraining test scores.

Indicator 1.4. Health Extension Workers', Community Health Development Agents', and Traditional Birth Attendants' View of Themselves as Part of a Care Team

At endline, almost all health extension workers, community health development agents, and TBAs reported that they viewed themselves as part of a CMNH care team (99%, 97%, and 94%, respectively). For Amhara health extension workers and TBAs in both regions, this represented a significant increase ($P = 0.04$ and $P < .001$, respectively).

Objective 2: Increase Demand for Targeted Maternal and Newborn Health Services and Improved Self-Care Practices

Women surveyed at both baseline and endline were predominantly aged between 20 and 34 years, were multiparous, and had little formal education. More Oromiya women had some education than did Amhara women (35% vs 21%, $P < .001$). More than two-thirds of the women were from land-owning households. By endline, more than half of the women had interacted with MaNHEP guide teams and quality improvement teams and had participated in CMNH family meetings (69% in Oromiya vs 47% in Amhara, $P < .001$). Fewer women reported exposure to the project's behavior change communication strategies (37% in Oromiya vs 18% in Amhara, $P < .001$).

Indicator 2.1. Community Maternal and Newborn Health Care Package Elements Women Received from any Health Extension Worker, Community Health Development Agent, or Traditional Birth Attendant

The mean proportion of the CMNH care package elements that women reported were received from a health extension worker, community health development agent, or TBA at their most recent birth increased from

Table 2. Community Maternal and Newborn Health Care Steps Correctly Demonstrated by Health Extension Workers, Community Health Development Agents, and Traditional Birth Attendants, by Region

Region

Amhara Region

Indicator	Health Extension Workers					Community Health Development Agents					Traditional Birth Attendants				
	Baseline			Endline		Baseline			Endline		Baseline			Endline	
	Pre	Post	P value[a]	Postint	P value[b]	Pre	Post	P value[a]	Postint	P value[b]	Pre	Post	P value[a]	Postint	P value[b]
	(n = 42)	(n = 42)		(n = 36)		(n = 154)	(n = 155)		(n = 59)		(n = 154)	(n = 152)		(n = 62)	
1.1.CMNH care steps demonstrated correctly, mean (SD), %	25.1 (9.0)	82.5 (9.9)	<.001	78.7 (10.7)	.11	13.8 (9.8)	83.1 (15.7)	<.001	66.6 (12.7)	<.001	16.5 (8.9)	80.1 (15.1)	<.001	65.0 (14.6)	<.001

Oromiya Region

Indicator	Health Extension Workers					Community Health Development Agents					Traditional Birth Attendants				
	Baseline			Endline		Baseline			Endline		Baseline			Endline	
	Pre	Post	P value[a]	Postint	P value[b]	Pre	Post	P value[a]	Postint	P value[b]	Pre	Post	P value[a]	Postint	P value[b]
	(n = 51)	(n = 51)		(n = 39)		(n = 183)	(n = 184)		(n = 68)		(v129)	(n = 127)		(n = 45)	
1.1.CMNH care steps demonstrated correctly, mean (SD), %	28.8 (8.3)	77.2 (11.3)	<.001	82.2 (13.7)	.06	18.6 (11.9)	81.3 (11.9)	<.001	79.2 (15.6)	.23	20.7 (10.4)	76.5 (13.5)	<.001	78.9 (11.1)	.24

Abbreviations: CMNH, community maternal and newborn health; Post, immediate posttraining performance testing and pretesting; Postint, postintervention; Pre, pretraining; SD, standard deviation.
[a] Comparison of immediate posttraining performance testing and pretesting.
[b] Comparison of postintervention performance testing and immediate posttraining testing.

