Proximity to a community health worker is associated with utilization of malaria treatment services in the community among under-five children: a cross-sectional study in rural Uganda

Micheal Mazzi[a,b,*], Francis Bajunirwe[a], Emmanuel Aheebwe[a], Simpson Nuwamanya[a] and Fred N. Bagenda[a]

[a]*Mbarara University of Science and Technology, Department of Community Health, P.O. Box 1410, Mbarara, Uganda;* [b]*Lakka Infectious Disease Hospital, Ministry of Health and Sanitation, Freetown, Sierra Leone*

*Corresponding author: Tel: +23278360558/+256755059023; E-mail: mazzimicheal@yahoo.com

Background: In rural areas of sub-Saharan Africa, health facilities are difficult to access for prompt treatment of malaria. Community health workers (CHWs) have been trained and equipped to treat malaria. Utilization of their service has not been adequately evaluated. The aim of this study was to determine the level of utilization of CHWs, and whether distance and other factors influence the utilization.

Methods: The authors conducted a cross-sectional study among households with a child below 5 y of age and interviewed caregivers in Sheema district, rural western Uganda. Logistic regression was used to calculate adjusted ORs (aOR) for factors associated with use of CHW services.

Results: Among 547 households, 64% (338/528) reported using CHWs as the first point of consultation for their febrile children. Factors associated with the use of CHWs services were lower asset index (aOR=1.9, p=0.02), mother being the decision maker for site of first consultation (aOR=1.9, p=0.01), distance to nearest CHW of <3 km (aOR=2.1, p=0.03) compared to >3 km, and trust for CHWs services (aOR=7.8, p<0.001).

Conclusion: Proximal location to a CHW is associated with use of CHW services. Programs should ensure that CHW are well located to enable easy access.

Keywords: caregivers, community health workers (CHW), household, malaria, prompt malaria treatment

Introduction

Malaria is still a leading cause of morbidity and mortality among children under 5 y old.[1] In 2015, there were 303 000 estimated under-5 deaths due to malaria globally and over 95% of them occurred in the African region.[2] In Africa, malaria is responsible for about 20–30% of hospital admissions and about 30–50% of outpatient consultations. In Uganda, 15–20% admissions[3] and 43% of under-5s inpatient mortality[4] are due to malaria, making the country third in the ranking of countries with the largest burden of cases of *Plasmodium falciparum* malaria.[5]

The WHO estimates that, a total of 33 million cases of malaria, diarrhea and pneumonia go untreated every year due to human resource gaps and missed opportunities in health facilities. Prompt access to treatment is one of the pillars in the fight against malaria.[6] However, facility-based services are not easily accessible, most especially within the critical period of 24 h after the onset of symptoms, defined as prompt treatment. The delay in receiving treatment results in an increased risk of disease severity and death, especially in young children.[7]

Although 72% of Uganda's population lives within a 5 km radius of a health facility,[8] significant challenges remain for caregivers to access services at these health facilities due to factors such as difficult terrain and low staffing levels at the facilities.

Community health workers (CHWs) are lay persons chosen by the community to promote the health and well-being of all village members.[9] They have been proposed as complementary to the shortfall in the health system because they promote equity in access to preventive and curative services at the household level.[10] Several studies have shown that CHWs can successfully test and treat for malaria in communities.[11] CHWs can now test

for malaria using rapid diagnostic tests (RDTs)[12] with safety and effectiveness,[13] and have been found to be well accepted by the community.[14] They have also been found to reduce consultation for malaria at health facilities[15] and to give high quality services.[4] The proximity of CHWs ensures prompt access to correct diagnosis and treatment for the largest majority.[16] CHWs, through community case management of all cases of malaria, can reduce overall and malaria-specific under-5 mortality by 40% and 60%, respectively, and severe malaria morbidity by at least one-half.[7]

Despite the demonstration of successful implementation of CHW activities in several countries, including Uganda,[17,18] data on the level of utilization varies widely in sub-Saharan Africa.[19] Secondly, many studies on CHWs have focused on their performance and less on factors associated with their utilization, such as distance and other potential factors, since iCCM was introduced. In addition, it is not clear what proportion of caregivers of under-5 children with fever will report to the CHW as their first point of consultation. Therefore, the purpose of this study was to determine the level of utilization of CHW services by caregivers of children under 5 y and the associated factors in rural Uganda. The results will inform CHW programs in rural settings on how best to increase utilization by identifying modifiable factors that promote or hinder utilization of CHW services.

