WPS6901

Strengthening Malaria Service Delivery through Supportive Supervision and Community Mobilization in an Endemic Indian Setting

An Evaluation of Nested Delivery Models

Ashis Das
Jed Friedman
Eeshani Kandpal
GNV Ramana
R K Das Gupta
Madan M Pradhan
Ramesh Govindaraj

Abstract

Malaria continues to be a prominent global public health challenge, in part because of the slow population adoption of recommended preventive and curative behaviors. This paper tests the effectiveness of two service delivery models designed to promote recommended behaviors, including prompt treatment seeking for febrile illness, in Odisha India. The tested modules include supportive supervision of community health workers and community mobilization promoting appropriate health seeking. Program effects were identified through a randomized cluster trial comprising 120 villages from two purposively chosen malaria-endemic districts. Significant improvements were measured in the reported utilization of bed nets in both intervention arms vis-à-vis the control. Although overall rates of treatment seeking were equal across the study arms, treatment seeking from community health workers was higher in both intervention arms and care seeking from trained providers also increased with a substitution away from untrained providers. Further, fever cases in both treatments were more likely to have received timely medical treatment (within 24 hours) from a skilled provider. The study arm with supportive supervision was particularly effective in shifting care seeking to community health workers and ensuring prompt diagnosis and treatment. A community-based intervention combining the supportive supervision of community health workers with intensive community mobilization can be effective in shifting care seeking and increasing preventive behavior, and thus may be used to strengthen the national malaria control program.

Strengthening Malaria Service Delivery through Supportive Supervision and Community Mobilization in an Endemic Indian Setting: An Evaluation of Nested Delivery Models

Ashis Das[1], Jed Friedman[1], Eeshani Kandpal[1], GNV Ramana[1], R K Das Gupta[2], Madan M Pradhan[3], Ramesh Govindaraj[1]

[1] The World Bank [2] National Vector Borne Disease Control Program, Ministry of Health and Family Welfare, Government of India [3] Department of Health And Family Welfare, Government of Odisha, India

Background

Globally, malaria control programs have experimented with innovative strategies aligned with the healthcare delivery system status of each country [1]. One of the foremost strategies involves the introduction of community-based management of malaria through the deployment of community health workers [2-6]. During the last decade, India's malaria control strategies under the aegis of the National Vector Borne Disease Control Program (NVBDCP) introduced this strategy among other innovations to strengthen its fight against malaria [7] as the disease burden remains high – India continues to contribute around two-thirds of confirmed malaria cases in the South East Asia region of the World Health Organization [8]. The endemic eastern and central regions of the country, in particular, experience adverse socio-economic impacts due to their malaria burden [7, 9].

Under the Indian community-based approach, the village CHW, known as Accredited Social Health Activist (ASHA) is designated to address early detection, management and prevention of malaria at the community level [7, 10, 11]. Thus far, this ASHA-led community approach has been instituted in 50 *falciparum* malaria endemic districts in the country [7]. The ASHAs have been trained to test for Plasmodium falciparum (PF) malaria cases using rapid diagnostic tests and to treat these cases with Artemisinin Combination Therapy (ACT) if PF malaria is found. To further prevent any delays in the diagnosis or treatment of malaria, the ASHAs have also been provided with the requisite supplies of Rapid Diagnostic Test (RDT) kits and ACT [7, 10]. In addition, long lasting insecticidal treated bed nets (LLIN) have been distributed free of cost to populations in high endemic districts to strengthen prevention activities [7].

The global evidence on malaria management suggests necessary preconditions to ensure the effectiveness of community-based approaches [12]. For instance, the community should engage at the inception and planning stage rather than being mere recipients. Developing intervention modalities at the community level through institutions and individuals further enhances the community's participation and ownership. Communities should be empowered to regularly monitor and evaluate the effectiveness of interventions [8]. In terms of the involvement of CHW, the global evidence suggests that regular and systematic supervision with clearly defined objectives can improve the performance of community health workers involved in primary health care [13-16]. Such evidence for India, however, is lacking and insufficient community capacity, trust, and coordination may keep the new malaria control strategies from meeting expected outcomes [9, 17, 18]. Hence, without addressing these community level impediments, ongoing control efforts may lead to diminished outcomes and the wastage of resources.

This study tests the effect of two complementary community-based interventions implemented in Odisha, India, through local non-government organizations (NGO) to support NVBDCP's ongoing efforts. The two interventions, in essence a partnership between the public sector, the private sector and the community, tested the effectiveness of:

(a) community mobilization promoting appropriate malaria related behavior such as bed net use and timely and appropriate care seeking from a community level designated provider (i.e. CHW) for febrile illnesses

(b) supportive supervision of community health workers (CHW) on effective malaria case management

These interventions provide evidence not only on effectiveness but also possible scale up to similar settings. More generally, the findings should inform the development of a pragmatic policy approach to malaria control.

Methods

Study Settings

This study was carried out in Mayurbhanj and Sundargarh districts of Odisha. These areas are characterized by scheduled tribe (indigenous) populations and hilly and forest habitations [19, 20]. The districts were purposively selected from 50 highly malaria endemic districts in the country earmarked by the NVBDCP for an early roll-out of community-based management of malaria by CHWs and population level distribution of long lasting insecticidal treated bed-nets (LLIN).

Study design and participants

The study consisted of three arms, two arms of intervention – which we call Arms A and B – and one of control. In each study district, two endemic blocks (sub-districts) were randomly selected from among the set of all endemic blocks. In each of the study blocks all endemic villages were enumerated and 10 villages (with an average population of 900) were randomly assigned to arm A, 10 villages randomly assigned to arm B, and 10 villages randomly assigned to observational control. Given the four study sub-districts, the total study population was comprised of 120 villages – 40 in one intervention arm, 40 in another intervention arm, and 40 as controls. The NVBDCP characterizes a village with an annualized parasite incidence (confirmed malaria cases in thousand population per annum) of above five as malaria endemic.

4

Arm A received supportive supervision of ASHA along with community mobilization support (i.e. combined interventions), while Arm B was provided with only community mobilization activities. The control arm received the routine activities of the government's malaria control program, i.e. case management by ASHA without any additional supervision or community mobilization. The routine community mobilization activities in the control villages included two meetings (one each during June and October), one street theatre performance, and one mobile public address campaign with the distribution of informative leaflets on malaria during the year. This study was conceived, implemented, and evaluated in collaboration with the NVBDCP and the Department of Health and Family Welfare (DoHFW), Government of Odisha, which also provided the necessary approval. Ethical approval was obtained from an independent ethical committee in Bhubaneswar, India, which was constituted as per the guidelines of the Indian Council of Medical Research [16].