Table 3. Completeness of Community Maternal and Newborn Health Care Provided by Health Extension Workers, Community Health Development Agents, and Traditional Birth Attendants and their Level of Confidence to Provide This Care, by Region

Region — Amhara Region

Indicator	Health Extension Workers			Community Health Development Agents			Traditional Birth Attendants		
	Baseline (n = 35)	Endline (n = 46)	P value	Baseline (n = 70)	Endline (n = 46)	P value	Baseline (n = 57)	Endline (n = 50)	P value
1.2. CMNH care package elements[a] provided at last birth attended, mean (SD), %	68.3 (23.2)	95.9 (7.4)	< 0.001	27.8 (20.4)	75.6 (20.9)	<.001	20.0 (18.8)	85.4 (16.9)	<.001
1.3. Level of confidence in ability to provide CMNH care, mean (SD)[b]									
Pregnancy	7.3 (1.6)	8.1 (1.6)	.02	5.9 (2.3)	7.5 (2.2)	<.001	4.1 (2.6)	8.4 (1.7)	<.001
Birth	7.0 (1.7)	8.3 (1.5)	<.001	4.1 (2.6)	7.0 (2.5)	<.001	6.7 (2.2)	8.5 (1.9)	<.001
Postpartum	7.7 (1.8)	8.5 (1.5)	.03	5.7 (2.1)	7.4 (2.2)	<.001	4.4 (2.9)	8.3 (2.1)	<.001
Newborn	8.2 (1.8)	8.3 (1.5)	.63	6.4 (2.4)	7.4 (2.4)	.04	3.9 (3.0)	8.0 (2.6)	<.001

Region — Oromiya Region

Indicator	Health Extension Workers			Community Health Development Agents			Traditional Birth Attendants		
	Baseline (n = 29)	Endline (n = 39)	P value	Baseline (n = 36)	Endline (n = 56)	P value	Baseline (n = 39)	Endline (n = 51)	P value[a]
1.2. CMNH care package elements[a] provided at last birth attended, mean (SD), %	77.1 (17.7)	98.4 (5.8)	<.001	54.2 (20.0))	90.0 (16.0)	<.001	63.5 (24.4)	96.8 (7.9)	<.001
1.3. Level of confidence in ability to provide CMNH care, mean (SD)[b]									
Pregnancy	8.9[c] (1.7)	9.5 (1.0)	.09	7.3 (2.3)	8.6 (2.2)	.01	7.2 (2.6)	9.1 (1.4)	<.001
Birth	7.4 (2.5)	9.0 (1.6)	.002	6.7 (2.7)	8.6 (2.3)	<.001	7.0 (2.7)	9.0 (1.6)	<.001
Postpartum	8.8 (2.1)	9.3 (1.3)	.21	6.9 (2.6)	8.6 (2.4)	.002	6.9 (2.4)	9.3 (1.2)	<.001
Newborn	8.3 (2.2)	9.6 (0.7)	<.001	7.4 (2.0)	8.9 (2.1)	.12	7.2 (2.1)	9.2 (1.4)	<.001

Abbreviations: CMNH, community maternal and newborn health; SD, standard deviation.
[a] CMNH care package includes 17 elements.
[b] Confidence was measured on a 10-point Likert scale: 1 = not at all confident, 10 = extremely confident.

baseline to endline (Amhara 18%-70% and Oromiya 43%-87%, $P < .001$ for both). At endline, women reported having received 79% of elements, which was only slightly lower than that reported by health extension workers, community health development agents, and TBAs. Compared with the Amhara region, the mean proportion of care elements that were received by Oromiya women was higher (87% vs 70%, $P < .001$).

Indicator 2.2. Women Who Knew the Health Extension Workers, Community Health Development Agents, and Traditional Birth Attendants in Their Own Kebele

There were significant increases from baseline to endline in the proportion of women who reported that they knew the health extension workers, community health development agents, and TBAs in their own *kebele* (Table 4). At endline, most women knew the health extension workers (91%) and TBAs (92%) in their *kebele*. Compared with women in Amhara, more women in Oromiya knew the community health development agents in their *kebele* (89% vs 56%, $P < .001$).

Indicator 2.3. Women's Level of Trust in Health Extension Workers, Community Health Development Agents, and Traditional Birth Attendants to Provide Community Maternal and Newborn Health Care

With one exception (Amhara women's level of trust in TBAs to provide pregnancy care), women's self-assessed level of trust in health extension workers, community health development agents, and TBAs to provide the components of CMNH care increased significantly from baseline to endline (Table 4). At endline, the mean self-ratings for trust in health extension workers, community health development agents, and TBAs to provide the combined care components were 4.2, 3.9, and 3.8, respectively (1 = least trust, 5 = most trust).

