Increased Use of Community Medicine Distributors and Rational Use of Drugs in Children Less than Five Years of Age in Uganda Caused by Integrated Community Case Management of Fever

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Abstract. We compared use of community medicine distributors (CMDs) and drug use under integrated community case management and home-based management strategies in children 6–59 months of age in eastern Uganda. A cross-sectional study with 1,095 children was nested in a cluster randomized trial with integrated community case management (CMDs treating malaria and pneumonia) as the intervention and home-based management (CMDs treating only malaria) as the control. Care-seeking from CMDs was higher in intervention areas (31%) than in control areas (22%; *P* = 0.01). Prompt and appropriate treatment of malaria was higher in intervention areas (18%) than in control areas (12%; *P* = 0.03) and among CMD users (37%) than other health providers (9%). The mean number of drugs among CMD users compared with other health providers was 1.6 versus 2.4 in intervention areas and 1.4 versus 2.3 in control areas. Use of CMDs was low. However, integrated community case management of childhood illnesses increased use of CMDs and rational drug use.

INTRODUCTION

Approximately 1.4 million children in Africa die of malaria and pneumonia each year.[1] Effective drugs for treatment of these two illnesses are available, but they should be administered promptly, i.e., within 24 hours, to minimize the adverse outcomes of the illnesses.[2,3] However, caregivers experience several barriers and children do not always receive timely and effective treatment.[4–9]

Efforts to overcome some of these barriers were made through the introduction of the so called home-based management of fever strategy (HBMF) in regions with endemic malaria. Uganda was one of the first countries to implement this strategy in 2002. In this strategy, community medicine distributors (CMDs), also known as community drug distributors or community health workers, treat children with fever in the community with antimalarial drugs.[10–12] The CMDs lacked formal medical training but were trained for at least five days in management of fever as a symptom of malaria. The proportion of children receiving prompt and appropriate treatment increased with this strategy, but was nevertheless below the 2000 Abuja targets of 60%[13] and its use was low.[7,9,14,15] Furthermore, some children with other illnesses (e.g., pneumonia) were treated with antimalarial drugs[16] because of symptom overlap or co-infection.[17]

Integrated community case management of childhood illnesses (ICCM) was recommended in 2004 and has been adopted by some countries, including Uganda. In ICCM, CMDs use an evidence-based algorithm to treat children at the community level with antimalarial drugs, antibiotics, and oral rehydration salts. More drugs are accessible to the community under ICCM than under HBMF and this increased acccessibility may improve treatment patterns of children. However, easy access to drugs could also promote drug misuse, leading to wasting of resources and development of resistance to antibiotics. In Zambia, ICCM improved pneumonia

treatment of children treated by CHWs.[18] However, it remains unclear whether this new strategy will improve use and appropriateness of treatment compared with what has been achieved with the HBMF strategy in other settings with different care-seeking and treatment practices. Therefore, the aim of this study was to compare the effect of ICCM and HBMF strategies on use of CMDs and community drug use patterns in children 6–59 months of age.

METHODS

Study design and setting. A cross-sectional study was conducted during January–February 2011 in Iganga-Mayuge Health and Demographic Surveillance Site in eastern Uganda. The population in the area is approximately 70,000 persons living in 13,000 households in 65 villages, where approximately 90% live in rural areas. Malaria is endemic to the area, and there are two main transmission seasons (March and September). The population of children less than five years is approximately 11,000 and the mortality rate in children less than five years of age is 128 per 1,000 live births.[19] The study area has 10 government and 3 non-governmental organization health facilities, 122 drug shops and private clinics, and 132 CMDs. A cluster randomized trial to evaluate the impact of integrated presumptive management of malaria and pneumonia with antimalarial drugs and antibiotics on mortality in children less than five years of age has been ongoing in the area since 2009 (trial registration no. ISRCTN52966230).

Description of cluster randomized trial. The 65 villages in the area were aggregated into 8 urban and 18 rural clusters, which were then randomized to either intervention arm or control arm. Each village has two CMDs that treat children less than five years of age. The basic criteria for working as a CMD are that one is able to read and write, is chosen by the community, and has received short-term training in treatment of children. The CMDs were all trained initially for one week in the management of malaria. In the intervention arm, the CMDs received additional training in the management of pneumonia for one week. Finally, CMDs in both arms receive monthly refresher training. In the intervention arm,

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CMDs treat children with fever using antimalarial drugs (artemether–lumefantrine [AL]). Children with non-severe respiratory symptoms according to Integrated Management of Childhood Illnesses guidelines[20] are also treated with antibiotics (amoxicillin). In the control arm, CMDs treat children with fever using antimalarial drugs (AL), and those with respiratory symptoms of any severity are referred to health facilities. In both arms, children with severe respiratory or severe malaria symptoms[20] are referred to health facilities (Figure 1). The medicines used by the CMDs were pre-packaged in age-specific doses. Health workers from the nearest health center or hospital conduct monthly support supervision of CMDs in both arms to assess drug storage, treatment practices, and record keeping. Before the start of the study, community sensitization seminars about the intervention, recognition of illness in children, and prompt care seeking were conducted.