Interventions

As summarized in project timeline Figure 1, the study was divided into two phases – planning (September-December, 2009) that included formative research, recruitment and training of project staff; and implementation (January-December, 2010) of the interventions. Necessary criteria for NGO participation were the following: (a) previous experience with malaria-related activities and (b) previous activity in the study sub-districts. Only three operating NGOs fulfilled these criteria and were enrolled in the study, two NGOs operating in separate blocks in Sundargarh district while one NGO in Mayurbhanj was able to conduct intervention activities in both blocks. Implementer training conducted by the investigators oriented the participating

NGOs on the scope of the project and its effective management. The specific design of the community-based activities and their operationalization required an evidence-base on the communities' socio-economic and cultural characteristics, life style, health seeking pattern and knowledge regarding febrile and other common illnesses. Baseline qualitative research provided such evidence [10]. Community level meetings and participatory social mapping exercises conducted in every study village led to the further fine-tuning of intervention strategies. These meetings also provided an opportunity for the implementing NGO and the community to build rapport. As part of the national malaria control program's strategy, LLINs were distributed and the ASHA were provided with RDT and ACT for management of fever and malaria cases in all three arms. Every study village – both in treatments and control – contained an active ASHA worker previously trained in malaria case management.

Community mobilization: Community mobilization efforts focused on modifying population health seeking behavior towards effective malaria control and management. Specifically, mobilization efforts aimed at 1) increasing the consistent use of long lasting insecticide treated bed nets that were provided to the community free of cost by the NVBDCP, and 2) timely care seeking for febrile illnesses from the ASHA in the village. Activities included the dissemination of appropriate behavior change messages through locally acceptable communication channels. The formative research conducted during the planning phase helped incorporate local norms and customs into the design of the community mobilization strategies and messages [10]. Mobilization activities were most intensive during the transmission season with follow up activities afterwards. Various target groups such as local self-government, social organizations, women, men, youth, school and religious groups were chosen for community mobilization. The

main messages for the community mobilization activities were as follows: (1) "whenever you have fever, visit the ASHA as early as possible to get your blood tested"; (2) "avail medicines from the ASHA if the blood test is positive for the malaria parasite"; (3) "always consume the full course of drugs given by the ASHA"; (4) "use bed nets every night during sleep"; and (5) "give preference to pregnant women and young children if bed nets are insufficient in the household". The messages were conveyed through community-based meetings (held separately for different target groups considering the local social norms), posters and leaflets, cinema shows, street plays, and community notices (photo examples given in Figure 2). Further, door-to-door visits were undertaken to promote the consistent use of bed nets as well as timely care-seeking from the ASHA for fever. The NGOs utilized local community-based groups (CBO) such as the Village Health and Sanitation Committee (VHSC) and women's Self Help Groups (SHG) for community mobilization. The SHG members were assigned a few households (10-15) each in every participating village to monitor bed net usage at nights. Details of the community mobilization activities are provided in the appendix (Appendix Table 1).

Supportive supervision: Supportive supervision was designed to improve effective case management of febrile cases by the ASHA by enhancing her professional competence and confidence, increasing community engagement, and ensuring the regular availability of drugs, RDT kits, and other relevant supplies. Under such supervision, a trained NGO field worker visited each ASHA at least twice a month. Every NGO field worker was responsible for 10 ASHA. The supervision activities involved sensitization on the knowledge about transmission, diagnosis and treatment of malaria; hands-on support for performing and interpreting rapid diagnosis tests; administration of the correct dosage of ACT and follow-up to ensure compliance;

management of malaria surveillance records; and orientation on community and health center engagement. A typical visit by the NGO field worker lasted for one to two hours for each CHW. In treatment arm A, these activities were conducted in conjunction with the community mobilization activities described above.

Outcomes

Intervention effectiveness was assessed through a comparison of outcome measures between the intervention and control arms. Main outcome measures were related to the reported consistent usage of LLINs and care seeking patterns of febrile cases. Specific measures included proportion of fever cases seeking care from a trained provider and receipt of test and treatment, if appropriate, for malaria within a day of developing symptoms; households owning at least one LLIN; and population sleeping under a bed net.

Evaluation

A brief quantitative household survey instrument was implemented in 90 study villages before intervention activities and a more extensive household and community survey was conducted in all study villages at the end of the intervention period (November 2010-January 2011). Data instruments utilized the local language Odia and were piloted and modified before each survey. The baseline survey collected basic demographic data from 22 households per village. These data are mainly used to explore balance of socio-demographic characteristics across intervention arms.

For the end line survey, instruments consisted of a household questionnaire and an individual-level questionnaire administered to recent (two-week recall) fever cases. The household-level questionnaire recorded demographic, socio-economic and health characteristics, general health seeking behavior, knowledge on malaria and utilization of bed nets. The individual fever questionnaire collected information on treatment seeking behavior from the recent fever cases. In each study village, a full household listing was conducted from which 10 randomly selected households were interviewed for the household level information. The full household listing also included a listing of all recent fever cases (determined through 2-week recall) and 10 cases were randomly selected from each village and interviewed for individual-level information. For both surveys, interviews were recorded on paper forms and double-entered in CS Pro software (version 4.0) at a central location. Project level cost data were extracted from the financial reports and government level data from the registers at the health centers.

Statistical analysis

The data were analyzed as an intention-to-treat analysis with treatment at the cluster (village) level. Balance across treatment arms in pre-intervention or fixed characteristics measured at end-line but unaffected by the intervention were assessed through normalized mean differences and differences exceeding a threshold of 25% were considered significant [21]. Pair-wise t-tests of difference were also estimated. Differences in outcomes between intervention and control clusters were examined with logistic regression. Socio-economic status (SES) was calculated by a principal component analysis of key household characteristics and assets to create a wealth index [22]. Since no differences were found between unadjusted and adjusted odds ratios – i.e. results are unchanged if we adjust for the observable characteristics in Table 2 – we present

unadjusted odds ratios. Typically, with clustered outcomes such as here, robust standard errors adjusted for clustering at the village level are reported [23]; however, given that only binary response outcomes are analyzed with logistic regression, clustered standard errors are identical to unclustered standard errors. Data were analyzed with Stata software (version 12).

Cost data were calculated on the expenditures for each type of intervention consisting of human resources (including time, travel and per diems), training, community mobilization, stationery and overheads. The costs were compared with the outcomes (i.e. bed net use and timely treatment seeking) extrapolated at the population level for the study clusters. Incremental cost effectiveness ratios were estimated against the control arm.

Role of the funding source

The sponsors of this study had no role in the study design, interventions, data collection, analysis, interpretation, dissemination or writing of the report.

Results

Balance of key characteristics across treatment arms

As village randomization into treatment or control was conducted before the collection of population information, successful randomized assignment is checked through a comparison of potentially influential population characteristics across treatment and control arms that may influence the outcomes of interest. Tables 1 and 2 present, respectively, the baseline and endline means of such characteristics in the three study arms as well as the normalized mean difference for each pair-wise comparison across study arms. Randomized assignment appears to have

resulted in a balanced study sample across a wide range of population characteristics. Only one standardized mean-difference exceeds the 25 percent threshold [21]; even that mean difference, API at baseline between arms B and control, is only at 25.5 percent. Any observed differences in intervention performance are unlikely to have been driven by an imbalance of characteristics across treatment arms as virtually none are observed. Next, we use unadjusted odds ratios to measure program impact on targeted outcomes such as bed net ownership, fever-care seeking behavior, and village-level fever prevalence.