Indicator 2.4. Women's Use of Community Mental and Newborn Health Services

Antenatal Care

Significant increases in the proportion of women who reported having received any antenatal care and who received 4 or more antenatal care visits were observed from baseline to endline in both regions (Table 5). At endline, 86% of women reported having received any antenatal care and 51% of women had received 4 or more visits. About half of those reporting any visits (54%) received the first visit in the second trimester of pregnancy. In Amhara, a significant increase in first visits in the first trimester (15%-30%, $P < .001$) brought the rate of first trimester visits up to that observed in Oromiya. The use of skilled providers (physician, nurse, midwife) for antenatal care decreased significantly in both regions (Amhara 72%-54%, Oromiya 49%-38%) while use of health extension workers increased (Amhara 19%-44%, Oromiya 42%-61%).

Birth Care

The pattern of birth care varied by region. In Amhara, women's use of skilled providers and health extension workers for care increased significantly from baseline to endline (Table 5). At endline, 18% of women used a skilled provider and 19% of women used a health extension worker. Use of TBAs also increased significantly (12%-40%), while use of family and other unskilled providers decreased significantly (77%-23%). Thus, in Amhara, there was a shift from family and other unskilled birth attendants to more highly skilled providers for birth care. Thirty-seven percent of women used either a skilled provider or a health extension worker in 2012, compared with 10% in 2010 ($P < .001$). Moreover, 17% of births occurred in a health facility in 2012, compared with 6% in 2010 ($P < .001$).

In Oromiya, women's use of skilled providers and health extension workers for birth care remained essentially unchanged from baseline to endline. At endline, 14% of women used a skilled provider while 9% used a health extension worker. However, their use of community health development agents and TBAs increased (community health development agents 3%-10%, TBAs 28%-47%, both $P < .001$) while their use of family and other unskilled providers decreased (46%-20%, $P < .001$). There was little change in the proportion of women who used a health facility for birth (14%).

Postnatal Care

There were large, significant increases in the proportion of women and newborns who received any postnatal care from baseline to endline in both regions (Table 5). In the Amhara and Oromiya regions, respectively, the use of skilled providers did not change significantly, but the use of health extension workers increased substantially (46%-70% and 31%-59%, respectively). At endline, 84% of Amhara and 77% of Oromiya women used a skilled provider or health extension worker for postnatal care. The use of family and other unskilled providers decreased (both regions 56%-2%, both $P < .001$). Of all women and newborns who received any postnatal care, the majority received it within 48 hours of birth.

Objective 3: Demonstrate a Lead *Woreda* to Improve Community Maternal and Newborn Health Services.

Indicator 3.1. Successful Solutions to Community Maternal and Newborn Health Care Delivery Adopted by New Kebeles

Most of the successful solutions for improving pregnancy identification, antenatal care registration, and labor-birth notification and postnatal care follow-up were adopted by original and new *kebeles* (Table 6). Ideas for improving CMNH family meeting attendance were not relevant for new *kebeles* due to a change in Federal Ministry of Health strategy.

Indicator 3.2. Number of Days Between Perinatal Deaths

The G-chart (Figure 1) shows that there was a significant increase in the number of days between the 175 perinatal deaths, beginning about 9 months after the rollout of CMNH family meetings and quality improvement activities. By one year, the interval between deaths began to exceed the upper control limit, indicating that there was some special cause for the variation, not normal monthly fluctuations in the frequency of deaths.

