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International Journal of Gynecology and Obstetrics

journal homepage: www.elsevier.com/locate/ijgo



CLINICAL ARTICLE

Evaluation of a novel training package among frontline maternal, newborn, and child health workers in South Sudan

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ARTICLE INFO

Article history:

Received 27 January 2012

Received in revised form 11 May 2012

Accepted 24 June 2012

Keywords:

Child health
Maternal health
Midwifery
Newborn health
South Sudan
Traditional birth attendant
Training package

ABSTRACT

Objective: To develop, implement, and evaluate an evidence-based Maternal, Newborn, and Child Survival (MNCS) package for frontline health workers (FHWs) in South Sudan. **Methods:** A multimodal needs assessment was conducted to develop a best-evidence package comprised of targeted training, pictorial checklists, and reusable equipment and commodities. Implementation utilized a training-of-trainers model. Program effectiveness was assessed through knowledge assessments, objective structured clinical examinations (OSCEs), focus groups, and questionnaires. **Results:** A total of 72 trainers and 708 FHWs were trained in 7 South Sudan states. Trainer knowledge assessments improved significantly: from 62.7% to 92.0% ($P < 0.001$). Mean FHW scores on maternal OSCEs were 21.1% pre-training, 83.4% post-training, and 61.5% 2–3 months after training ($P < 0.001$). Corresponding mean newborn OSCE scores were 41.6%, 89.8%, and 45.7% ($P < 0.001$). Questionnaires revealed high levels of use, satisfaction, and confidence. FHWs reported an average of 3.0 referrals (range, 0–20) to healthcare facilities during the 2–3 months following training, and 78.3% of FHWs were more likely to refer patients. Seven focus groups showed high satisfaction with trainings, commodities, and checklists, with few barriers. **Conclusion:** The MNCS package has led to improved FHW knowledge, skills, and referral. A novel package of training, checklists, and equipment can be successfully implemented in resource-limited settings and enhance links between community-based providers and healthcare facilities.

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1. Introduction

Worldwide, pregnant women, newborns, and children under 5 years of age are among the most vulnerable segments of society, particularly in low-resource countries [1]. They carry a disproportionately large burden of global disease and death. Cost-effective solutions have been developed to prevent or save many of these lives [2,3]. However, the vast majority of maternal, newborn, and child (MNC) deaths are occurring in resource-limited settings far from well-established health facilities and fully trained health personnel [4,5].

One leading approach for reducing maternal and newborn mortality has been to encourage every pregnant woman to deliver in a health facility among adequately skilled birth attendants [6]. To help achieve this aim, significant efforts are focusing on increasing MNC

capacity among skilled birth attendants, such as midwives, nurses, and physicians.

However, in some low-resource settings, this cadre of skilled birth attendants is nearly nonexistent and may take decades to effectively establish [7,8]. Therefore, while efforts are underway to develop a skilled workforce, training of unskilled birth attendants may be necessary [9,10]. One such setting is South Sudan, which suffers from the world's worst maternal mortality and is among countries with the worst newborn and child mortality [11]. Emerging from nearly 50 years of conflict and neglect, South Sudan's health infrastructure is severely limited, and there are fewer than 250 physicians for this country of over 8 million people [12]. Up to 90% of births in South Sudan are occurring at home, attended by community-based unskilled birth attendants such as traditional birth attendants [13].

Given the large number of ongoing deliveries among unskilled birth attendants in South Sudan and many other low-resource countries, and given the anticipated time it will take to build sufficient health infrastructure and skilled workforce, the aim was to build appropriate capacity among current community-based providers, or

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frontline health workers (FHWs). In partnership with the Ministry of Health of South Sudan, an evidence-based package for improving MNC survival among these providers was developed, implemented, and critically evaluated. The hypothesis was that FHWs could be trained and equipped to prevent, initially manage, and refer the leading causes of morbidity and mortality in these settings.

2. Materials and methods

The development and contents of this Maternal, Newborn, and Child Survival (MNCS) package have been described previously [14]. In brief, under the direction of the Ministry of Health of South Sudan, a formal multimodal assessment of MNC health needs in South Sudan was conducted in August to September 2010. The needs assessment utilized semistructured key informant interviews, focus group discussions, health facility checklists, and assessments of local health provider knowledge and practices.