Participants and sampling. We sampled 1,400 children 6–59 months of age from the health and demographic surveillance site database by using random sampling stratified by intervention and control villages to obtain equal numbers from each arm of the cluster randomized trial. We assumed that with expected non-response rate of 25% based on a previous study in the area,[21] this would give us 1,094 children (547 in each arm) that we needed to answer the objectives. The sample size was estimated by using the formula for comparison of two proportions with adjustment for clustering.[22] Assumptions used were 5% level of significance, 80% power, design effect of 1.9, 54% of children ill in previous 2 weeks,[23] and a change in proportion of children receiving prompt and appropriate treatment of malaria equivalent to what was observed under HBMF (i.e., 7.4–13.5%),[9] giving a change rate of 13.5–24.3%. This sample size was also adequate to detect a 30% difference in use of CMDs in the intervention and control areas. All children whose caregivers were available at home and consented to participate in the study were enrolled.

Data collection. Eight experienced and trained interviewers used a pre-tested questionnaire to interview the caregivers. The interviewers were supervised by a pharmacist (Joan N. Kalyango) and a pediatrician (Ann Lindstrand). Data were collected on knowledge about fever, malaria, and pneumonia; perceptions of quality of care; availability of health providers; illness in the previous two weeks; care-seeking patterns; and treatment received including the dose, frequency, duration, timeliness, and source.

Medicine posters showing drugs commonly used in the area for treatment of children were used to help the caregivers to identify which treatment children had received. Medicine packages, when available, were also checked to confirm the drug and dose prescribed. Data on child and caregiver demographics, distances of the households from the nearest CMD (using global positioning system coordinates), and the wealth index of the household were extracted from the health and demographic surveillance site data base. The wealth index was computed by using principal components analysis on the basis of household characteristics and assets similar to those used by the Uganda Bureau of Statistics,[19] and categorized into five quintiles of relative wealth (poorest to least poor) as described elsewhere.[24]

Variable definitions. A child was considered as having had malaria if the caregiver reported fever in the previous two weeks.[25] Self-reported pneumonia symptoms were defined as caregiver report of cough and fast breathing with or without fever; cough and difficult breathing with or without fever; difficult and fast breathing with or without fever; and fever and difficult breathing.[2]

We categorized treatment as appropriate if the child used the recommended drug, dose, frequency, and duration. In addition, if the child used appropriate treatment promptly, i.e., if it was administered on the day of onset of symptoms or the next day,[14,23] it was categorized as prompt and appropriate.[9] Assessment for appropriateness of treatment was conducted for the first treatment given to the child (i.e., first treatment action) and for the second treatment given to the child if they needed further treatment (i.e., second treatment action).

We based assessment of appropriateness of medicines used on national[26] and CMD treatment guidelines,[27] and treatment recommendations of the British National Formulary,[28] which is widely used in Uganda. The medicines considered
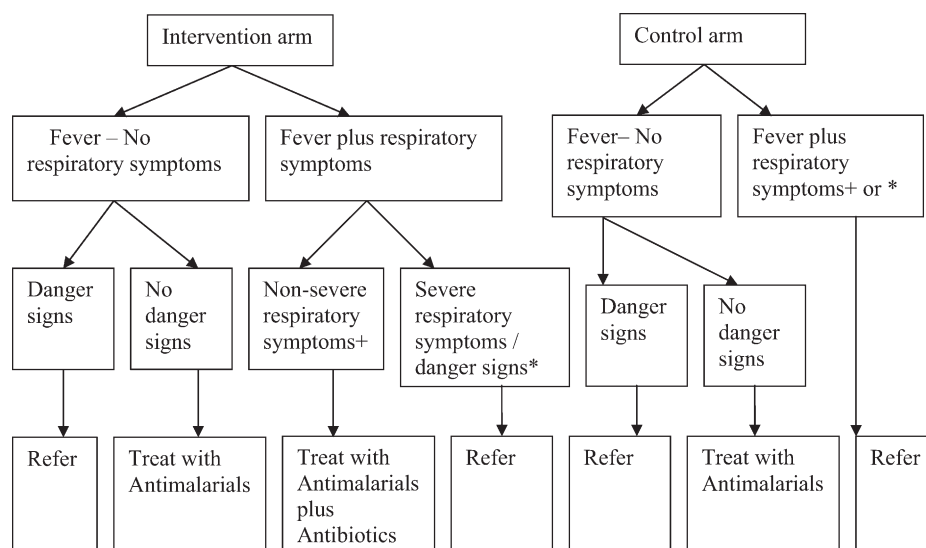

FIGURE 1. Algorithm for treatment of children by Community Medicines Distributors in Iganga-Mayuge health and demographic surveillance site. + Cough or difficult breathing with fast breathing (i.e. ≥ 50 breaths per minute for child aged 4-12 months; ≥ 40 breaths per minute for child aged 12–59 months). * Cough or difficult breathing with chest indrawing or noisy breathing.

appropriate for treatment of malaria and pneumonia are shown in Appendix 1.

Use of CMDs was defined as care seeking from a CMD for the first or second treatment action for illness in the previous two weeks.

We classified a respondent as having knowledge of transmission of malaria if they could identify mosquito bites as the method by which malaria is transmitted from person to person. A score was generated for each of the other knowledge dimensions, i.e., knowledge of malaria and pneumonia prevention, symptoms, and danger signs of illness in children. The respondent obtained one mark on knowledge for each correct answer they gave.[29]

Data management and analysis. Data were double-entered in a FoxPro computer package and exported to STATA version 10 (StataCorp LP, College Station, TX) for analysis. Descriptive statistics were used for description of participants, estimation of the proportions of persons receiving appropriate treatment, and CMD use. Chi-square or Fisher's exact tests were used for comparison of proportions. Logistic regression was used to assess the relationship between various independent variables and prompt and appropriate treatment and CMD use. Unadjusted analysis was performed and on the basis of this analysis, factors that had P values < 0.2 were carried forward for multivariate analysis. Interaction was assessed

by comparing log likelihoods of reduced and full models. All analyses were adjusted for the loss in variation because of use of stratified sampling with svy commands in STATA. A P value of 5% was considered statistically significant.