Table 4. Completeness of Community Maternal and Newborn Health Care Women Reported That They Received From Health Extension Workers, Community Health Development Agents, and Traditional Birth Attendants, and Women's Knowledge of and Trust in These Groups to Provide This Care, by Region

Indicator	Region								
	Amhara Region (Baseline n = 493; Endline n = 479 women)								
	Health Extension Worker			**Community Health Development Agent**			**Traditional Birth Attendant**		
	Baseline	Endline	P value	Baseline	Endline	P value	Baseline	Endline	P value
2.2. Women know health extension worker, community health development agent, or traditional birth attendant in own kebele, %	59.0	87.7	<.001	16.1	55.7	<.001	76.9	90.2	<.001
2.3. Women's level of trust in health extension worker, community health development agent, or traditional birth attendant to provide CMNH care, mean (SD)[a]									
Pregnancy	3.3 (1.6)	4.3 (0.9)	<.001	2.4 (1.5)	3.7 (1.1)	<.001	3.5 (1.5)	3.6 (1.0)	.08
Birth	3.1 (1.6)	4.2 (0.9)	<.001	2.3 (1.5)	3.7 (1.1)	<.001	4.0 (1.3)	3.8 (1.2)	.01
Postpartum	3.1 (1.6)	3.9 (1.0)	<.001	2.5 (1.5)	3.5 (1.1)	<.001	3.2 (1.5)	3.5 (1.1)	<.001
	Oromiya Region (n, Baseline n = 534; Endline n = 540)								
	Health Extension Worker			**Community Health Development Agent**			**Traditional Birth Attendant**		
	Baseline	Endline	P value	Baseline	Endline	P value	Baseline	Endline	P value
2.2. Women know health extension worker, community health development agent, or traditional birth attendant in own kebele, %	80.1	94.6	<.001	26.3	88.5	<.001	76.4	92.8	<.001
2.3. Women's level of trust in health extension worker, community health development agent, or traditional birth attendant to provide CMNH care, mean (SD)[a]									
Pregnancy	3.8 (1.0)	4.4 (0.8)	<.001	3.1 (1.1)	4.2 (1.0)	<.001	3.0 (1.2)	4.0 (1.2)	<.001
Birth	3.6 (1.2)	4.2 (1.1)	<.001	3.1 (1.1)	4.0 (1.1)	<.001	3.2 (1.2)	4.1 (1.1)	<.001
Postpartum	3.6 (1.2)	4.2 (1.0)	<.001	3.1 (1.1)	4.0 (1.1)	<.001	2.9 (1.3)	3.9 (1.2)	<.001

Abbreviations: CMNH, community maternal and newborn; SD, standard deviation.
[a] Includes only women who reported knowing the health extension workers, community health development agents, or traditional birth attendants in their own *kebele* (the smallest administrative unit of Ethiopia, similar to a village or neighborhood). Trust was measured on a 5-point Likert scale: 1 = least trust, 5 = most trust.

MNH Service Use	Amhara Region			Oromiya Region			Endline P value Amhara vs Oromiya[b]
	Baseline, % (n = 493)	Endline, % (n = 479)	P value[a]	Baseline, % (n = 534)	Endline, % (n = 540)	P value[a] B vs E	
Antenatal care received[c]							
Any visits	47.5	81.8	< .001	49.4	90.5	< .001	< .001
4 or more visits	12.2	52.2	< .001	19.8	52.5	< .001	.92
Antenatal care provider[d]							
Skilled provider	71.5	53.5	< .001	48.6	37.5	.003	< .001
Health extension worker	18.7	44.4	< .001	42.4	60.7	< .001	< .001
Community health development agent	0.5	0.3	.69	1.2	1.2	.95	.12
Traditional birth attendant	1.9	1.6	.81	6.3	0.6	< .001	.16
Family, friend, other	7.5	0.3	< .001	1.6	0	< .001	.26
Timing of first antenatal visit[e]							
First trimester	15.4	30.4	< .001	35.0	33.3	.63	.36
Second trimester	66.4	53.7	.003	51.2	54.8	.35	.73
Third trimester	18.2	16.0	.48	13.8	11.9	.47	.08
Birth care provider[f]							
Skilled provider	7.1	18.4	< .001	12.7	13.6	.67	.04
Health extension worker	3.1	19.1	< .001	11.3	8.7	.18	< .001
Community health development agent	0.4	2.1	.03	2.8	10.4	< .001	< .001
Traditional birth attendant	12.0	37.9	< .001	27.5	47.4	< .001	.003
Family, friend, other	77.3	22.5	< .001	45.7	19.9	< .001	.32
Place of birth[g]							
Home	93.9	82.3	< .001	86.7	85.2	.47	.21
Health facility	6.1	17.3	< .001	12.1	13.5	.50	.09
Other	0.0	0.4	.15	1.2	1.3	.83	.14
Postnatal care received[h]	11.6	72.0	< .001	36.7	77.6	< .001	.04
Postnatal care provider[i]							
Skilled provider	12.3	14.8	.84	23.6	17.9	.10	.28
Health extension worker	46.3	70.4	.003	31.3	58.6	< .001	< .001
Community health development agent	5.1	3.5	.64	6.5	6.7	1.0	.05
Traditional birth attendant	22.8	9.3	.006	30.8	15.1	< .001	.02
Family, friend, other	56.1	2.0	< .001	56.4	1.7	< .001	.79
Timing of postnatal care, within 48 hours of birth[j]	100.0	59.3	< .001	100.0	65.2	< .001	0.05