Materials and methods

Study setting and population

A community-based cross-sectional survey was conducted between January and March 2017 among households in Kyangyenyi sub-county in Sheema District of western Uganda, a predominantly rural population that practices subsistence agriculture as the main source of livelihood. Sheema, like many other districts in Uganda, has received training of CHWs and is implementing integrated community case management (iCCM) of childhood illnesses. Kyangyenyi sub-county has a hilly terrain, making transportation to outside of the district difficult. iCCM was launched here in 2014. The sub-county has two parishes, Muzira and Matsyoro. Muzira has 12 villages with 24 CHWs and Matsyoro has 10 villages with 20 CHWs who were trained in iCCM. The total population in the sub-county is approximately 9396 people, with 18.5% being children under 5 y of age.[5] The sub-county has three health facilities, two at the parish level (health center level II) and one at sub-county level (health center level III). A household was enrolled if they had a child younger than 5 y. The study population was comprised of caregivers of these children. A caregiver was defined as any person 18 years or older who was directly responsible for providing care to the under-5s for a period of not less than 3 mo at the time of the study. A household was defined as a group of people who were living together and sharing meals.

Inclusion and exclusion criteria

Caregivers were eligible to participate if they had been resident in the study area for at least 3 mo at the time of the study. The caregiver must have had a child who had suffered from a fever within the 3 mo preceding the study. These interviews focused on the child who had had fever in the past 3 mo and, where two children in the same household had been reported to have fever, one of them was selected by a simple random process to be the subject of the interview.

Sample size consideration

The sample size was estimated using the prevalence formula [$n=z^2p(1-p)/d^2$] for single proportions,[20] where p is the estimated prevalence and d is the error margin. A standard normal value was used, $z = 1.96$, with an estimated utilization of CHW services of 57% based on a study in Uganda.[21] A margin of error of 5%, assuming 95% CI, and 1.2 as the design effect due to a cluster effect of households in some villages, yielded a final sample size of 547 participants.

Sampling strategy

A list was made of all villages located in the study parishes with the assistance of the Sheema District Planning Unit. The CHWs provided a list of households with children under 5 y of age within each village with approval from the village chairpersons. The list was used as the sampling frame, and from this 547 households were selected using simple random sampling. In case a household had more than one child under 5 y, lots were drawn to select one child to participate.

Data collection

The data collection team consisted of eight research assistants who received training in assessing for eligibility and administration of the study tool. The tool was pretested in another village that was not within the study area. The tool had questions about history of fever among under-5s in the last 3 mo, socio-demographic characteristics of caregivers, first source of consultation when the child gets a fever, decision maker on the first source of consultation, distance of household from nearest health facility and CHW, and type of housing. The housing was classified as 'temporary' if it was made of mud and wattle, 'semi-permanent' if it was one with iron sheets but not bricks, and 'permanent' if it was made of bricks and iron sheets. Household items were also used to assess socioeconomic status. Health-seeking behavior was measured, perception of quality of health services, and use and trust of CHW services. For instance, participants were asked whether they were satisfied with CHW services.

Distance between households and CHW or health facilities were classified differently. A distance of ±3 km from a CHW was used because a village is a smaller unit and, therefore, households can be closer and, in principle, CHWs should be within the nearest distance to the households they serve for easy access. For the health facilities, the Uganda Ministry of Health recommends a distance of no more than 5 km to a health facility; therefore, this was used as the cutoff for near versus far.

Data analysis

The data was checked for completeness, entered into Epi data (Version 3.1; Odense, Denmark) and analyzed using Stata version 11 (College Station, TX, USA). A descriptive analysis of the independent variables was conducted using means and medians for continuous variables, such as age, gender and proportions for categorical variables, such as marital status, occupation, religion, relationship of respondent to under-5-year-old, and awareness of CHW services. Principal components analysis was used to create a household socioeconomic status index, based on possession of household items including radio, television, bicycle, car, motorcycle and cell phone, using standard methods.[22] The index was divided into tertiles, and households were classified as low, medium or high wealth asset index. Land was excluded as this is commonly owned by the majority of households in rural Uganda.