Effects on preventive malaria related behaviors

We find that 99% of all households in the study sample owned at least one bed net (Table 3). This lack of significant difference across study arms is not surprising since all three received wide distribution of free LLINs. However, bed net use patterns show more variation across study arms. Significantly more respondents reported to have slept under a bed net the previous night of the survey in Arm A (84.54%; p<0.001; 95% CI 1.328-1.661) and Arm B (82.43%; p<0.001; 95% CI 1.143-1.419) than the control arm (78.65%). Almost 97 percent of all children in arm A (p=0.003; 95% CI 1.383-4.688) and 94% in arm B (p=0.01; 95% CI 1.186-3.592) slept under a bet net, while it was less than 91 percent in control arm. Women of reproductive age in arm A reported significantly higher use of bed net than the control arm (96.79% vs. 94.09; p=0.006).

Effects on care seeking behavior for fever

Diagnosis and treatment within 24 hours are crucial to decreasing morbidity and mortality from malaria. We considered providers as trained if they had been trained by the malaria control program, including medical doctors, nurses and CHWs. Table 4 shows that diagnosis within a

day of the onset of fever was not significantly different between the intervention and control arms for any study sub-group. However prompt diagnosis from a trained provider is significantly higher in both intervention arms (60.6%; OR=1.529; p=0.004 and 59.3%; OR=1.450; p=0.007 vs. 50.1% in control). This effect is even more pronounced when restricting the analysis to young children (63.2%; OR=1.935; p=0.059 and 63.51%; OR=1.958; p=0.049 vs. 47.1% in control) or women of reproductive age (61.6%; OR=1.867; p=0.028 and 64.3%; OR=2.094; p=0.006 vs. 47.2% in control). Further, both interventions shifted care seeking towards front-line representatives – diagnosis from a CHW was significantly higher in both intervention arms (28%; OR=1.642; p=0.005 and 27.6%; OR=1.603; p=0.007) than in the control arm (19.2%). If we focus on CHW performance, proportionately more fever cases visiting an ASHA in Arm A had timely diagnosis than the control arm (82.08% vs. 67.14%; OR=2.24; p=0.025).

The survey also asked about the receipt of any malaria treatment. Treatment from any kind of trained providers was more prevalent in the intervention arms; some of this change came from substitution away from untrained providers (10.85% in arm A, 13.65 percent in arm B, 21.1% in control). Further, significantly more fever cases from both arm A (60.58%; OR=1.529; p=0.004) and arm B (59.32%; OR=1.45; p=0.012) than controls (50.14%) received timely treatment from a trained provider. In particular, women from arm A were more likely than women in control areas to receive prompt treatment from a trained provider (61.62% vs. 47.12%; OR=1.8; p=0.039). We also found overall timely treatment seeking was higher in treatment areas. However, these results were not statistically significant.

Effects on reported fever incidence

We also examined whether changes in bed net use and fever care seeking patterns resulted in decreases in the village-level prevalence of malaria or other febrile illness. Using estimated community rates of two-week fever incidence during the high transmission period, we find that reported fever incidence in treatment villages was indeed lower than in control villages: 15.5% in both Arms A and B relative to 17.7% in control; however, these differences were not statistically significant (p-values of 0.16 and 0.20 respectively).

Cost effectiveness analysis

While the cost-effectiveness analysis is summarized here, the details are given in Appendix 2. The per capita cost of the combined interventions was 97 US cents and community mobilization was 62 cents, whereas the routine program cost 10 cents. The incremental cost for combined interventions was $13.07 per additional person reported to sleep under a bed net the night before the survey, whereas it was $14.26 for community mobilization. The combined interventions arm was more effective at increasing bed net use, timely diagnosis by a trained provider, and timely treatment by a CHW, while the community mobilization arm was more cost-effective at improving timely diagnosis by a CHW and timely treatment by a trained provider.

Discussion

A community-based intervention targeting prevention and management of malaria in Odisha, India, attempted to (1) empower CHWs with training and support; (2) utilize intensive community mobilization with reliance on the traditional media considering the local social and cultural norms; (3) build local capacity through community based organizations and groups to enhance the effectiveness of malaria case management by CHWs; and (4) demonstrate a public

sector program model of partnership between the public sector, private not-for-profit sector, and the community to enhance sustainability. These interventions led to significant improvements in reported bed net use, especially for vulnerable sub-groups, and timely care seeking from a trained health care provider. Results show significant increases in the reported *utilization* of bed nets in treatment arms relative to controls, which is particularly encouraging because the surveys were conducted towards the end of the high transmission season and there were no significant differences in the *ownership* of bed nets between households in treated and control villages. The increases in utilization were somewhat more pronounced among the villages where community mobilization was supplemented with supportive supervision of the community health workers.

The studied intervention sought to strengthen the Indian CHW (ASHA) program through supportive supervision. While the ASHA have been integrated into the national malaria control program, they are female volunteers with primary education, selected by the rural communities they reside in, and do not have any formal training in healthcare prior to their selection. Their low levels of formal education and lack of experience with the health sector suggests the potential for hands-on support of specific management of diseases and health conditions. This study demonstrates that a supportive intervention on malaria case management by CHWs shifted care-seeking behavior and bed net use in desirable ways in two highly malaria endemic districts. The supportive supervision by NGO workers through semi-monthly visits provided them with a structured learning process. Similar to other low- and middle-income country settings, we believe more hands-on support through supportive supervision imparted more confidence, knowledge and skills in CHWs and thereby improved their motivation to perform [13-16]. Further, the supervisors provided the conduit for efficient communication between the CHWs

and the formal health system to maintain an uninterrupted supply of commodities. Through supportive supervision, the study brought in considerable change in the community's acceptance and response towards CHWs in contrast to the situation in control communities [10]. Indeed, in a particularly encouraging sign, treated households moved away from seeking fever care from untrained providers to the ASHA. Interestingly, other trained providers also noticed a drop in the proportion of total cases compared to the control villages due to the care seeking from the CHWs, which may benefit the health system by allowing more prompt diagnosis and treatment of fever and by letting trained providers devote their time and skills to the management of more complicated health conditions as CHWs deal with uncomplicated fever cases at the village level in a cost-effective manner [24].

This shift in care seeking from facility based providers to community health workers is consistent with patterns observed from similar supportive supervision interventions in malaria endemic settings in Africa [25-29]. Since malaria is typically endemic in remote areas with hilly terrain, a tailored community health worker or volunteer model may be most suitable for disease control and management. However, care should be taken to ensure that the supervisors are adequately oriented and skilled on key aspects of malaria control and management of community health.