Ethical issues. Ethical clearance was obtained from the Makerere University School of Public Health Higher Degrees Research and Ethics Committee, the Uganda National Council of Science and Technology and the Regional Ethics Committee of Karolinska Institutet, Sweden. Permission to conduct the study in the area was also obtained from the local administration of Iganga and Mayuge Districts and the demographic surveillance site. Written informed consent was obtained from the participants.

RESULTS

Demographic and illness characteristics of participants. We enrolled 1,095 (78%) of the 1,400 sampled children in the study (547 in the control arm and 548 in the intervention arm). Households where either the child or caregiver was not available at the first visit were visited a second time. Approximately half (49.3%) of the children were females and the mean (SD) age was 34.9 (20.3) months (Table 1). Households were mostly within the poorer to less poor wealth quintiles. The median distance to the nearest CMD was 422 meters

TABLE 1
Demographic and illness characteristics of 1,095 children in Iganga-Mayuge demographic surveillance site, Uganda*

Characteristic	Overall	Intervention	Control	P
No. children	1,095	548	547	
Female children, no. (%)	540 (49.3)	263 (48.0)	277 (50.6)	0.38
Mean age of children, months (SD)	34.9 (20.3)	35.5 (24.4)	34.4 (15.1)	0.47
Female respondent, no. (%)	870 (80.1)	444 (81.6)	426 (78.6)	0.21
Mean age of respondents, years (SD)	33.2 (10.8)	32.9 (11.0)	33.5 (10.8)	0.22
Male household heads, no. (%)	941 (89.2)	466 (88.4)	475 (90.0)	0.42
Mean age of household head, years (SD)	41.5 (12.3)	41.4 (12.5)	41.6 (12.3)	0.85
Wealth Index of household				
Poorest	164 (17.5)	86 (18.3)	78 (16.8)	0.48
Poorer	207 (22.1)	106 (22.5)	101 (21.7)	
Poor	238 (25.4)	108 (22.9)	130 (28.0)	
Less poor	212 (22.7)	104 (22.1)	108 (23.2)	
Least poor	115 (12.3)	67 (14.2)	48 (10.3)	
Median distance from CMD, meters (range)	422 (5.6–1,635)	415 (12.0–1,466.9)	425.3 (5.6–1,635.4)	0.48
Children ill, no. (%)	811 (74.1)	419 (76.5)	392 (71.7)	0.07
Treated for illness, no. (%)	780 (96.2)	406 (96.9)	374 (95.4)	0.27
Sought care outside home, no. (%)	703 (86.7)	358 (85.4)	345 (88.0)	0.09
Malaria symptoms among the ill, no. (%)	754 (93.0)	381 (90.9)	373 (95.2)	0.02
Pneumonia symptoms among the ill, no. (%)	236 (29.1)	134 (32.0)	102 (26.0)	0.06
Mean knowledge score of malaria (SD)	4.1 (1.8)	4.1 (1.9)	4.1 (1.9)	0.66
Mean knowledge score of pneumonia (SD)	1.0 (1.3)	1.0 (1.3)	1.0 (1.3)	0.70
Mean knowledge score of danger signs (SD)	2.3 (1.0)	2.4 (1.2)	2.3 (1.1)	0.18
Symptoms of children, no. (%) (n = 811)				
Runny nose	755 (93.1)	383 (91.4)	372 (94.9)	0.05
Fever	754 (93.0)	381 (90.9)	373 (95.2)	0.02
Cough	652 (80.4)	333 (79.5)	319 (81.4)	0.50
Loss of appetite	380 (46.9)	192 (45.9)	188 (48.0)	0.55
Headache	302 (37.2)	142 (33.9)	160 (40.8)	0.05
Diarrhea	244 (30.1)	132 (31.5)	112 (28.6)	0.37
Chills	243 (30.0)	118 (28.2)	125 (31.9)	0.26
Vomiting	211 (26.0)	108 (25.8)	103 (26.3)	0.87
Difficult breathing	157 (19.4)	86 (20.5)	71 (18.1)	0.39
Fast breathing	145 (17.9)	83 (19.5)	62 (15.8)	0.15
Convulsions	32 (4.0)	19 (4.5)	13 (3.3)	0.27
Stomach pain	22 (2.7)	13 (2.4)	9 (1.6)	0.34
Rash	21 (2.6)	6 (1.1)	15 (2.7)	0.23
Other†	32 (3.9)	23 (4.2)	9 (1.6)	0.44

*CMD = community medicine distributor.
† Includes nose bleeding, weakness, yellowing of eyes, pallor, mouth sores, loss of consciousness, mumps, measles, painful eyes, chicken pox, itching, and excessive crying.