Table 5. Women's Use of Antenatal Care, Birth Care, and Postnatal Care Services by Region

[a]Comparison of baseline and endline data within region.
[b]Comparison of endline data between regions.
[c]Women who reported antenatal care, minus missing data. Oromiya region baseline n = 530; endline n = 539.
[d]Women who reported antenatal care and reported provider, minus missing data. Amhara region baseline n = 214; endline n = 376. Oromiya region baseline n = 255; endline n = 488.
[e]Women who reported antenatal care and reported trimester initiated, minus missing data. Amhara region baseline n = 214; endline n = 382. Oromiya region baseline n = 254; endline n = 487.
[f]Women who reported birth care, minus missing data. Amhara region baseline n = 450; endline n = 435. Oromiya region baseline n = 433; endline n = 528.
[g]Women who reported birth care, minus missing data. Amhara region baseline n = 490; endline n = 479. Oromiya region baseline n = 520; endline n = 540.
[h]Due to missing data, Amhara region baseline n = 491 and endline n = 479. Oromiya region baseline n = 532; endline n = 539.
[i]Women who reported postnatal care (for mother or newborn), minus missing data. Amhara region baseline n = 57; endline n = 345. Oromiya region baseline n = 195; endline n = 418.
[j]Women who reported postnatal care (for mother or newborn), minus missing data. Amhara region baseline n = 57; endline n = 479. Oromiya region baseline n = 195; endline n = 538.

Table 6. Successful Solutions to Ensure Timely Community and Maternal Newborn Health Care Used by Original and New *Kebeles*,[a] by Region

Indicator	Original *Kebeles*			New *Kebeles*	
3.1. Successful solutions used by original new *kebeles*, mean, %	Amhara (n = 27)	Oromiya (n = 24)	Total (n = 51)	Oromiya Pilot (n = 5)	Total (n = 39)
Pregnancy identification					
Develop system for tracking new pregnancies (3 ideas)	94.4	96.3	95.3	93.3	92.3
Build awareness or importance of pregnancy disclosure, care (4 ideas)	69.9	99.1	85.3	85.0	88.5
Ask about possible pregnancies in community (4 ideas)	96.9	92.6	94.6	85.0	88.4
Observe woman's behavior for signs of pregnancy (4 ideas)	85.4	65.7	75.0	85.0	62.2
Antenatal care registration					
Build awareness, knowledge about benefits of antenatal (3 ideas)	95.8	98.8	97.4	100	93.2
Reorganize antenatal service delivery to allow increased access (3 ideas)	97.2	97.5	97.4	86.7	86.3
Establish system of monitoring, follow-up pregnant women (3 ideas)	100	98.8	99.3	100	91.4
Provide social, moral support for women in using services (3 ideas)	76.4	98.8	87.6	80.0	82.1
CMNH family meeting attendance					
Build awareness for CMNH family meetings (3 ideas)	100	100	100	NA	NA
Schedule CMNH family meetings (2 ideas)	92.9	100	94.1	NA	NA
Monitor that CMNH family meetings are conducted (2 ideas)	100	100	100	NA	NA
Labor and birth notification and postnatal follow-up					
Build family awareness of benefit of notifying health extension worker (1 idea)	100	100	100	100	100
Organizing volunteer to notify health extension worker (1 idea)	95.8	96.3	96.1	60.0	69.2
Using technologies, other communication mechanisms (1 idea)	93.6	92.6	93.1	80.0	69.3