Based upon assessment findings, an evidence-based MNCS package for FHWs was developed and was comprised of: (1) a targeted training course; (2) pictorial checklists to guide prevention, care, and referral; and (3) reusable medical equipment and commodities (Table 1, Fig. 1). Program implementation began in November 2010 and utilized a training-of-trainers model. With the assistance of federal and state ministries of health, trainers were recruited and empowered to teach and supervise community-based FHWs. Each FHW received a complete set of equipment, commodities, and checklists.

Table 1

Components of the Maternal, Newborn, Child Survival package for frontline health workers.

Components	Description
1. Targeted training course	8-day training course for local trainers 5-day training course for FHWs Trainer's manual Trainer's flipchart Maternal and newborn training mannequins for trainers ^a
2. Pictorial checklists to guide prevention, care, and referral	Healthy pregnancy and prenatal care referral Danger signs during pregnancy Preparing for delivery Danger signs during labor Bleeding after delivery Newborn care Danger signs in children Diarrhea and vomiting Child malnutrition
3. Reusable medical equipment and commodities	Laminated checklists (see above) Reusable newborn bag-and-mask device Reusable newborn suction device Scissors, with sharpening stone String (for tying umbilical cord) Blood pressure cuff Intrauterine balloon (composed of Foley catheter, large condom, 60-mL syringe, and string ties) [15–17] Gloves Thermometer and hourglass MUAC tapes MUAC training cylinders (for trainers) MNCS backpack and t-shirt (and duffle bag for trainers)

Abbreviations: FHWs, frontline health workers; MUAC, mid-upper arm circumference; MNCS, maternal, newborn, child survival package.

^a The maternal mannequin consists of common household materials, including a pillow (representing the maternal abdomen) surrounding an empty 1-L plastic water bottle (representing the uterus). For the newborn mannequin, the training utilizes the affordable NeoNatalie mannequin developed for the Helping Babies Breathe initiative [18].

In addition to these items, every trainer was also provided with a training manual, flipchart, and newborn mannequin.

Focused monitoring and evaluation were conducted during the first 6 months of program implementation in the southeast state of Eastern Equatoria, which was the first state to receive the country-wide training package.

To help ensure trainer mastery of training materials, a 20-question written knowledge assessment was administered to local trainers before and after their training. Prior to receiving a trainer certificate and materials, each trainer was also required to show mastery of all curriculum skills.

Among the FHWs, most of whom were nonliterate, understanding of the training material was assessed with objective structured clinical examinations (OSCEs) administered pretraining, immediate post-training, and several months post-training. OSCEs evaluated management and referral of postpartum hemorrhage and management of newborn asphyxia.

Focus group discussions assessed the impact of the training package on FHW practices and perceptions. Discussions were held several months post-training among all identified FHWs trained in Eastern Equatoria. The authors conducted semistructured discussions with the assistance of trained local translators. Discussions were recorded and transcribed in preparation for analysis.

Lastly, concurrent with the follow-up OSCEs and focus group discussions several months post-training, closed-response questionnaires were administered to identified FHWs in Eastern Equatoria. Seven-page questionnaires assessed FHW post-training experiences, practices, outcomes, satisfaction, confidence, and knowledge. Given the nonliteracy of participating FHWs, questionnaires were administered verbally in the local language by trained local research assistants.

Quantitative analysis involved standard descriptive analyses using SPSS version 19 (IBM, Armonk, NY, USA) and Microsoft Excel 2011 (Redmond, WA, USA). Analyses of closed-response questionnaires included measures of central tendency (mean), analyses of variance (standard deviation), and frequency statistics. Descriptive statistics and 2-way paired *t* tests were determined for OSCEs pretraining, immediately after training, and at follow-up. *P*<0.05 was considered statistically significant.

Standard qualitative analyses were conducted using qualitative research software, NVivo 9 (QSR International, Melbourne, Australia), to organize and code the focus group transcripts. A pair of researchers independently coded the transcripts for emergent findings, followed by the full research team performing consensus coding and developing the final set of key themes.

Prior approval for this work was obtained from the Ministry of Health of South Sudan.

3. Results

The initial needs assessment involved 33 FHWs, 8 diverse health facilities in Eastern Equatoria, and stakeholders within 18 governmental and nongovernmental organizations. Overall, the assessment revealed a severely limited MNC workforce, with the vast majority of care being provided by community-based FHWs. FHWs typically had no formal education, were nonliterate, and had received very little or no medical training. Medical supply lines were unreliable and stock-outs of essential medications and supplies regularly existed for up to 1 year or more. FHWs commonly reported traditional practices, many of which ran counter to conventional medical practice. Communication with and referral to health facilities was significantly limited among community-based FHWs. Nevertheless, FHWs were deeply committed to their work, eager to learn new approaches, and frequently well respected and appreciated by their communities.