The intervention introduced globally proven methods (RDT, ACT and LLIN) with locally adapted delivery strategies to achieve the targets of "Roll Back Malaria" for women and children under five [2, 12]. The targeted vulnerable populations of children under-five and women of childbearing age benefitted in particular from a greater utilization of both bed nets and fever care

services. The impact on these vulnerable populations could be an effect of the enhanced case management activities by the CHW, who was a female from the same village with an in-depth understanding of the socio-cultural context. The involvement of women's groups in the intervention may have further facilitated prompt care seeking among women and children, although the present study is unable to explicitly test this channel of impact. The deployment of female CHWs and women's groups in community health management is likely reflected in terms of community health awareness and behavior [30-34]. The community's health-seeking pattern for fever distinctly shifted from untrained to trained providers, which suggests the potential for minimizing inappropriate treatment regimens, catastrophic health expenses and consequent fatalities [3, 10]. These findings are consistent with the evidence from similar Asian and African settings about leveraging local capacity to ensure sustainability of community health approaches [35]. The thrust of the intervention was to identify and empower local stakeholders especially CBOs and women's groups on building up social trust, cohesion, support, mutual capacity building and thereby improving positive health seeking behavior [36, 37]. Locally constituted women's groups are well-poised to be cost-effective and sustainable change makers for community mobilization and gradual behavior changes [31, 32, 34].

The studied intervention identified and built local capacity to enhance the effectiveness of malaria case management by CHWs and demonstrated a model for locally sustainable community based service-delivery and monitoring. The community mobilization relied on the traditional media and involved various community structures considering the social and cultural norms. The design and dissemination of the community mobilization strategy were based on a bottom-up approach with the participation of the community. Apart from engaging women's

groups, the intervention also capitalized on other community-level formal and informal associations, such as local self-government, village health and sanitation committees, men's groups and youth clubs. Print and electronic media supplemented the group activities and community notices and the interventions were intensively aligned with the disease transmission season to maximize impact. Empowerment of community entities is a corner stone of the community focus for public health interventions and is also a mandate of India's National Rural Health Mission [38]. However, community based organization for supportive supervision and management must be carefully chosen to be locally acceptable and possess adequate coordinating capacity. Transparency, clear delegation of responsibilities and coordination among various stakeholders, including CHWs, is essential to the success of such interventions. As the project suggests, linking the CHW with the higher levels of the health facilities to ensure uninterrupted supply of commodities, recording of health information and monitoring, is a another key component of the potential success of such supportive interventions.

This project introduced a three-way partnership between the public sector, private not-for-profit sector, and the community, i.e. public-private-community participation (PPCP). The engagement of local NGOs enabled the easy rollout and monitoring of the project, allowed the intervention to be incorporated into the public sector program, and led to sustained activities rather than duplicating or substituting for any pre-existing program activity. However, as may be expected with such community mobilization interventions, the cost of implementation was high in our interventions compared to the standard program. Note, however, that the total cost of the combined intervention was 97 cents per capita, which is slightly lower than the $1.06 per capita cost of similar a community mobilization program involving shopkeepers and communities in

rural Kenya [39]. We believe the fixed nature of start-up and administration costs will further decrease the cost of this intervention if it is implemented over a longer period. As the community becomes more aware of the malaria control activities and changes its health seeking behavior, the intensity of the community mobilization activities could be scaled down, further bringing down total costs.

This study is not without limitations. In traditional rural Indian settings, informal sharing of information is common among the inhabitants of a locality; thus, informational spillovers might have contaminated the control group particularly since the treatment and control villages were often geographically contiguous villages. However, we do not find that outcomes in neighboring treated villages (weighted by distance to the treated village) have a significant impact on outcomes in control villages. This lack of a significant relationship suggests that the results reported above are not contaminated by spillovers. Note that even if spillovers existed, they would have led to a downward bias in the estimated treatment effect since such spillovers would have improved outcomes in control areas. Secondly, while recall bias is not uncommon in community-based surveys, any such bias would have influenced all three study arms in a similar manner. Finally, self-reported preventive behavior may have been biased by social desirability concerns. This type of reporting bias has been observed when contrasting behavior recorded at the health facility and data reported through household survey, with survey data presumed to be the more accurate [40, 41]. Differential program effectiveness observed by district suggests that desirability bias cannot fully account for the program impacts measured here as certain implementers are more effective in achieving outcomes [42]. Nevertheless, any such reporting bias may result in an overestimation of program effects for self-reported preventive behaviors.

Conflicts of interest

The authors declare that they have no conflicts of interest.

References

1. WHO: **World Malaria Report** Geneva: World Health Organization; 2009.
2. WHO: **The Roll Back Malaria Strategy for Improving Access to Treatment through Home Management of Malaria.** . Geneva: World Health Organization; 2005.
3. Pagnoni F, Convelbo N, Tiendrebeogo J, Cousens S, Esposito F: **A community-based programme to provide prompt and adequate treatment of presumptive malaria in children**. *Trans R Soc Trop Med Hyg* 1997, **91**(5):512-517.
4. Ghebreyesus TA, Witten KH, Getachew A, Yohannes AM, Tesfay W, Minass M, Bosman A, Teklehaimanot A: **The community-based malaria control programme in Tigray, northern Ethiopia. A review of programme set-up, activities, outcomes and impact**. *Parassitologia* 2000, **42**(3-4):255-290.
5. Sirima SB, Konate A, Tiono AB, Convelbo N, Cousens S, Pagnoni F: **Early treatment of childhood fevers with pre-packaged antimalarial drugs in the home reduces severe malaria morbidity in Burkina Faso**. *Trop Med Int Health* 2003, **8**(2):133-139.
6. Lewin SA, Dick J, Pond P, Zwarenstein M, Aja G, van Wyk B, Bosch-Capblanch X, Patrick M: **Lay health workers in primary and community health care**. *Cochrane Database Syst Rev* 2005(1):CD004015.
7. MoHFW: **Operational Manual for Implementation of Malaria Programme** New Delhi: Directorate of National Vector Borne Disease Control Programme, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India; 2009.
8. WHO: **World Malaria Report** Geneva: World Health Organization; 2012.
9. Dash AP, Valecha N, Anvikar AR, Kumar A: **Malaria in India: challenges and opportunities**. *J Biosci* 2008, **33**(4):583-592.
10. Das A, Das Gupta RK, Friedman J, Pradhan MM, Mohapatra CC, Sandhibigraha D: **Community perceptions on malaria and care-seeking practices in endemic Indian settings: policy implications for the malaria control programme**. *Malar J* 2013, **12**:39.
11. Das LK, Jambulingam P, Sadanandane C: **Impact of community-based presumptive chloroquine treatment of fever cases on malaria morbidity and mortality in a tribal area in Orissa State, India**. *Malar J* 2008, **7**:75.
12. WHO: **Community involvement in rolling back malaria**. Geneva: World Health Organization; 2002.
13. Yeboah-Antwi K, Pilingana P, Macleod WB, Semrau K, Siazeele K, Kalesha P, Hamainza B, Seidenberg P, Mazimba A, Sabin L *et al*: **Community case management of fever due to malaria and pneumonia in children under five in Zambia: a cluster randomized controlled trial**. *PLoS Med* 2010, **7**(9):e1000340.
14. Mogasale V, Wi TC, Das A, Kane S, Singh AK, George B, Steen R: **Quality assurance and quality improvement using supportive supervision in a large-scale STI intervention with sex workers, men who have sex with men/transgenders and injecting-drug users in India**. *Sex Transm Infect* 2010, **86 Suppl 1**:i83-88.
15. Djibuti M, Gotsadze G, Zoidze A, Mataradze G, Esmail LC, Kohler JC: **The role of supportive supervision on immunization program outcome - a randomized field trial from Georgia**. *BMC Int Health Hum Rights* 2009, **9 Suppl 1**:S11.
16. Afenyadu GY, Agyepong IA, Barnish G, Adjei S: **Improving access to early treatment of malaria: a trial with primary school teachers as care providers**. *Trop Med Int Health* 2005, **10**(10):1065-1072.
17. Brooks MI, Singh N, Hamer DH: **Control measures for malaria in pregnancy in India**. *Indian J Med Res* 2008, **128**(3):246-253.