Abbreviations: CMNH, community maternal and newborn health; NA, the ideas related to CMNH family meetings contained in the Change Package were not relevant because we changed the structure of CMNG family meeting attendance (i.e., we could not do a strict comparison of original and new *kebeles*).
[a] *Kebele* is the smallest administrative unit of Ethiopia, similar to a village or neighborhood.

Indicator 3.3. Community Maternal and Newborn Health Package Approved and Adopted by Federal Ministry of Health and Regional Health Bureaus

In March 2012, the Amhara and Oromiya regional health bureaus and *Woreda* health offices requested the integration of MaNHEP's CMNH package into the revised government Health Extension Program and Primary Health Care Unit structure, with a pilot test of scale-up in new *kebeles* within the current project *woredas*, where this structure is functional. Discussions of potential regional scale-up are underway, even after the official close of the project in May 2013.

DISCUSSION

MaNHEP's theory of action proposed that increasing the provision of essential CMNH care in and around the time of birth through improved interactions (more, better, and more equitable) between the team of health extension workers, community health development agents, and TBAs and childbearing women and families would contribute to increased maternal and newborn health and well-being, as well as to reduced mortality and morbidity. Compared with the project's formative research[35] and baseline survey,[28] which together revealed a very limited role and involvement of
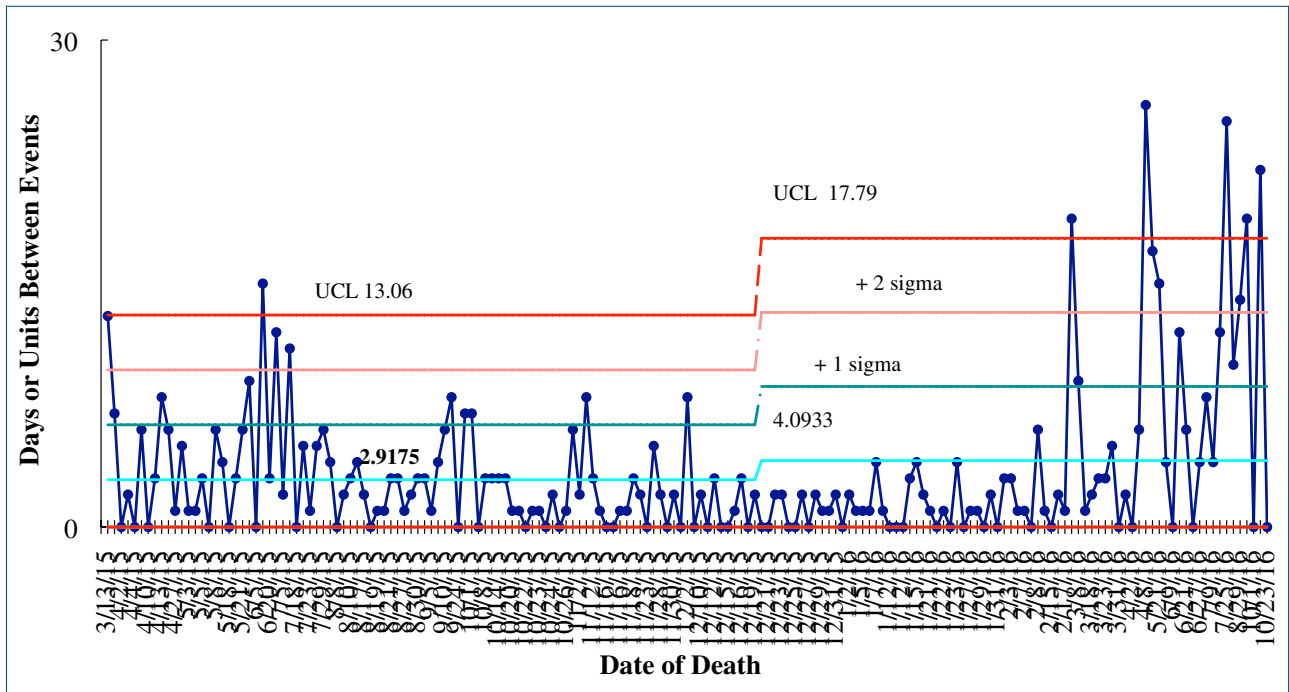
Figure 1. Number of Days Between Perinatal Deaths