Between November 2010 and October 2011, a total of 72 local trainers and 708 FHWs were trained in 7 of the 10 states of South Sudan (Fig. 2). Trainers were local nurses (26.4%), midwives (20.8%), clinical officers (19.4%), medical officers (11.1%), and others



Fig. 1. Reusable equipment and commodities and an example of the pictorial checklists for frontline health workers.

(22.2%). Trainees consisted of community-based traditional birth attendants (64.5%), maternal-child-health workers (14.0%), community midwives (8.7%), community health workers (8.3%), and others (1.0%). Other trainee demographics included a mean age of 42.7 ±

9.6 years, a mean of 11.6 ± 10.4 years of MNCH experience, and a median of 76 total career deliveries (interquartile range, 21–250).

To ensure trainers received the essential information, knowledge assessment scores were obtained immediately before and after

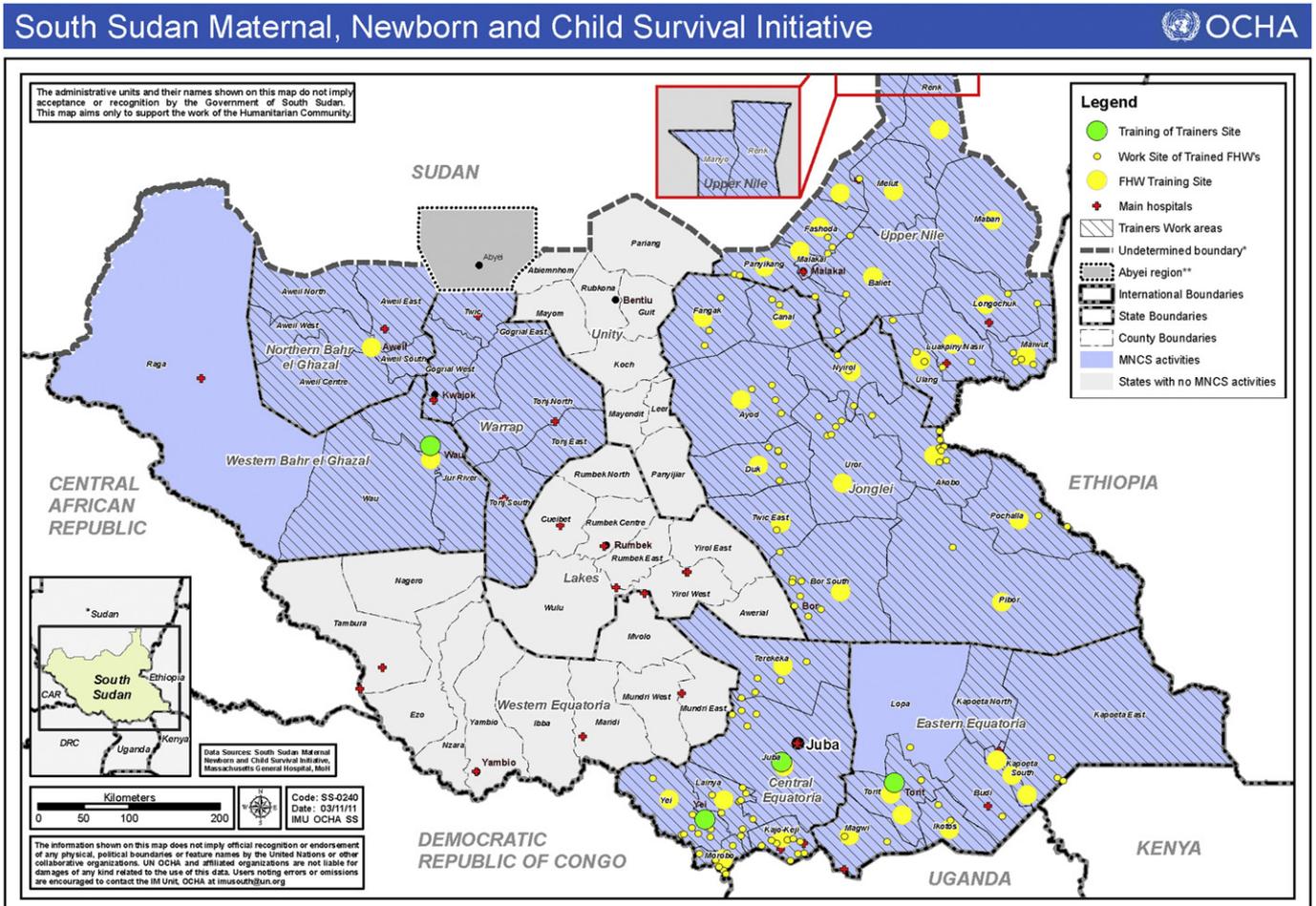


Fig. 2. Distribution of local trainers and frontline health workers trained in South Sudan (Permission to reproduce this figure granted by the United Nations Office for the Coordination of Humanitarian Affairs, South Sudan Office [19]).