18.   Chatterjee P: **India faces new challenges in the fight against malaria**. *Lancet Infect Dis* 2006, **6**(6):324.
19.   **District profile, Mayurbhanj district: Government of Odisha;** [http://mayurbhanj.nic.in/]
20.   **District profile, Sundargarh district: Government of Odisha;** [http://sundergarh.nic.in/Introduction.htm]
21.   Imbens G, Wooldridge J: **Recent Developments in the econometrics of program evaluation.** *Journal of Economic Literature* 2009, **47**(1):5-86.
22.   Filmer D, Pritchett LH: **Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India**. *Demography* 2001, **38**(1):115-132.
23.   White H: **A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity**. *Econometrica* 1980, **48**(4):817–838.
24.   Chanda P, Hamainza B, Moonga HB, Chalwe V, Banda P, Pagnoni F: **Relative costs and effectiveness of treating uncomplicated malaria in two rural districts in Zambia: implications for nationwide scale-up of home-based management**. *Malar J* 2011, **10**:159.
25.   Seidenberg PD, Hamer DH, Iyer H, Pilingana P, Siazeele K, Hamainza B, MacLeod WB, Yeboah-Antwi K: **Impact of integrated community case management on health-seeking behavior in rural Zambia**. *Am J Trop Med Hyg* 2012, **87**(5 Suppl):105-110.
26.   Ewing VL, Lalloo DG, Phiri KS, Roca-Feltrer A, Mangham LJ, SanJoaquin MA: **Seasonal and geographic differences in treatment-seeking and household cost of febrile illness among children in Malawi**. *Malar J* 2011, **10**:32.
27.   Tiono AB, Kabore Y, Traore A, Convelbo N, Pagnoni F, Sirima SB: **Implementation of Home based management of malaria in children reduces the work load for peripheral health facilities in a rural district of Burkina Faso**. *Malar J* 2008, **7**:201.
28.   Akweongo P, Agyei-Baffour P, Sudhakar M, Simwaka BN, Konate AT, Adongo PB, Browne EN, Tegegn A, Ali D, Traore A *et al*: **Feasibility and acceptability of ACT for the community case management of malaria in urban settings in five African sites**. *Malar J* 2011, **10**:240.
29.   Nanyonjo A, Nakirunda M, Makumbi F, Tomson G, Kallander K: **Community acceptability and adoption of integrated community case management in Uganda**. *Am J Trop Med Hyg* 2012, **87**(5 Suppl):97-104.
30.   Manandhar DS, Osrin D, Shrestha BP, Mesko N, Morrison J, Tumbahangphe KM, Tamang S, Thapa S, Shrestha D, Thapa B *et al*: **Effect of a participatory intervention with women's groups on birth outcomes in Nepal: cluster-randomised controlled trial**. *Lancet* 2004, **364**(9438):970-979.
31.   Prost A, Colbourn T, Seward N, Azad K, Coomarasamy A, Copas A, Houweling TA, Fottrell E, Kuddus A, Lewycka S *et al*: **Women's groups practising participatory learning and action to improve maternal and newborn health in low-resource settings: a systematic review and meta-analysis**. *Lancet* 2013, **381**(9879):1736-1746.
32.   Azad K, Barnett S, Banerjee B, Shaha S, Khan K, Rego AR, Barua S, Flatman D, Pagel C, Prost A *et al*: **Effect of scaling up women's groups on birth outcomes in three rural districts in Bangladesh: a cluster-randomised controlled trial**. *Lancet* 2010, **375**(9721):1193-1202.
33.   Gopalan SS, Mohanty S, Das A: **Assessing community health workers' performance motivation: a mixed-methods approach on India's Accredited Social Health Activists (ASHA) programme**. *BMJ Open* 2012, **2**(5).
34.   Tripathy P, Nair N, Barnett S, Mahapatra R, Borghi J, Rath S, Gope R, Mahto D, Sinha R, Lakshminarayana R *et al*: **Effect of a participatory intervention with women's groups on birth outcomes and maternal depression in Jharkhand and Orissa, India: a cluster-randomised controlled trial**. *Lancet* 2010, **375**(9721):1182-1192.

35. Nair N, Tripathy P, Costello A, Prost A: **Mobilizing women's groups for improved maternal and newborn health: evidence for impact, and challenges for sustainability and scale up**. *Int J Gynaecol Obstet* 2012, **119 Suppl 1**:S22-25.

36. Katabarwa MN, Habomugisha P, Agunyo S, McKelvey AC, Ogweng N, Kwebiiha S, Byenume F, Male B, McFarland D: **Traditional kinship system enhanced classic community-directed treatment with ivermectin (CDTI) for onchocerciasis control in Uganda**. *Trans R Soc Trop Med Hyg* 2010, **104**(4):265-272.

37. Katabarwa MN, Habomugisha P, Richards FO, Jr., Hopkins D: **Community-directed interventions strategy enhances efficient and effective integration of health care delivery and development activities in rural disadvantaged communities of Uganda**. *Trop Med Int Health* 2005, **10**(4):312-321.

38. MoHFW: **National Rural Health Mission, Meeting people's health needs in rural areas. Framework for Implementation, 2005-2012**. New Delhi: Ministry of Health and Family Welfare, Government of India; 2005.