This G-chart is designed to produce an estimate of the number of days between perinatal deaths. The data are presented in terms of the mean, standard deviation (sigma 1 and 2), and UCL and gives a picture of the change in the number of deaths over time. A significant shift in the mean number of days between deaths occurred in December 2012. The data points that exceed the upper control limit indicate that the observed increase in the number of days between deaths is due to some special cause and not normal variation.

Abbreviation: UCL, upper control limit.

health extension workers, community health development agents, and TBAs in CMNH care, the observed improvements by endline are striking.

The first project objective—improve the capacity and performance of a team of health extension workers, community health development agents, and TBAs to provide targeted maternal and newborn health services—was met. The project recorded substantial improvements in the completeness of the CMNH care that they provided at the most recent birth attended, in both their demonstrated ability and self-reported confidence to provide this care, and in their sense of being part of a care provider team.

The second objective—increase the demand for targeted CMNH services and improved self-care practices—was also met. There were significant improvements in women's awareness of and trust in the health extension workers', community health development agents', and TBAs' ability to provide care and in the completeness of care that women reported receiving from these providers at their most recent birth. Moreover, women's use of skilled providers and health extension workers for antenatal and postnatal care services and timing of these services improved substantially. There was a shift toward the use of providers with a higher level of skills for birth care, but this shift differed in the 2 regions. There were increases in Amhara women's use of skilled providers (7%-18%), health extension workers (3%-19%), and health facilities (6%-17%), but there were no comparable increases in Oromiya. In both regions, however, there were increases in the use of trained TBAs, coupled with substantial decreases in reliance on family members and other unskilled providers for birth care. These

improvements in women's use of skilled providers and health extension workers are very encouraging and in line with national priorities and policies, particularly the engagement of health extension workers in ambulatory care.[19–21] With respect to maternal health, there is a clear need for continued improvement, particularly with regard to the use of skilled providers and an appropriate use of health facilities for normal birth and emergency obstetric care.[36] For rural communities in Ethiopia, this transition to facility-based care will take time.

The third objective—demonstrate the effectiveness of lead *woredas*—was met. The large majority of successful local solutions to improve pregnancy identification, antenatal care registration, labor and birth notification, and postnatal care follow-up within 48 hours were adopted by the original and new project *kebeles*. The significant increase in number of days between perinatal deaths in the context of increased exposure to the project interventions also suggests a positive association between key intervention components (CMNH family meetings and quality improvement activities) and improved perinatal outcomes. The role of the behavior change component in this result is unclear, given a later implementation. Finally, discussions of potential regional scale-up are being held.

MaNHEP was a learning project, implemented in *woredas* where there were no other organizations with projects focusing on CMNH. Evaluation of the project objectives was based on an uncontrolled before/after study design, with data for project-level indicators collected through baseline and endline knowledge, practice, coverage surveys

and clinical skills assessments,[28,29] a quality improvement survey,[30] and a verbal autopsy study.[31] While the uncontrolled before/after design is appropriate for a learning project, the limitations of this design are well known and include a variety of threats to internal validity.[37] This design can be used to determine the magnitude and direction of a change, but it does not permit attribution to some or all of the components or to external factors. As with all self-report methods, the survey and verbal autopsy data are subject to recall and social desirability biases. However, the baseline and endline surveys[28,29] anchored the monthly quality-improvement monitoring that tracked changes in selected indicators, including CMNH family meeting attendance, antenatal care registration, labor-birth notification, and postnatal care follow-up over the course of the project before the endline survey. This monthly monitoring also documented the solutions that were tested by the quality improvement teams and that were associated with the observed changes. MaNHEP also facilitated and documented regularly occurring learning sessions and coaching visits. Finally, MaNHEP tracked completeness of CMNH care through quarterly interviews with random samples of 10% of women who gave birth in the previous 3 months and whose births were reported to the health extension workers. The change observed between baseline and endline surveys was consistent with the change observed in monthly quality-improvement monitoring and quarterly birth audits. This consistency increases confidence in the findings.