TABLE 2
Treatment-seeking characteristics for 734 children that sought care in Iganga-Mayuge demographic surveillance site, Uganda*

Characteristic	Overall	Intervention	Control	P
Source of first treatment				
Private clinic	231 (31.5)	120 (31.4)	111 (31.5)	0.97
CMDs	187 (25.5)	112 (29.3)	75 (21.3)	0.01
Drug shop	180 (24.5)	87 (22.8)	93 (26.4)	0.26
Government unit	126 (17.2)	56 (14.7)	70 (19.9)	0.07
NGO unit	5 (0.7)	4 (1.1)	1 (0.3)	0.21
General shop	3 (0.4)	2 (0.5)	1 (0.3)	0.61
Traditional healer	2 (0.3)	1 (0.3)	1 (0.3)	0.95
CMD use				
Sought treatment from CMD as first or second action	195 (26.6)	117 (30.6)	78 (22.2)	0.01
Ever used services of CMD (n = 1,095)	765 (70.0)	392 (71.7)	373 (68.3)	0.23
Mention CMDs as one of the providers where can take child (n = 1,095)	797 (73.0)	415 (75.9)	382 (70.1)	0.04
Willing to take child to CMD again (n = 700)	678 (96.9)	342 (96.3)	336 (97.4)	0.45
CMD use among children with pneumonia symptoms (n = 213)†	61 (28.6)	43 (35.5)	18 (19.6)	0.01
CMD use among children with malaria symptoms (n = 687)†	175 (25.5)	103 (29.5)	72 (21.3)	0.01

*Values are no. (%). CMD = community medicine distributor; NGO = non-government organization.
†Children with specific symptoms who sought care.

(range = 5.6–1,635 meters). There was no difference in demographic characteristics of the children, respondents and household heads in the two arms of the cluster randomized trial. There was also no difference in their knowledge of malaria, pneumonia, and danger signs.

Approximately 74% of the children were reported to have been ill in the two weeks before the study. Of these children, 96% were treated with some type of medication and 87% sought care outside the home. More children in the control arm reported malaria symptoms (i.e., fever) than in the intervention arm (95% vs. 91%), and more children in the intervention arm reported pneumonia symptoms (32% vs. 26%). Runny nose and fever were the most common symp-

toms (both reported by 93%), followed by cough (80%) (Table 1).

Use of CMDs. Of the children that sought care outside home 27% (95% confidence interval [CI] = 23–30%) sought care from a CMD, and there was a higher proportion in the intervention arm than in the control arm (31% vs. 22%; P = 0.01). Approximately 70% had used the services of CMDs, and 97% of these persons were willing to take their children to CMDs again. The most common source of initial treatment was private clinics (32%), followed by CMDs (Table 2). The most common reasons for seeking care from CMDs were not having to pay for treatment (60%), services were nearby (60%), and services were good (10%).

TABLE 3
Medicines received among 811 children that were ill in Iganga-Mayuge demographic surveillance site, Uganda

Drug class	Overall	Intervention	Control	P
Drugs used in home treatment, no. (mean)	n = 77	n = 48	n = 29	
Antipyretics*	48 (0.62)	29 (0.60)	19 (0.66)	0.65
Antimalarial drugs†	22 (0.29)	16 (0.55)	6 (0.21)	0.003
Antibiotics‡	16 (0.21)	10 (0.21)	6 (0.21)	0.99
Antihistamines§	5 (0.06)	4 (0.08)	1 (0.03)	0.40
Other¶	9 (0.11)	4 (0.08)	5 (0.17)	0.24
Drugs given by health providers, no. (mean)	n = 734	n = 381	n = 353	
Antimalarial drugs#	471 (0.64)	249 (0.65)	222 (0.63)	0.83
Antipyretics**	459 (0.63)	222 (0.58)	237 (0.67)	0.44
Antibiotics††	359 (0.49)	207 (0.54)	152 (0.43)	0.34
Antihistamines§	80 (0.11)	39 (0.10)	41 (0.12)	0.85
Steroids‡‡	56 (0.08)	28 (0.07)	28 (0.08)	0.92
Hematinics	15 (0.02)	8 (0.02)	7 (0.02)	0.98
Vitamins	14 (0.02)	6 (0.02)	8 (0.02)	0.83
Other§§	14 (0.02)	9 (0.02)	5 (0.01)	0.76
Combination drugs for flu¶¶	13 (0.02)	8 (0.02)	5 (0.01)	0.82
Dewormers	9 (0.01)	4 (0.01)	5 (0.01)	0.87
Anticonvulsant (diazepam)	8 (0.01)	4 (0.01)	4 (0.01)	0.97
Received at least one drug	733 (90.4)	387 (92.4)	346 (88.3)	0.05
Received at least one antibiotic	132 (33.7)	187 (44.6)	319 (39.3)	0.007
Overall mean number of medicines (SD)	2.2 (1.1)	2.3 (1.0)	2.2 (1.1)	0.94
Unidentified crushed tablets,## no. (%)	34 (4.6)	12 (3.1)	22 (6.2)	0.05

*Paracetamol, aspirin, and ibuprofen.
†Artemether–lumefantrine and quinine.
‡Amoxicillin, metronidazole, and cotrimoxazole.
§Chlorpheniramine and cetirizine.
¶Combination drugs for influenza, vitamins, hematinics, diazepam, bronchodilators, steroids, and dewormers.
#Artemether–lumefantrine, quinine, amodiaquin, sulfadoxine–pyrimethamine, chloroquine, and artemether.
**Paracetamol, aspirin, ibuprofen, and diclofenac.
††Amoxicillin, cotrimoxazole, metronidazole, erythromycin, azithromycin, benzyl penicillin, penicillin V tablets, chloramphenicol, ampicillin, ampicillin plus cloxacillin, and cloxacillin.
‡‡Dexamethasone and prednisolone.
§§Metoclopramide, antacids, bronchodilators, oral rehydration salts, nystatin oral suspension.
¶¶Combinations of antihistamines, antipyretics, and systemic nasal decongestants.
##Medicines mixed and crushed by health worker and given to caregiver in powder form.