39. Goodman CA, Mutemi WM, Baya EK, Willetts A, Marsh V: **The cost-effectiveness of improving malaria home management: shopkeeper training in rural Kenya**. *Health Policy Plan* 2006, **21**(4):275-288.

40. Skarbinski J, Winston CA, Massaga JJ, Kachur SP, Rowe AK: **Assessing the validity of health facility-based data on insecticide-treated bednet possession and use: comparison of data collected via health facility and household surveys--Lindi region and Rufiji district, Tanzania, 2005**. *Trop Med Int Health* 2008, **13**(3):396-405.

41. Wei SC, Vanden Eng JL, Patterson AE, Doumbia S, Kleinbaum DG, Ryman TK, Toure MB, McMorrow ML: **Validity of Expanded Program on Immunization Contact Method health behavior estimates in Mali**. *J Infect Dis* 2012, **205 Suppl 1**:S112-119.

42. Das A, Friedman J, Kandpal E: **Does Involvement of Local NGOs Enhance Public Service Delivery? Cautionary Evidence from a Malaria-Prevention Evaluation in India**. In *World Bank Policy Research Working Paper Series* Washington, DC: World Bank; 2014.

Table 1 Baseline mean characteristics in intervention and control clusters, and normalized mean differences across arms[1,2]

	Supportive supervision and community mobilization (Arm A)	Community mobilization (Arm B)	Control	Normalized Differences: Arms A-B	Normalized Differences: Arms A-K	Normalized Differences: Arms B-K
Annual malaria parasite incidence per cluster	12.26	10.79	9.12	-0.025	-0.049	0.255
Household characteristics n/N (%)						
Hindu	304/390 (77.9)	291/400 (72.8)	298/390 (76.4)	0.085	0.026	-0.058
Christian	74/390 (18.9)	96/400 (24.0)	78/390 (20.0)	-0.088	-0.020	0.068
Others	12/390 (3.1)	13/400 (3.3)	14/390 (3.6)	-0.008	-0.020	-0.012
Scheduled Tribe	282/390 (72.3)	306/400 (76.5)	303/390 (77.7)	-0.068	-0.088	-0.020
Scheduled Caste	26/390 (6.7)	34/400 (8.5)	21/390 (5.4)	-0.048	0.039	0.086
Others	82/390 (21.0)	60/400 (15.0)	66/390 (16.9)	0.159	0.109	-0.036

[1] None of the 21 pairwise t-tests for equality of means across study arms revealed a significant difference between the average household characteristics, at a 5% level of significance.
[2] There are 390 households in Arm A, 400 in Arm B and 390 in the control arm.

Table 2 Endline mean characteristics in intervention and control clusters, and normalized mean differences across study arms[3,4,5]

	Supportive supervision and community mobilization (Arm A)	Community mobilization (Arm B)	Control	Normalized Differences: Arms A-B	Normalized Differences: Arms A-K	Normalized Differences: Arms B-K
Wealth Index	0.452 (0.696)	0.372 (0.628)	0.337 (0.611)	0.085	0.124	0.040
Livestock (count)	2.131 (2.478)	2.413 (2.953)	2.362 (2.824)	-0.073	-0.061	0.012
Poultry (count)	4.926 (6.836)	4.885 (7.624)	5.095 (6.633)	0.004	-0.018	-0.021
Cropped During Previous Season (proportion)	0.982 (0.133)	0.985 (0.123)	0.983 (0.131)	-0.017	-0.005	0.011
Household Has Bank Account (proportion)	0.810 (0.393)	0.803 (0.399)	0.777 (0.417)	0.012	0.058	0.045

---

[3] None of the 39 pairwise t-tests for equality of means across study arms revealed a significant difference between the average household characteristics at a 5% level of significance.

[4] There are 788 households in Arm A, 781 in Arm B and 775 in the control arm.

[5] Standard deviations in parentheses.

	Supportive supervision and community mobilization (Arm A)	Community mobilization (Arm B)	Control	Normalized Differences: Arms A-B	Normalized Differences: Arms A-K	Normalized Differences: Arms B-K
Household Head is Male (proportion)	0.913 (0.282)	0.910 (0.287)	0.918 (0.275)	0.007	-0.013	-0.020
Household Head is Currently Married (Proportion)	0.885 (0.320)	0.848 (0.360)	0.867 (0.340)	0.077	0.039	-0.038
Household Head Has Less Than Primary Education (proportion)	0.309 (0.463)	0.307 (0.462)	0.290 (0.455)	0.003	0.029	0.026
Males in Wage Labor (count)	0.730 (0.444)	0.773 (0.419)	0.805 (0.397)	0.070	-0.126	-0.055
Females in Wage Labor (count)	0.415 (0.493)	0.473 (0.500)	0.541 (0.499)	-0.083	-0.180	-0.096
Household Has Non-farm Enterprise (proportion)	0.200 (0.401)	0.258 (0.438)	0.167 (0.373)	-0.098	0.060	0.158
Household Younger than 5 (proportion of total)	0.101 (0.132)	0.109 (0.142)	0.112 (0.146)	-0.041	-0.056	-0.015

25

	Supportive supervision and community mobilization (Arm A)	Community mobilization (Arm B)	Control	Normalized Differences: Arms A-B	Normalized Differences: Arms A-K	Normalized Differences: Arms B-K
Total Household Size (count)	5.500 (2.100)	5.458 (2.188)	5.359 (1.870)	0.014	0.050	0.034

Table 3 Reported utilization of bed nets by intervention arm and relative odds ratios of intervention impacts

	Supportive supervision plus community mobilization	Community mobilization	Control	Supportive supervision plus community mobilization Vs Control		Community mobilization Vs Control	
	n/N (%)	n/N (%)	n/N (%)	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value
Bed net ownership							
Households with at least one bed net	760/768 (99.15)	774/781 (99.1)	750/755 (99.34)	0.633 [0.206, 1.945]	0.425	0.737 [0.233, 2.33]	0.604
Slept last night under a bed net							
Total population	3,571/4,224 (84.54)	3,589/4,354 (82.43)	3,219/4,093 (78.65)	1.485 [1.328, 1.661]	0.000	1.274 [1.143, 1.419]	0.000
Children under 5 years	451/466 (96.78)	488/508 (94.29)	461/500 (90.68)	2.544 [1.383, 4.688]	0.003	2.064 [1.186, 3.592]	0.010
Women of Childbearing Age (15-49 years)	998/1,031 (96.79)	990/1,035 (95.65)	934/991 (94.09)	1.846 [1.191, 2.859]	0.006	1.343 [0.899, 2.005]	0.149