A bivariate analysis was conducted to assess the association between several independent factors, including gender and age of the respondents, number of children under 5 in the household, number of children who had reported fever within the previous 3 mo, type of housing, distance from nearest health facility, distance from CHW, seeking for treatment when child had fever, and decision maker on first source of treatment, with dependent variables as use of CHWs services by caregivers for treatment of malaria. In this bivariate analysis, logistic regression was used to determine the ORs for the independent factors. A stepwise multivariate logistic regression was conducted with the variables that were found to be significant in the bivariate analysis ($p<0.05$). Variables that did not improve the fit of the regression model as measured by the log likelihood were left out. Factors for the multiple regression based on statistical significance and biological importance were considered, and factors that were correlated based on prior knowledge into the model were not included. Interactions were not tested for because there was no prior hypotheses on interactions. aORs and 95% CIs were then reported on.

The primary outcome of this study was utilization of CHW services by caregivers for the treatment of malaria in children under 5. Utilization of CHW services for malaria treatment was defined as accessing services for treatment of malaria within 24 h after the onset of fever.

Results

Baseline characteristics of respondents and their children

A total of 547 participants were enrolled in the study. Over 98% (514/522) lived within 5 km of a public health facility, with a mean distance of 1.6 km (Table 1). The mean time it took them to reach the nearest public health facility was 45.5 min (SD 34.9) and the main form of transport to the health facility was by foot, as reported by 89% (485/546) of the respondents. Almost 90% lived within 3 km of a CHW. About half of the children in the households visited were female. About 72% (391/545) were aged between 24 and 59 mo, with a mean age of 30.4 (SD 15.1) mo.

Table 1. Demographic characteristics of the caregivers

Variables	No.	n (%)
Gender of the respondent	547	
Female		496 (90.7)
Male		51 (9.3)
Age of the respondent (y)	546*	
18–24		152 (27.8)
25–49		327 (59.9)
≥50		67 (12.3)
Age of the respondents in years mean (SD)		32 (11)
Marital status	547	
Single		29 (5.3)
Married/cohabiting		460 (84.0)
Widowed		26 (4.8)
Divorced		32 (5.9)
Number of children under 5 y	546*	
1		333 (61.0)
2		179 (32.8)
3–4		34 (6.2)
Number of children who reported fever in the last 3 mo in a household	545*	
1		506 (92.9)
2		36 (6.6)
3		3 (0.6)
Wealth Asset Index	547	
1st tertile (low)		331 (60.5)
2nd tertile (medium)		100 (18.3)
3rd tertile (high)		116 (21.2)
Distance to the nearest public health facility (km)	522*	
<5		514 (98.5)
≥5		8 (1.5)
Mean distance to nearest public health facility (km)		1.6 (S.D 1.1)
Distance to the nearest CHW (km)	545*	
<3		490 (89.9)
≥3		55 (9.1)

*Some participants did not answer question.

Health-seeking behavior of the respondents

About 97% (528/543) of the respondents had sought some form of treatment when the child had a fever. Sixty-four percent (338/528) went to CHWs as the first source of consultation, while the rest went to either public or private health facilities, and 1.5% (8/525) consulted a traditional healer first. Sixty-nine percent (377/547) of the respondents mentioned that the mother was the major decision maker on where to take the child first for treatment in case of fever (Table 2).

Community factors influencing use of CHWs

Table 3 shows the community factors that influence the use of CHWs. The majority of caregivers reported that they were aware

Table 2. Health-seeking behavior of caregivers of children under 5 y in Sheema, western Uganda

Variable	No.	n (%)
Seeking for treatment when the child was sick	543*	
Yes		528 (97.2)
No		15 (2.8)
First source of consultation when child had a fever	528	
CHW		338 (64.0)
Public health facility		87 (16.5)
Private health facility		94 (17.8)
Traditional healer		9 (1.7)
Decision maker for first source of consultation	547	
Father		121 (22.1)
Mother		377 (68.9)
Grandmother		68 (12.4)
Grandfather		5 (0.9)
Sister/brother		1 (0.2)

*Some participants did not answer question.