Factors associated with use of CMDs by multivariate analysis were being in the intervention arm of the cluster randomized trial (odds ratio [OR] = 1.60, 95% CI = 1.09–2.35), being in the poorest to less poor wealth quintiles compared with the least poor quintiles (OR = 1.92, 95% CI = 0.99–3.71), increased knowledge of malaria prevention strategies (OR = 1.39, 95% CI = 1.12–1.73), increased knowledge of danger signs of illness (OR = 1.22, 95% CI = 1.03–1.43), and not having fever (OR = 2.55, 95% CI = 1.26–5.16). Distance of the household from the nearest CMD of more than 500 meters was negatively associated with use of CMDs by unadjusted analysis (OR = 0.68, 95% CI = 0.47–0.96) but not by multivariate analysis.

Approximately 80% of caregivers that sought care from CMDs rated the service as good and 20% rated it as fair. None of them rated the quality of care received as poor. Respondents whose children sought care from the government health unit, private clinics, and drug shops rated the care received as poor in 4.8%, 1.3%, and 0.6%, respectively.

Treatment practices. *Medicines used.* Antipyretics were the most commonly used drugs in self (home) treatment, and antimalarial drugs were the most commonly used by those who sought care outside the home. More children in the intervention arm (92%) who were ill received at least one drug than children in the control arm (88%). The proportion of children that received any antibiotic was higher in the intervention arm than in the control arm (45% versus 34%; $P = 0.007$). The mean (SD) number of medicines per child was 2 (1.1), and there were no difference between arms. Overall, 5% of the children used unidentified crushed medicines (medicines mixed and crushed by the health worker and given to the caregiver in powder form with directions on how to estimate the dose), and 2% were treated with herbs (Table 3).

Antibiotic use was lower among children that sought care from CMDs than in those that sought care from elsewhere in the intervention arm (44% versus 49%; $P = 0.003$) (CMDs in the control arm did not have antibiotics). The mean number of drugs was lower among children that had sought care from CMDs than in those that sought care from elsewhere in the control arm (1.4 versus 2.3; $P < 0.001$) and in the intervention arm (1.6 versus 2.4; $P < 0.001$).

Treatment of malaria symptoms. More than 90% of the children with malaria symptoms (i.e., fever) received prompt treatment. However, only 61% received an antimalarial drug and 51% received a recommended antimalarial drug. Overall, only 15% received prompt and appropriate treatment of malaria symptoms, and this proportion was higher in the intervention arm than in the control arm (18% versus 12%; $P = 0.03$) (Figure 2).

A higher proportion of children received prompt and appropriate treatment for malaria among CMD users than among other health providers (37% versus 9%; $P < 0.001$). All children who received care from CMDs were treated with the recommended drug, compared with only 38% among the children who received care from other health care providers. There were also significant differences in children receiving recommended dose, frequency, and duration (Figure 3).

Multivariate analysis showed that the factors associated with prompt and appropriate treatment of malaria were CMD use (OR = 7.27, 95% CI = 4.47–11.82), age of the household head (OR = 1.02, 95% CI = 1.00–1.04), younger children (OR = 0.98, 95% CI = 0.96–0.99), knowledge of malaria transmission (OR = 2.05, 95% CI = 1.23–3.41), and increasing knowledge of signs of pneumonia (OR = 1.40, 95% CI = 1.14–1.72). Being in the intervention arm of the
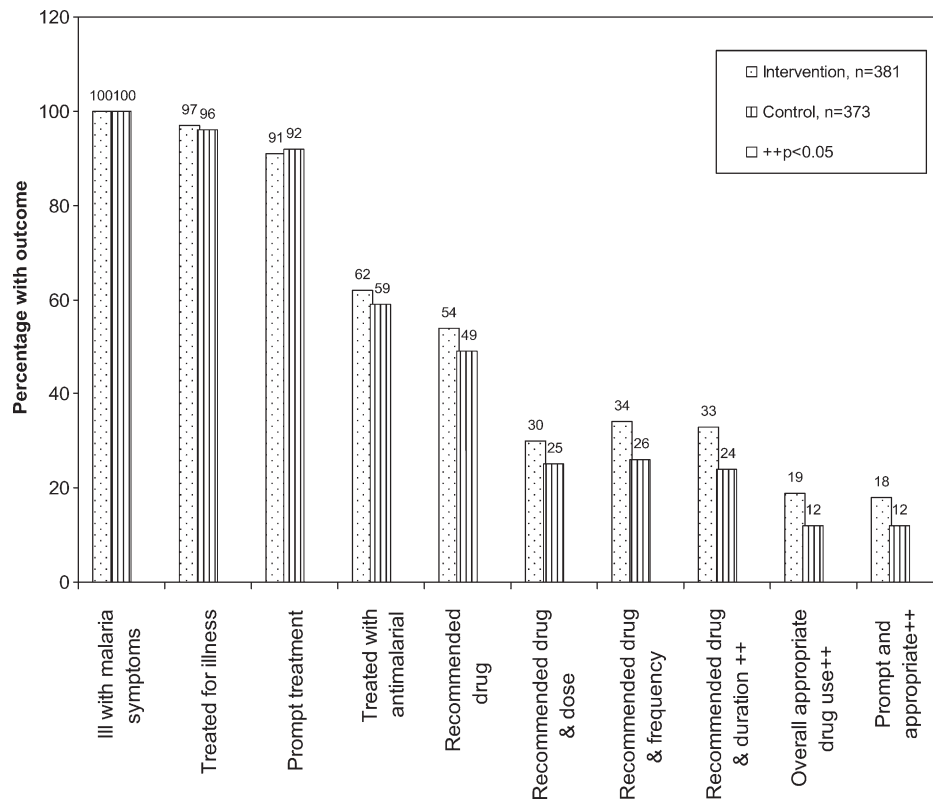