Table 4 Reported fever care seeking and treatment behavior by intervention arm

	Supportive supervision + Community mobilization	Community mobilization	Control	Supportive supervision + Community mobilization versus Control		Community mobilization versus Control	
	n/N (%)	n/N (%)	n/N (%)	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value
Prompt fever diagnosis (<24 hrs)							
Total fever cases	261/378 (69.05)	260/381 (68.24)	248/365 (67.95)	1.05 [0.772, 1.434]	0.746	1.014 [0.745, 1.379]	0.931
Children under 5 years	46/68 (67.65)	54/74 (72.97)	42/68 (61.76)	0.773 [0.382, 1.564]	0.473	0.598 [0.295, 1.22]	0.156
Women	71/99 (71.72)	81/126 (64.29)	65/106 (61.32)	1.054 [0.777, 1.429]	0.736	1.106 [0.814, 1.501]	0.520
Prompt fever diagnosis (<24 hrs) by a trained provider							
Total	229/378 (60.58)	226/381 (59.32)	183/365 (50.14)	1.529 [1.143, 2.045]	0.004	1.450 [1.086, 1.937]	0.012
Children under 5 years	43/68 (63.24)	47/74 (63.51)	32/68 (47.06)	1.935 [0.975, 3.840]	0.059	1.958 [1.001, 3.832]	0.049
Women	61/99 (61.61)	81/126 (64.29)	49/106 (47.22)	1.867 [1.070, 3.258]	0.028	2.094 [1.235, 3.549]	0.006
Fever diagnosed by a CHW							
Total	106/378 (28.04)	105/381 (27.56)	70/365 (19.18)	1.642 [1.164, 2.316]	0.005	1.603 [1.114, 2.262]	0.007
Children under 5 years	13/53 (24.53)	12/55 (21.82)	9/53 (16.98)	1.589 [0.614, 4.115]	0.340	1.364 [0.522, 3.567]	0.526
Women	29/99 (29.29)	34/126 (26.98)	20/106 (18.87)	1.782 [0.929, 3.417]	0.082	1.589 [0.850, 2.971]	0.147

	Supportive supervision + Community mobilization	Community mobilization	Control	Supportive supervision + Community mobilization versus Control		Community mobilization versus Control	
	n/N (%)	n/N (%)	n/N (%)	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value
Prompt (<24 hrs) fever diagnosis by a CHW							
Total	87/106 (82.08)	83/105 (79.05)	47/70 (67.14)	2.241 [1.108, 4.529]	0.025	1.846 [0.930, 3.664]	0.080
Children under 5 years	12/13 (92.31)	9/12 (75.00)	6/9 (66.67)	7.549 [0.509, 70.668]	0.154	1.500 [0.223, 10.077]	0.677
Women	24/29 (82.76)	26/34 (76.47)	16/20 (80.00)	1.2 [0.279, 5.162]	0.807	1.846 [0.930, 3.664]	0.080
Fever treatment by provider							
Community Health Worker	106/378 (28.04)	105/381 (27.56)	70/365 (19.18)	1.642 [1.164, 2.316]	0.005	1.603 [1.137, 2.617]	0.007
Other trained providers	43/378 (11.38)	44/381 (11.55)	29/365 (7.95)	1.487 [0.907, 2.439]	0.116	1.513 [0.924, 2.476]	0.100
Medical Doctors	161/378 (42.59)	154/381 (40.42)	164/365 (44.93)	0.909 [0.680, 1.215]	0.521	0.832 [0.622, 1.112]	0.213
Untrained providers	41/378 (10.85)	52/381 (13.65)	77/365 (21.10)	0.455 [0.302, 0.686]	0.000	0.591 [0.402, 0.869]	0.008
No treatment sought	27/378 (7.14)	26/381 (6.82)	25/365 (6.85)	1.046 [0.595, 1.839]	0.875	0.996 [0.564, 1.759]	0.989
Prompt (<24 hrs) fever treatment							
Total	236/378 (62.44)	226/381 (59.32)	190/365 (52.06)	1.530 [1.143, 2.051]	0.004	1.343 [1.005, 1.794]	0.046
Children under 5 years	48/71 (67.61)	47/74 (63.51)	35/68 (51.47)	1.968 [0.989, 3.915]	0.054	1.641 [0.839, 3.211]	0.148

	Supportive supervision + Community mobilization	Community mobilization	Control	Supportive supervision + Community mobilization versus Control		Community mobilization versus Control	
	n/N (%)	n/N (%)	n/N (%)	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value
Women	61/99 (61.61)	67/126 (53.18)	50/106 (47.17)	1.798 [1.031, 3.136]	0.039	1.272 [0.758, 2.134]	0.363
Prompt (<24 hrs) fever treatment by a trained provider							
Total	229/378 (60.58)	226/381 (59.32)	183/365 (50.14)	1.529 [1.143, 2.045]	0.004	1.450 [1.086, 1.937]	0.012
Children under 5 years	43/71 (63.24)	47/74 (63.51)	32/68 (47.06)	1.935 [0.975, 3.840]	0.059	1.958 [1.001 3.832]	0.050
Women	61/99 (61.62)	67/126 (54.03)	49/106 (47.12)	1.802 [1.030, 3.151]	0.039	1.319 [0.783, 2.224]	0.298

Figure 1 Timeline of intervention

Formative research; selection of implementing NGO; training of CHWs
Sep - Dec, 2009

Implementation of supportive supervision and community mobilization
Jan-Dec, 2010

Mass distribution of LLINs
Sep 2009-Jan 2010
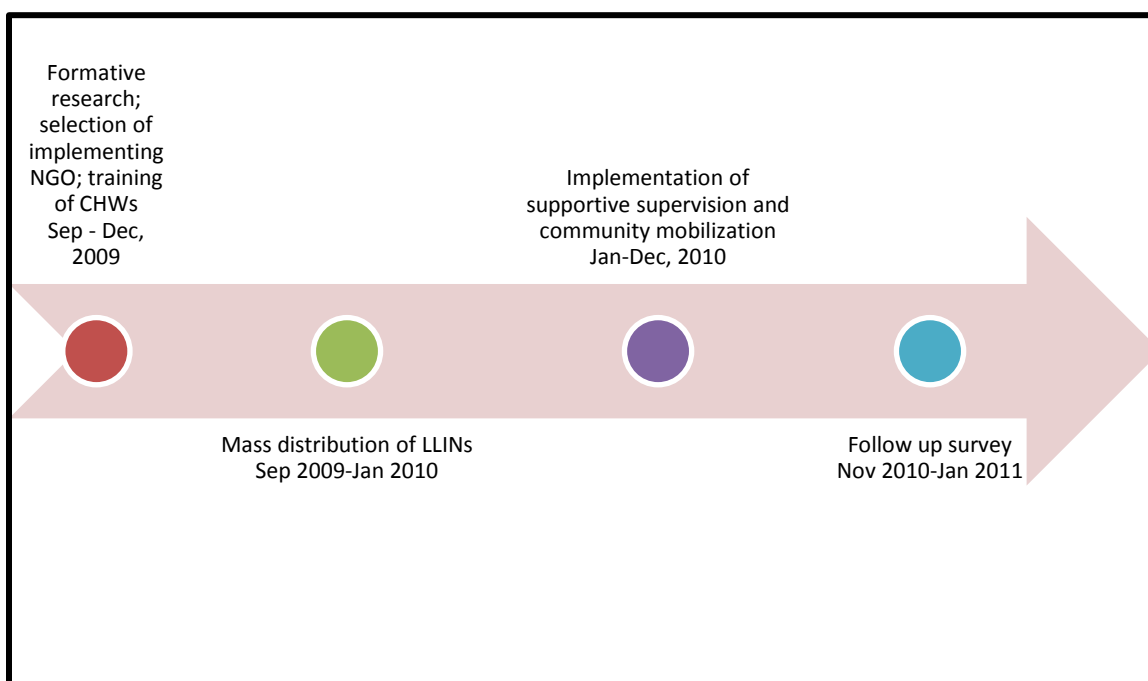
Follow up survey
Nov 2010-Jan 2011