Table 3. Community factors influencing use of CHWs among caregivers of children under 5 y in Sheema, western Uganda

Variable	No.	n(%)
Awareness of CHWs services by the community	539*	
Yes		517 (95.9)
No		22 (4.1)
Availability of CHW at home ready to offer treatment to the child	437*	
Yes		431 (98.6)
No		06 (1.4)
Trust for CHW services by the community	536*	
Agree		471 (87.9)
Disagree		24 (4.5)
Uncertain		41 (7.7)
Satisfaction with the CHW services by the community	509*	
Yes		414 (81.3)
No		95 (18.7)

*Some participants did not answer question.

of the CHWs services. They also reported having trust and being satisfied with the services offered by CHWs.

Factors associated with the utilization of CHW services for treatment of malaria among children under 5 y

Table 4 shows that respondents within the first or low asset index rank were more likely to use CHW services compared with

those in the third or high asset index class (aOR=1.9, 95% CI 1.2 to 3.3, p=0.02). The other demographic factors did not show statistical significance. In circumstances where the mother was the decision maker, households were more likely to use CHW services compared with those where the mother was not (aOR=1.9, 95% CI 1.2 to 2.9, p=0.01). Participants who reported having trust for CHW services were more likely to use the services compared with those who did not trust the services (aOR=7.8, 95% CI 2.6 to 24.2, p<0.001).

Households that were within less than 3 km of a CHW were more likely to use the CHW services compared with those who were living more than 3 km from a CHW (aOR= 2.1, 95% CI 1.5 to 4.6, p=0.02).

Discussion

This community-based study found that a high proportion of the study participants used CHWs as the first point of contact for their febrile children. There is a high level of trust for CHWs and this may partly explain the high utilization rate. Other studies have shown that the high utilization may be explained by reduced expenses of transport, testing for malaria with RDTs[23] and showing high adherence to test results.[24] This study adds to the data that show that utilization of CHW services can be high. An intervention study in Zambia showed that the proportion of caregivers that sought care for their children from CHWs was high and increased, while that of patients seeking care from the rural health centers declined.[25] However, success has not been reported everywhere. Although this study shows a higher rate of utilization, a study in Eastern Uganda showed much lower utilization of CHWs at 57%.[21] In the West African country of Burkina Faso, one study showed that CHW services were rarely used.[26] This study showed that less than 9% of sick children consulted a CHW in rural areas, much lower than in this study.

This study found that several other factors that were significantly associated with the utilization of CHW services for the treatment of malaria. The factors included proximity to the CHW, asset index rank, mother as decision maker for where to seek care and trust for CHW services.

The respondents from households in the low wealth asset index category were more likely to use CHW services compared with those in the high wealth asset index. These data suggest that poorer persons are more likely to utilize CHW services for malaria compared with richer ones. These findings are in agreement with those in another study, in Kenya,[27] where data showed that while provision of iCCM services was not based on household wealth ranking, mothers from the poorest households were more likely to use CHW services. This study also agrees with another one conducted in Kenya,[28] which found that in a resource-limited setting, poorer persons were more likely to use CHW services.

This study showed that mothers are key decision makers about where to seek treatment and that, where the mother is the decision maker, they are more likely to use the CHW services. This may be due to the fact that the children under 5 y are more likely to be with their mother than the father or other guardian. If the child gets fever, the mothers might find a CHW

Table 4. Bivariate and multivariate analysis for factors associated with use of CHW services for treatment of malaria in children under 5 y in Sheema, western Uganda