FIGURE 2.   Malaria symptoms treatment practices in intervention and control arms in Iganga-Mayuge demographic surveillance site, Uganda.
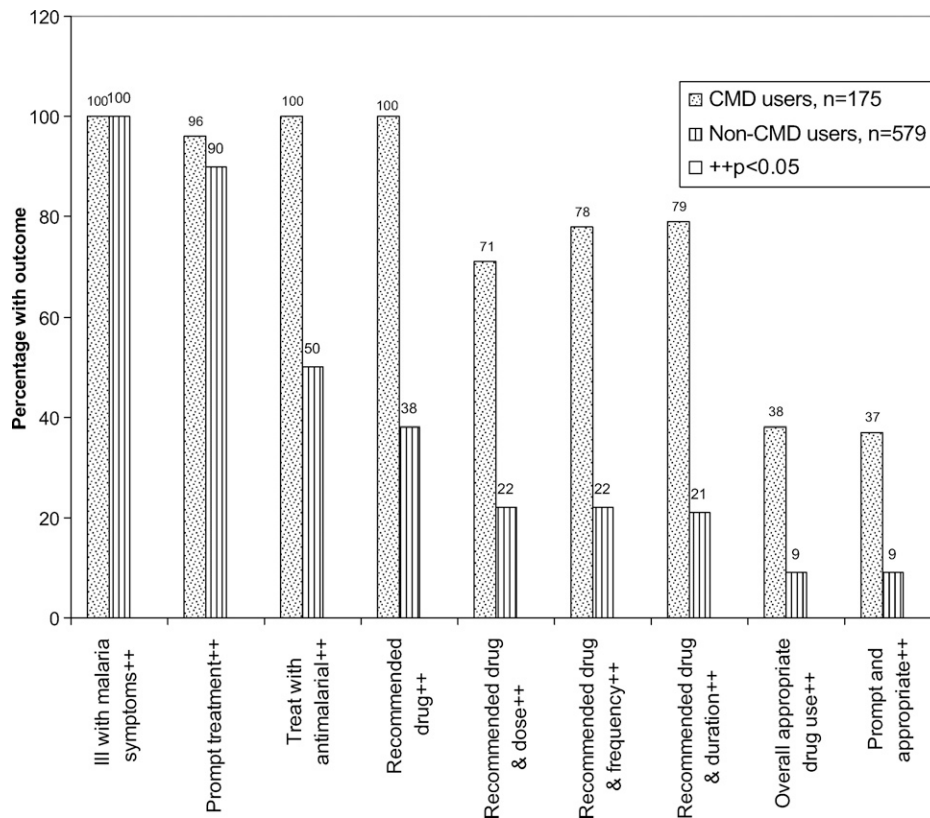
FIGURE 3. Malaria symptoms and treatment practices among community medicine distributor (CMD) and non-CMD users in Iganga-Mayuge demographic surveillance site, Uganda.

cluster randomized trial was significantly associated with prompt and appropriate treatment of malaria symptoms by unadjusted analysis (OR = 1.52, 95% CI = 1.01–2.28) but not by multivariate analysis.

Treatment of pneumonia symptoms. Approximately 42% of children with self-reported pneumonia symptoms received a correct antibiotic, but with no significant difference observed between the intervention and control arms (45% versus 37%; *P* = 0.44). However, only 9% received prompt and appropriate antibiotics, but there was no significant difference between the intervention and control arms (11% versus 5%; *P* = 0.10) (Figure 4).

Approximately 48% of children treated with antibiotics received cotrimoxazole, and only 39% were treated with amoxicillin. A higher proportion of children treated with antibiotics for self-reported pneumonia symptoms in the intervention arm received amoxicillin than those in the control arm (49% versus 21%; *P* = 0.007). Approximately 47% of those treated with amoxicillin received it from CMDs. The proportion of children who received antibiotics for pneumonia symptoms did not differ between CMDs users and non-CMD users in the intervention arm (42% versus 45%; *P* = 0.39). There were also no differences in proportions of children that received the correct dose, frequency, and duration of antibiotics (Figure 5).

DISCUSSION

Care-seeking from CMDs for sick children was higher in the intervention arm (31%) than in the control arm (22%), although it was quite low overall (27%). The CMDs were the second most preferred source of treatment after private clinics. Most caregivers highly rated the quality of care received from CMDs. The CMDs improved rational use of medicines through reduction of polypharmacy, better malaria treatment practices, and improved promptness of treatment.