Table 2

Frontline health workers' (n = 55) skills test results before training, after training, and at 2–3 months follow-up.^{a,b}

Assessment	Pretraining	Post-training	Follow-up
Maternal OSCE	21.1 ± 13.8	83.4 ± 21.5	61.5 ± 25.8
Newborn OSCE	41.6 ± 16.5	89.8 ± 14.0	45.7 ± 23.1

Abbreviation: OSCE, objective structured clinical examination.

^a Values are given as mean ± SD.

^b Paired *t* tests between pretraining/post-training scores and between post-training/follow-up scores for maternal and newborn OSCEs showed significance at *P* < 0.001.

training-of-trainer courses. Trainer scores (n = 57) improved significantly, from 62.7% ± 20.1% to 92.0% ± 11.8% (*P* < 0.001).

Pre- and post-training OSCEs were conducted among the first 73 trained FHWs in 5 counties in Eastern Equatoria. Among these, 55 (75.3%) were located in their communities for follow-up OSCEs 2–3 months (mean, 83.0 days) after their initial training (Table 2). Mean scores on the maternal OSCE (postpartum hemorrhage scenario) were 21.1% ± 13.8% pretraining, 83.4% ± 21.5% immediately post-training, and 61.5% ± 25.8% at follow-up (paired *t* tests *P* < 0.001). On the newborn OSCE (newborn asphyxia scenario), mean scores were 41.6% ± 16.5% pre-training, 89.8% ± 14.0% immediately post-training, and 45.7% ± 23.1% at follow-up (paired *t* tests *P* < 0.001).

Seven focus group discussions were conducted involving 41 of the FHWs trained in Eastern Equatoria (response rate 56.2%). These FHWs had completed training, on average, 83 days prior to the discussions. Qualitative analysis of the transcriptions revealed 4 major themes (Table 3): (1) high FHW satisfaction with MNCS trainings, commodities, and checklists; (2) FHW use of MNCS checklists to educate and encourage referral of pregnant women; (3) frequent FHW utilization of provided commodities; and (4) few barriers to effective FHW commodity and checklist use.

As part of the post-training follow-up in Eastern Equatoria, questionnaires were administered to 54 of the FHWs (response rate 74.0%). Almost half (45.3%) of the participants reported no previous training prior to the MNCS package. Those with previous training had typically received training in maternal health (93.1%) and infrequently in newborn (17.2%) or child health (13.8%). On a 5-point Likert scale, all participants reported being either very satisfied (64.8%) or somewhat satisfied (35.2%) with the MNCS program.

FHWs were surveyed on the use and usefulness of each checklist, equipment, and commodity in the last 30 days (Table 4). Participants used the healthy pregnancy and prenatal care referral checklist most frequently (5.02 ± 5.79)—more often than deliveries attended (4.60 ± 3.37). The equipment items most frequently used were the hour-glass (5.54 ± 7.34), blood pressure cuff (5.24 ± 6.71), nonsterile gloves (4.98 ± 4.91), and string (4.57 ± 3.06). On average, an overwhelming majority (85.2%) of participants rated the checklists as either “useful” (44.5%) or “very useful” (40.7%). Similarly, the vast majority (87.3%) rated the commodities as either “useful” (27.5%) or “very useful” (59.9%). When surveyed about their confidence with the materials, an

Table 4

Closed-response questionnaire responses from 54 frontline health workers at 2–3 months post-training regarding the use, usefulness, and confidence with the checklists and equipment in the last 30 days.^a