Figure 2 Sample pictures of community mobilization materials and activities

---

Panel 1: Research in context

Systematic review

We searched for relevant records in PubMed from January 01, 1990 to December 31, 2013. We utilized a combination of MeSH and non-MeSH search terms such as "community mobilization" OR "community participation" OR "supportive supervision" AND "malaria". The records were restricted to English language only.

Interpretation

As far as we know, this is the first community-based randomized intervention testing the effectiveness of supportive supervision of community health workers to improve the health seeking behavior of the population in a malaria endemic setting. Our findings show a significant improvement in the utilization of bed nets and timely care seeking for febrile illnesses. The interventions were integrated within the existing health systems and community level structures that could make them sustainable.

Appendix 1

Summary community mobilization activities conducted in both treatment arms

Method	Frequency
Community hoarding (billboards)	One in each village
Community meetings	Twice a year each separately for men's groups, women's groups, village health and sanitation committees, churches
Flip book	Distributed during the community meetings once a year
Community based organization booklet	Distributed during the community meetings once a year
School meetings	Twice a year
School booklet and malaria wheel	Distributed during the schools meetings twice a year
Folk media (street play)	Twice a year
Audio-visual show	Twice a year
Posters and leaflets	Distributed during street play and audio-visual show, community meetings

Appendix 2

Cost effectiveness analysis

Cost data were calculated from a provider's perspective for each type of intervention consisting of human resources (including time, travel and per diems), training, community mobilization, stationery and overheads. Total cost was divided by the population for the study area to compute per capita cost of the interventions. The costs were compared with the outcomes (i.e. bed net use and timely treatment seeking) extrapolated at the population level for the study clusters. The effectiveness of the interventions were defined by the gains in the outcomes, e.g. additional people sleeping under the bed net compared to the standard program. Incremental cost effectiveness ratios (ICER) were calculated by dividing the differences in cost between intervention and control (incremental cost) with the differences in the outcomes between intervention and control (incremental effectiveness) as shown by the formula below.

$$ICER = \frac{Cost_{Intervention} - Cost_{Control}}{Outcome_{Intervention} - Outcome_{Control}}$$

Two assumptions were made while doing the cost analysis. First, all members of the community were exposed equally to the interventions; second, for each assessed outcome, the amount was entirely spent on that particular outcome. No discounting was applied as the project was implemented for only a year. The mean exchange rate for the US dollar was 45.75 Indian Rupees (1 INR = 2 US Cents approx.) during the study period.

Cost effectiveness analysis
We compared the costs and outcomes between supportive supervision and community mobilization with the control arm as the base case. The per capita cost of the combined interventions was 97 US cents and community mobilization was 62 cents, whereas the routine program cost 10 cents (table A1). Applying the proportion of people sleeping under bed nets from the survey population (84.54% Arm A, 82.43% Arm B and 78.65% control) to the total population in the intervention area, we extrapolate that 38227 people sleeping under a bed net was estimated in Arm A, 37273 in Arm B, and 35564 in the control arm. Hence, relative to the control arm, 2663additional people slept under a bed net in Arm A and 1709 in Arm B. The combined interventions (Arm A) would cost $13.07 per additional person reported to sleep under a bed net the night before the survey, whereas only community mobilization (Arm B) would cost $14.26. We applied similar principles to estimate the incremental effectiveness of other outcome indicators on timely diagnosis and treatment. Between the two interventions, the combined interventions arm was thus most effective at increasing bed net use, timely diagnosis by a trained provider, and timely treatment by a CHW. Community mobilization, on the other hand was cost-effective at improving timely diagnosis by a CHW and timely treatment by a trained provider.

Table A1 Cost-effectiveness analysis of the interventions

	Supportive supervision and community mobilization	Community mobilization	Standard program
Population coverage [A]	39645	45218	34402
Total cost of intervention (USD) [B]	38388	27959	3584
Per capita cost (USD) [B/A]	0.97	0.62	0.10
Incremental cost with control as the base (USD) [C]	34803.96	24375.11	CG
Proportion of survey sample sleeping under a bednet (%) [D]	84.54	82.43	78.65
Estimated number sleeping under a bed net [E = D*A]	38227	37273	35564
Additional people sleeping under a bed net with control as the base [F]	2663	1709	CG
Incremental cost-effectiveness ratio for bed net use (USD) [C/F]	13.07	14.26	CG
Estimated fever cases [G]	1018	1018	1017
Proportion of survey sample timely diagnosis by a CHW (%) [H]	82.08	79.05	67.14
Estimated fever cases diagnosed timely by a CHW [I = H*G]	836	805	683
Additional fever cases diagnosed timely by a CHW with control as the base [J]	153	122	CG
Incremental cost-effectiveness ratio for timely diagnosis by a CHW (USD) [C/J]	227.48	199.80	CG
Proportion of survey fever sample timely diagnosis by a trained provider (%) [K]	53.87	50.92	44
Estimated fever cases diagnosed timely by a trained provider [L = K*G]	549	519	450
Additional fever cases diagnosed timely by a trained provider with control as the base [M]	98	68	CG
Incremental cost-effectiveness ratio for timely diagnosis by a trained provider (USD) [C/M]	355.14	358.46	CG
Proportion of survey fever sample timely treated by a CHW (%) [N]	21.4	12.3	2.7
Estimated fever cases timely treated by a CHW [O = N*G]	218	126	27
Additional fever cases timely treated by a CHW with control as the base [P]	191	81	CG
Incremental cost-effectiveness ratio for timely treatment by a CHW (USD) [C/P]	182.22	300.93	CG
Proportion of survey fever sample timely treated by a trained provider (%) [Q]	60.82	59.32	51
Estimated fever cases timely treated by a trained provider [R = Q*G]	619	604	515
Additional fever cases timely treated by a trained provider with control as the base [S]	104	89	CG
Incremental cost-effectiveness ratio for timely treatment by a trained provider (USD) [C/S]	334.34	274.65	CG

ICER - Incremental cost-effectiveness ratio; CG – Comparison group