The level of use of CMDs in our study is within the range of 2–59%, which has been reported in other studies.[9,14,21,30] Unlike in our study in which most CMDs were newly enrolled, Ajayi and others enrolled pre-existing CMDs, and this may have resulted in the much higher use rate of CMDs (59%).[14] In contrast, Rutebemberwa and others reported a low level of use of CMDs (2%), which was probably caused by a recent change in the Uganda malaria policy to artemisinin-based combination therapy as first-line antimalarial drug, which had not been accompanied by provision of artemisinin-based combination therapy to CMDs.[21]

The level of use of CMDs in Iganga-Mayuge was lower than could be expected given that the CMDs have been operational for approximately two years, and that the treatment was free and easily accessible. This finding may have been caused by caregiver preference for private clinics, which are perceived to have skilled health professionals and a wider range of services. Second, although there was community sensitization about the CMDs at the start of the program, there was no continued sensitization. Third, CMDs were affected by periodic drug shortages.

Having CMDs who can only treat malaria has been cited as one of the possible reasons for low use of their services because many children have multiple illnesses.[9] Our study
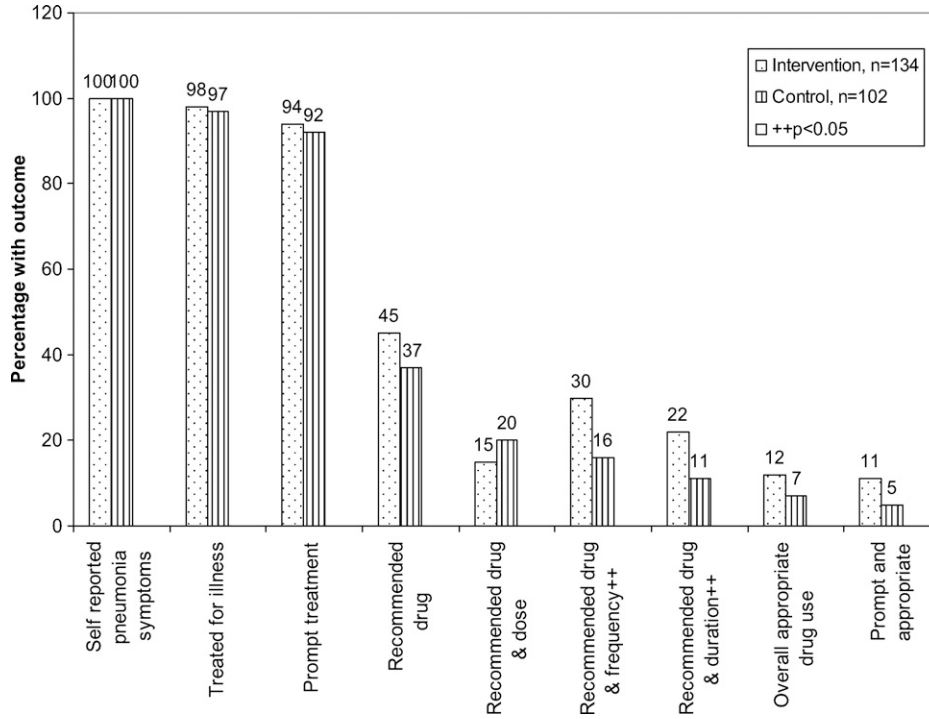
FIGURE 4.   Self-reported pneumonia symptoms and treatment practices in intervention and control arms in Iganga-Mayuge demographic surveillance site, Uganda.

suggests that CMDs with broader options, such as in the intervention arm of this study, have more clients. In our study, caregivers in the intervention arm were 1.6 times more likely to seek treatment for their children from CMDs than caregivers in the control arm.

Caregivers with lower socioeconomic status were more likely to seek care for their children from CMDs compared with caregivers with higher socioeconomic status. This finding confirms the findings of a qualitative study from Uganda, which showed that persons from the poorest quintile were more likely to use free public health facilities.[31] However, our findings contrast with those of a study in western Uganda in which children in the least poor quintile were more likely to receive medicines from CMDs.[9] The differences in the
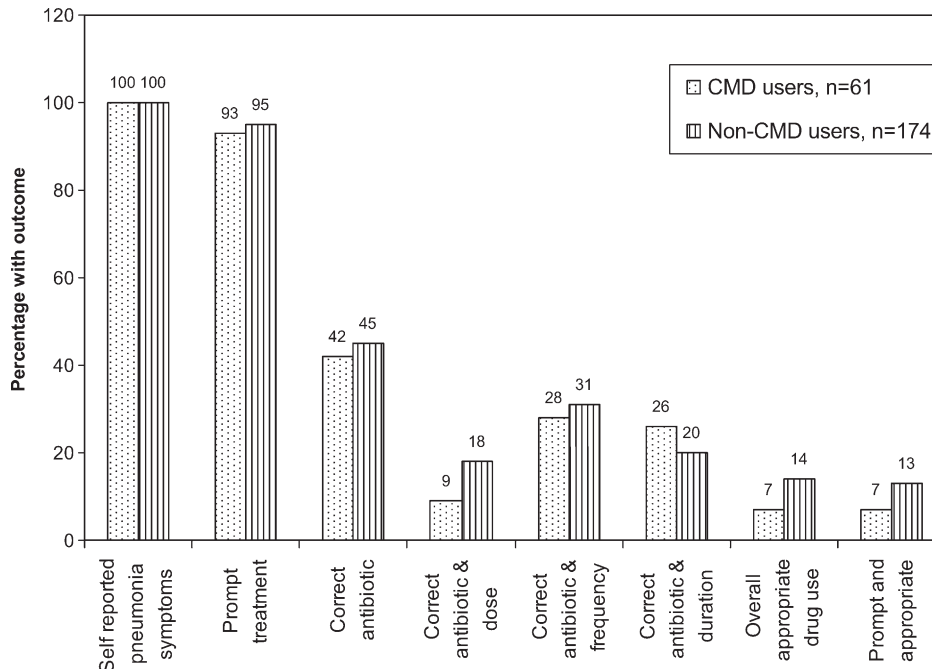

FIGURE 5.   Self reported pneumonia symptoms and treatment practices among community medicine distributor (CMD) and non-CMD users in the intervention arm in Iganga-Mayuge demographic surveillance site, Uganda.

study findings may be caused by differences in availability of other sources of health care, e.g., private clinics that the caregivers of higher socioeconomic status are more able to afford.