Variable	No CHW use	CHW use	Crude OR	p value	Adjusted OR	p-value
Wealth Asset Index						
1st tertile (low)	93 (29.4)	223 (70.6)	2.2 (1.4,3.4)		1.9 (1.2–3.3)	0.02
2nd tertile (medium)	43 (43.9)	55 (56.1)	1.2 (0.7,2.0)	0.0006*	1.1 (0.7–1.7)	
3rd tertile (high)	54 (47.4)	60 (52.6)	1.0		1.0	
Mother is decision maker on first source of consultation						
Yes	122 (32.9)	249 (67.1)	1.5 (1.1,2.3)	0.0234*	1.9 (1.2–2.9)	0.01
No	68 (43.3)	89 (56.7)	1.0		1.0	
Awareness of CHW services by the community						
Yes	174 (34.7)	328(65.3)	6.5 (2.1, 20.3)	0.0002*		
No	14 (77.8)	4 (22.2)	1.0			
Trust for CHW services by the community						
Agree	137 (29.8)	323 (70.2)	6.2 (2.4,16.4)	0.0000*	7.8 (2.6–24.2)	p<0.001
Disagree	16 (72.7)	6 (27.3)	1.0		1.0	
Uncertain	32 (86.5)	5 (13.5)	0.4 (0.1–1.0)		0.7 (0.1–3.0)	
Satisfaction with CHW services						
Yes	128 (31.7)	276 (68.3)	2.3 (1.4–3.6)	0.0007*		
No	45 (51.1)	43 (48.9)	1.0			
Distance to nearest health facility (km)						
5 or more	175 (35.4)	320 (64.6)	1.0	0.0234*		
Less than 5	6 (75)	2 (25.0)	0.2 (0.01–0.9)			
Distance to nearest CHW (km)						
Less than 3	95 (19.5)	391 (80.5)	1.8 (1.2–3.8)	0.0372*	2.1 (1.5–4.6)	0.02
3 or more	38 (73.1)	14 (26.9)	1.0		1.0	

*Factors used in multi-variate analysis.

to be more accessible than the health center, where they would need to cover transport fees and other costs. These study findings differ from those for a similar study in Kenya,[29] where the decision on when and where to take the child for treatment was made by the father.

These data showed that households that were nearer the CHW were more likely to use their services. The proximity brings the convenience of easy access. These data indicate a large proportion of households are living within 3 km of a CHW, and hence have easy access. These findings are in agreement with another study done in Uganda,[30] where distance to the CHW was one of the factors that were positively associated with the use of iCCM services. In this study, the authors noted that the short distance to reach the CHWs served the purpose of accessing the service within 24 h well. Because a significant proportion of persons still live far from health facilities,[31] CHWs will continue to play a significant role in improving their access to malaria treatment, which remains a major challenge in many areas of sub-Saharan Africa.[32]

This study showed that the majority of respondents trust the CHWs. Typically, CHWs are chosen by the community and are, hence, respected members. The principle of test and treat[33] has improved this trust, as the CHWs have proved to be capable of treating malaria among children under 5 safely.[34] The CHWs are also involved in other activities of health promotion, such as immunization, hygiene practices, visiting homes for health education and referral of patients. The communities now appreciate the CHW services more, probably due to the wider range available. The CHWs here also received training in iCCM and, in the process, improved their skills in handling children and counseling the mothers. Studies in the region have shown that training of CHWs on how to use RDTs improves their performance and increases their trust.[35] A study in Iganga, eastern Uganda, showed that CHWs were trusted by the majority of the community members, because of their commitment to volunteering, access and the perception that the anti-malarial medicines that they dispense to treat children work effectively.[36]

This study has some weaknesses. First, the distance to the CHW was self-reported and not objectively measured. Some participants may have over- or under estimated the distance, resulting in potential bias of these findings, especially since, for HIV patients, GPS-based, rather than self-reported, distance has been found to be correlated with treatment outcomes in rural Uganda.[37] Secondly, although this study shows distance is related to utilization of CHW services, it was not possible to test for spatial autocorrelation, due to the lack of geocoordinates of households. Thirdly, although the sample size was adjusted upwards due to potential clustering at village level for households in the same village, this study did not have a cluster sampling design and cluster analysis methods were not deployed; these analyses would require a much larger sample size. Future larger surveys should deploy cluster sampling designs and

analytical strategies that adjust for the clustering effect. Fourthly, attributes such as patient satisfaction and trust of the CHW were not measured with validated scales. Such scales need to be developed to ensure uniform measurement for these attributes for future studies.