	Frequency of use	Usefulness ^b	Confidence ^c
Checklists			
Healthy pregnancy	5.02 ± 5.79	3.18 ± 1.26	2.96 ± 0.19
Danger signs in pregnancy	2.55 ± 2.96	2.94 ± 1.29	2.88 ± 0.55
Preparing for delivery	3.28 ± 2.52	3.15 ± 1.24	2.96 ± 0.27
Danger signs in labor	2.16 ± 2.75	2.77 ± 1.40	2.88 ± 0.40
Heavy bleeding after delivery	1.88 ± 2.44	2.94 ± 1.26	2.84 ± 0.47
Newborn care	2.06 ± 2.81	3.10 ± 1.13	2.85 ± 0.41
Danger signs in children	1.56 ± 2.19	2.94 ± 1.21	2.84 ± 0.46
Diarrhea and vomiting	2.06 ± 2.53	2.94 ± 1.35	2.94 ± 0.31
Malnutrition	2.36 ± 4.69	2.94 ± 1.35	2.84 ± 0.42
Equipment			
Bag-and-mask device	0.94 ± 1.58	2.82 ± 1.55	2.94 ± 0.31
Bulb syringe	3.73 ± 3.27	3.63 ± 0.77	2.96 ± 0.19
Intrauterine balloon	0.13 ± 0.49	2.52 ± 1.56	1.86 ± 0.46
Mid-upper arm circumference tapes	3.39 ± 9.23	2.83 ± 1.44	2.87 ± 0.34
Thermometer	4.00 ± 7.44	2.94 ± 1.39	2.94 ± 0.24
4-minute hour glass	5.54 ± 7.34	3.38 ± 1.19	3.00 ± 0.00
Blood pressure cuff	5.24 ± 6.71	3.55 ± 2.66	2.98 ± 0.31
Medical scissors	4.44 ± 3.12	3.70 ± 0.67	3.00 ± 0.00
Ball of string	4.57 ± 3.06	3.74 ± 0.66	3.00 ± 0.00
Non-sterile gloves	4.98 ± 4.91	3.66 ± 0.76	3.00 ± 0.00

^a Values are given as mean ± SD.

^b Usefulness scored from 0 = not useful, to 4 = very useful.

^c Confidence scored as: 1 = I don't know; 2 = I'm not sure; 3 = I know.

average of 86.0% of FHWs reported knowing how to use each checklist, and 95.5% reported knowing how to use each piece of equipment. The single outlier in confidence was relative uncertainty with using the new intrauterine balloon for postpartum hemorrhage.

With regard to FHW practices since training, participants reported an average of 3.0 ± 3.82 referrals (range, 0–20) to a health facility. Furthermore, 78.3% of FHWs were more likely to refer patients as a result of the training. Meanwhile, nearly all participants (96.2%) responded that they cleaned and boiled their delivery equipment after every use.

FHW retained knowledge was assessed at follow-up by showing each participant selected checklist images and asking the participant to state the key points they were taught for each image. The mean total score on this 18-point assessment was 62.1% ± 20.7%. Participants scored highest on questions related to healthy pregnancy and prenatal care (82.6% ± 25.7%) and scored lowest on child health-related questions (49.5% ± 31.0), which included child health topics previously outside the perceived role of many FHWs. Scores on danger signs in pregnancy and labor were 64.0% ± 31.3% and 69.3% ± 26.3%, respectively.

The surveyed FHWs had attended a total of 244 deliveries (4.60 ± 3.37) during the preceding 30 days. Of these deliveries, 6 mothers (2.5%) had heavy bleeding after delivery (i.e. postpartum hemorrhage)

Table 3

Qualitative analysis results of 7 focus groups with 41 frontline health workers throughout Eastern Equatoria.

Major theme identified	Description
1. High FHW satisfaction with the MNCS trainings, commodities, and checklists	FHWs noted high satisfaction with all aspects of the MNCS package and described several benefits of the package (e.g. increased knowledge of topics such as child health, use of checklists as useful visual reminders of when to refer patients to higher-level care, etc.).
2. FHW use of MNCS checklists to educate and encourage referral of pregnant women	FHWs described using checklists to educate pregnant women about the importance of prenatal care and when referral is necessary. Several FHWs reported increases in prenatal care visits among women they serve owing to the checklists as well as greater patient adherence to checklist-guided referral recommendations.
3. Frequent FHW utilization of provided commodities	Among the MNCS commodity items, FHWs most often cited bulb suction, disposable gloves, scissors, and string as useful items in the commodity backpacks.
4. Few barriers to effective FHW commodity and checklist use	FHWs reported few barriers to using commodities or checklists. Some requested refresher trainings and/or longer duration of the 5-day FHW training.