Several features of MaNHEP's model were essential to its success. First were the partnership, leadership, and active engagement of the Ministry of Health and local communities. Regional health bureaus and zonal health departments provided political leadership and support, while a variety of *Woreda* health office, health center, and health post leaders and staff actively participated in the CMNH training as well as quality improvement training, learning sessions, and monthly coaching of guide teams and quality improvement teams. Moreover, the project was implemented within a national policy environment that prioritized achievement of Millennium Development Goals 4 and 5, creating a shared vision that enhanced the partnership.

Second, the project operated from focused, mutually reinforcing objectives and skills-based intervention (CMNH clinical training and CMNH family meetings, continuous quality improvement, and behavior change communications) that targeted and linked pregnant women and those who will be present at birth, relevant community groups, and the health sector at different levels. The model was tightly integrated horizontally (through activities) and vertically (through actors) to improve care during and around the time of birth, and it included built-in mechanisms for ongoing support and supervision. MaNHEP's CMNH content is similar to other community-based programs that aim to reduce maternal and/or newborn morbidity and mortality and improve health outcomes. However, the model of integration differs from intervention packages that have been implemented by a range of community health workers, such as programs that consist primarily of building community support groups/women's groups; community mobilization, antenatal,

and postnatal home visits; antenatal care and TBA training for home birth care; community mobilization and home-based newborn care; or home-based newborn care by itself.[38]

Third, the project emphasized continuous, collaborative learning. While the desired general outcome of each component intervention was predetermined, the processes for achieving each outcome were not. Those processes evolved through an organic development of local ideas about how best to ensure that women and their newborns receive the targeted care. The project created a space for dialogue, development of trust, change, and local ownership.

Finally, MaNHEP demonstrated an ability to adapt to a changing policy landscape. Midway through implementation, the Federal Ministry of Health dramatically modified the Health Extension Program structure. In 2012, a volunteer health development army was launched with the goal of creating a network structure ensuring one volunteer per 5 households. The health development army is supervised by health development army team leaders (also part of the network) who, in turn, are supervised by *woreda* health center specialists (for administrative support) and health extension workers (for technical support). This new structure is in various stages of implementation nationally. Because MaNHEP's structure is similar to the new health development army structure (in its sub-*kebele* level guide teams, *kebele*-level quality improvement teams, and work with the chain of government health agencies), adaptation and integration is occurring in new *kebeles* within the project area *woredas* in a relatively seamless manner at the request of the regional health bureaus. MaNHEP's model is adaptable and potentially scalable.

Future program and research efforts might include the addition and evaluation of other primary health care components to the model. A detailed qualitative study of factors associated with the differential development of motivation, self-efficacy, and empowerment of those participating in the project interventions, including *woreda* administration, quality improvement coaches, health extension workers, community health development agents, TBAs, women, and families, would be helpful. Insights on these more intangible benefits of participation and their sustainability would help to inform interventions that strengthen the health extension program and primary health care unit structure in Ethiopia. Given MaNHEP's achievements, we suggest that next steps include a high-quality cluster randomized controlled trial that includes cost-effectiveness. This is important for Health Extension Program policy and programming in Ethiopia and would contribute to the growing body of research on the effectiveness of CMNH care.

CONCLUSION

MaNHEP's integrated model was associated with more and better interactions among health extension workers, community health development agents, TBAs, and pregnant and postpartum women and their families; improved coverage and completeness of CMNH care; and improved perinatal survival. The model is adaptable and potentially scalable, and it should be further evaluated.

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CONFLICT OF INTEREST

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