In conclusion, the majority of caregivers with a febrile child use CHW services as their first point of consultation. Proximity to the CHW, trust for CHW services, the mother being decision maker on the first point for consultation and lower asset index were all associated with utilization of the CHW services. The authors recommend that CHW services should be brought closer to those households that are far away from these services, especially those that live further away from health centers.

Ethical approval: The study was approved by the Faculty of Medicine Research and Ethics Committee (FREC) and the Research Ethics Committee (REC) of Mbarara University of Science and Technology (Ref No. MUREC 1/7). Permission was obtained to collect data from the District Health Officer of Sheema, and verbal consent was obtained from the village chairperson and sub-county chief. At the household level, participants were informed of the study purpose and, objectives, and that participation was purely voluntary, with no penalties to the respondent in case they declined to participate. Study participants provided written informed consent before study procedures were conducted.

References

1 Buchner DL, Brenner JL, Kabakyenga J et al. Stakeholders' perceptions of integrated community case management by community health workers: a post-intervention qualitative study. PLoS One 2014;9(6):e98610.

2 World Health Organization. World Malaria Report 2016. Geneva: WHO. http://www.who.int/malaria/media/world-malaria-report-2016/en/ [Accessed 31 May 2018].

3 Rwashana A, Nakubulwa S, Nakakeeto-Kijjambu M et al. Uganda Malaria Indicator Survey 2014–15: key indicators. Health Res Policy Syst 2016;12(3):36.

4 Miller JS, English L, Matte M et al. Quality of care in integrated community case management services in Bugoye, Uganda: a retrospective observational study. Malar J 2018;17(1):99.

5 UBOS and ICF International, Uganda Bureau of Statistics (UBOS) and ICF. Uganda Demographic and Health Survey 2016: Key Indicators Report. Kampala, Uganda. Rockville, MD: UBOS and ICF; 2017.

6 Hetzel MW, Iteba N, Makemba A et al. Understanding and improving access to prompt and effective malaria treatment and care in rural Tanzania: the ACCESS Programme. Malar J 2007;6(1):83.

7 Young M, Wolfheim C, Marsh DR et al. World Health Organization/ United Nations Children's Fund joint statement on integrated community case management: an equity-focused strategy to improve access to essential treatment services for children. Am J Trop Med Hyg 2012;87(5_Suppl):6–10.

8 MoH Uganda. Second National Health Policy, Ministry of Health Uganda, 2010. https://www.unicef.org/uganda/The_Second_National_ Health_Policy.pdf [accessed 9 June 2018].

9 Lehmann U, Sanders D. Community health workers: what do we know about them. The state of the evidence on programmes, activities, costs and impact on health outcomes of using community health workers. Geneva: World Health Organization; 2007, p. 1–42.

10 McCollum R, Gomez W, Theobald S et al. How equitable are community health worker programmes and which programme features influence equity of community health worker services? A systematic review. BMC Public Health 2016;16(1):419.

11 Counihan H, Harvey SA, Sekeseke-Chinyama M et al. Community health workers use malaria rapid diagnostic tests (RDTs) safely and accurately: results of a longitudinal study in Zambia. Am J Trop Med Hyg 2012;87(1):57–63.

12 Paintain LS, Willey B, Kedenge S et al. Community health workers and stand-alone or integrated case management of malaria: a systematic literature review. Am J Trop Med Hyg 2014;91(3):461–70.

13 Mubi M, Janson A, Warsame M et al. Malaria rapid testing by community health workers is effective and safe for targeting malaria treatment: randomised cross-over trial in Tanzania. PLoS One 2011;6 (7):e19753.

14 Phiri TB, Kaunda-Khangamwa BN, Bauleni A et al. Feasibility, acceptability and impact of integrating malaria rapid diagnostic tests and pre-referral rectal artesunate into the integrated community case management programme. A pilot study in Mchinji district, Malawi. Malar J 2016;15(1):177.

15 Yansaneh AI, Moulton LH, George AS et al. Influence of community health volunteers on care seeking and treatment coverage for common childhood illnesses in the context of free health care in rural Sierra Leone. Trop Med Int Health 2014;19(12):1466–76.

16 Kamal-Yanni MM, Potet J, Saunders PM. Scaling-up malaria treatment: a review of the performance of different providers. Malar J 2012;11(1):414.