Abbreviations: FHWs, frontline health workers; MNCS, maternal, newborn, child survival package.

and 4 of these (75.0%) required intrauterine balloon placement and referral. There were no maternal deaths among the mothers who had postpartum hemorrhage or among the remaining deliveries. With regard to newborn outcomes, 14 newborns (5.7%) were not breathing, and all (100%) of these received additional resuscitation beyond initial warming and drying. Twelve (85.7%) of these asphyxiated newborns were successfully resuscitated, and 2 (14.3%) died, for an overall crude newborn mortality of 0.82%, or 8.2 per 1000 live births. Reported presumed causes of newborn mortality were birth asphyxia, birth trauma, and infection. Six respondents (11.1%) additionally reported a total of 8 stillbirths during the preceding 30 days. Of these 8 stillbirths, at least 3 were apparently nonfresh stillbirths with maceration and disfigurement.

4. Discussion

Addressing maternal, newborn, and child mortality is a leading priority in low-resource countries [20]. A frequent and significant barrier to reducing these deaths is a limited number of trained healthcare providers. Programs and governments appropriately strive to build capacity among facility-based skilled birth attendants. However, in some settings, such as in South Sudan, this skilled cadre of health workers is nearly nonexistent, and training of existing unskilled FHWs may be necessary in the absence of a critical mass of skilled birth attendants.

The present study suggests that an innovative, evidence-based package of training, checklists, and equipment can successfully change practices, improve life-saving knowledge and skills, and increase referrals to health facilities. For example, referral to facilities for preventive care and management was more likely among FHWs after this training. Although initial health outcome data are limited, they are encouraging; among the 244 deliveries of trained FHWs in the follow-up assessment, participants reported no maternal deaths and 2 newborn deaths. As reference, assuming South Sudan's current mortality ratios and rates, one could expect an average of 5.0 maternal and 16.4 newborn deaths among 244 deliveries [11,21].

There are several potential explanations for the successes in this program. First, the MNCS package is an integrated solution involving setting-appropriate training, checklists, equipment, and teaching materials specifically designed for FHWs in resource-limited settings. Each of these is an essential component to empowering FHWs and establishing sustained best practices. The development of the checklists built upon significant recent success of other new checklists and algorithms for resource-limited settings, including presurgical checklists and the Helping Babies Breathe initiative by the American Academy of Pediatrics [22,23]. However, for the purposes of this initiative among a frequently untrained and nonliterate trainee audience, further simplified, wholly pictorial materials were required. Additionally, to be effective, checklists require training and the requisite equipment. With very limited supply lines in South Sudan, it was necessary to directly equip each FHW with reusable and setting-appropriate equipment [18]. Using a training-of-trainers model allowed rapid scale-up of the program as well as local instruction and supervision by community-based trainers who know the local language and culture. Lastly, the initiative was greatly facilitated through close collaboration with federal and state ministries of health and nongovernmental partners.

A number of notable lessons were also learned. Although the data suggest that FHWs can learn and master these skills, there was significant decline in the skills at follow-up, particularly for skills that were not previously part of the FHW's skillsets such as newborn resuscitation. As with any new knowledge and skills, refresher trainings are clearly necessary and are currently being implemented. Similarly, blood pressure measurement appeared to be a particularly challenging new technical skill for many FHWs and, although identifying pregnancy-related hypertension is important, it may need to remain one of the several prenatal services for which pregnant women are referred to the nearest health facility.

Limitations of this study were, in part, due to the inherent difficulties of working in an expansive, disrupted, and under-developed country without reliable communications or established reporting chains. Although there was a respectable response rate with 75.3% of FHWs in the assessment area located at follow-up, this assessment was necessarily focused on the first of the current 7 states in the intervention. Secondly, recall bias and response bias (i.e. social desirability bias) are possible, particularly among the questionnaire data, if participants answered in the manner they thought was desired. However, questionnaire instructions and the multimethod nature of the evaluation sought to minimize these biases.

Based upon these findings, the MNCS program is continuing to expand in South Sudan by increasing coverage, developing refresher trainings, and exploring additional training modules, such as FHW training on education and referral for family planning, voluntary counseling, and testing for HIV, and prevention of mother-to-child-transmission of HIV.

In conclusion, improving maternal, newborn, and child health is a leading priority worldwide, yet a limited health worker cadre in low-resource countries represents a significant barrier to change. The present study suggests that an innovative, evidence-based, MNCS package—including targeted training, pictorial checklists, and reusable equipment and commodities—can build local capacity and improve knowledge, skills, and practices among community-based providers.

Acknowledgments

Funding for this initiative came from the Ministry of Health of the Republic of South Sudan and from the Multi-Donor Trust Fund for South Sudan.

Conflict of interest

The authors have no conflicts of interest to declare.

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