17 Nsona H, Mtimuni A, Daelmans B et al. Scaling up integrated community case management of childhood illness: update from Malawi. Am J Trop Med Hyg 2012;87(5_Suppl):54–60.

18 Kalyango JN, Rutebemberwa E, Alfven T et al. Performance of community health workers under integrated community case management of childhood illnesses in eastern Uganda. Malar J 2012;11(1): 282.

19 Christopher JB, Le May A, Lewin S et al. Thirty years after Alma-Ata: a systematic review of the impact of community health workers delivering curative interventions against malaria, pneumonia and diarrhoea on child mortality and morbidity in sub-Saharan Africa. Hum Resour Health 2011;9(1):27.

20 Kish L. Samples and censuses. Int Stat Rev 1979:99–109.

21 Mukanga D, Tibenderana JK, Peterson S et al. Access, acceptability and utilization of community health workers using diagnostics for

case management of fever in Ugandan children: a cross-sectional study. Malar J 2012;11(1):121.

22 Vyas S, Kumaranayake L. Constructing socio-economic status indices: how to use principal components analysis. Health Policy Plan 2006;21(6):459–68.

23 Thiam S, Thwing J, Diallo I et al. Scale-up of home-based management of malaria based on rapid diagnostic tests and artemisinin-based combination therapy in a resource-poor country: results in Senegal. Malar J 2012;11(1):334.

24 Ruizendaal E, Dierickx S, Grietens KP et al. Success or failure of critical steps in community case management of malaria with rapid diagnostic tests: a systematic review. Malar J 2014;13(1):229.

25 Yeboah-Antwi K, Pilingana P, Macleod WB 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.

26 Druetz T, Ridde V, Kouanda S et al. Utilization of community health workers for malaria treatment: results from a three-year panel study in the districts of Kaya and Zorgho, Burkina Faso. Malar J 2015;14(1): 71.

27 Kisia J, Nelima F, Otieno DO et al. Factors associated with utilization of community health workers in improving access to malaria treatment among children in Kenya. Malar J 2012;11(1):248.

28 Siekmans K, Sohani S, Kisia J et al. Community case management of malaria: a pro-poor intervention in rural Kenya. Int Health 2013;5(3): 196–204.

29 Abubakar A, Van Baar A, Fischer R et al. Socio-cultural determinants of health-seeking behaviour on the Kenyan coast: a qualitative study. PLoS One 2013;8(11):e71998.

30 Muhumuza G, Mutesi C, Mutamba F et al. Acceptability and utilization of community health workers after the adoption of the Integrated Community Case Management Policy in Kabarole District in Uganda. Health Syst Policy Res 2015;2(1):13.

31 Marsh DR, Hamer DH, Pagnoni F et al. Introduction to a special supplement: evidence for the implementation, effects, and impact of the integrated community case management strategy to treat childhood infection. Am J Trop Med Hyg 2012;87(5_Suppl):2–5.

32 Chuma J, Okungu V, Molyneux C. Barriers to prompt and effective malaria treatment among the poorest population in Kenya. Malar J 2010;9(1):144.

33 Chanda P, Hamainza B, Moonga HB et al. Community case management of malaria using ACT and RDT in two districts in Zambia: achieving high adherence to test results using community health workers. Malar J 2011;10(1):158.

34 Hamer DH, Brooks ET, Semrau K et al. Quality and safety of integrated community case management of malaria using rapid diagnostic tests and pneumonia by community health workers. Pathog Glob Health 2012;106(1):32–9.

35 Ratsimbasoa A, Ravony H, Vonimpaisomihanta J-A et al. Management of uncomplicated malaria in febrile under five-year-old children by community health workers in Madagascar: reliability of malaria rapid diagnostic tests. Malar J 2012;11(1):85.

36 Mukanga D, Tibenderana JK, Kiguli J et al. Community acceptability of use of rapid diagnostic tests for malaria by community health workers in Uganda. Malar J 2010;9(1):203.

37 Siedner MJ, Lankowski A, Tsai AC et al. GPS-measured distance to clinic, but not self-reported transportation factors, are associated with missed HIV clinic visits in rural Uganda. AIDS 2013;27(9):1503.