Caregivers with more knowledge of malaria preventive strategies and danger signs of illness were more likely to seek care for their children from CMDs than those with less knowledge. This finding may reflect transmission of knowledge from CMDs to caregivers when the caregivers seek care for their children from CMDs. It could also be explained by caregivers having more knowledge about illness being more aware that they can get effective drugs for the illness from CMDs and therefore seek care from them. Knowledge has been shown to influence treatment practices in other studies.[9,32,33]

The findings of rational use of medicines among CMDs in our study are similar to those of studies in western Uganda, rural Senegal, and Zambia.[9,18,34] All children treated for malaria symptoms by CMDs received the recommended drug. However, only 37% of them received prompt and appropriate treatment. The children treated for malaria by CMDs had much better results than those treated by other health providers, for which only 38% received the correct drug and 9% received prompt and appropriate treatment. The main challenges of treatment for CMDs and other health providers were in dosing schedules and treatment duration. These challenges might be caused by dosing errors or inadequate information on drug administration given to caregivers by health providers, or misinterpretation of instructions by caregivers. In children treated by other health providers, there was an additional problem of prescription of ineffective medicines, which calls for stronger drug regulation to avoid having these drugs on the market. The proportion of children receiving prompt and appropriate treatment in our study was slightly higher than that found in a previous study in western Uganda under the HBMF strategy[9] and in rural Senegal.[34]

It is more difficult to interpret the results for the treatment of pneumonia symptoms from our study. We could only get self-reported pneumonia symptoms, and it is well known that not all children with self-reported pneumonia symptoms have objective signs of pneumonia and therefore should be treated with antibiotics. The CMDs have been trained to promote rational use of antibiotics through respiratory rate assessment before prescription. The proportion of children treated with recommended antibiotics did not differ between CMD users and non-CMD users in the intervention arm, which suggested that CMDs may perform as well in provision of appropriate medicines for pneumonia as other health care providers. Furthermore, the concern that CMDs may increase overuse of antibiotics does not seem to be correct. However, there is a need to ensure that their skills in respiratory assessment are adequate and that they are not failing to diagnose pneumonia in children. This finding is supported by findings from a study among CMDs in Uganda where classification of pneumonia was inadequate.[35] Further studies of pneumonia treatment by CMDs are needed in which objective measurements of pneumonia are included.

Surprisingly, the use of pre-packed antibiotics did not result in better dosing among children treated by CMDs for self-reported pneumonia symptoms. Pre-packaged drugs have been reported to result in better drug use.[36] These findings may result from caregiver's non-adherence to dosing instructions either because of misunderstanding of the instructions or of wrong perceptions about how the medicines should be administered to children. The dosing range for the amoxicillin used by CMDs is 1–3 tablets. This number of tablets is quite high compared with what caregivers are used to for treatment of common conditions in these age groups. This finding may explain why many of the children not treated with recommended doses had used does that were too low. This hypothesis may need to be explored with further studies. However, we also cannot not rule out incorrect dosing by CMDs, or misreporting of how medicines were administered because of problems in recall because we used caregiver reports of medicines used for illness in the past two weeks.

Having CMDs that provide amoxicillin increases the use of a more effective oral drug against pneumonia instead of cotrimoxazole, which most other health providers are prescribing but to which high levels of resistance have been demonstrated elsewhere.[37] Approximately half of the children who were treated with antibiotics received cotrimoxazole. However, approximately half of those that received amoxicillin received it from CMDs.

We had hypothesized that ICCM would improve drug use patterns for pneumonia because of the improved access to medicines, having pre-packaged medicines delivered by trained CMDs, and general improvement in practices especially of health workers that supervise the CMDs. However, our study did not find a significant difference in the proportions of children that received prompt and appropriate treatment for self-reported pneumonia symptoms in the intervention and control arms. Nevertheless, there were higher proportions of children in the intervention arm that received drugs in the correct frequency and duration. The non-significant difference in overall practices in the intervention and control arms may have been caused by insufficient power to detect differences because of the low numbers that were ill with pneumonia and subsequently the low numbers receiving appropriate treatment. It is likely that the influence of ICCM on the community drug use patterns may have been small, therefore requiring large sample sizes to detect it.

We used caregivers reports of illness in children in the two weeks before the interview, which may have led to inclusion of illness that occurred earlier than the two weeks. This finding may explain the high illness rate (74%) reported in our study. In addition, we did not have sufficient power to detect differences in pneumonia treatment practices between study arms because of the small number of children with pneumonia symptoms who received prompt and appropriate treatment. Measurement bias may have occurred because of misreporting of symptoms or treatments in children by caregivers, and misinterpretation of fast breathing. However, we showed caregivers posters of commonly used drugs in the area to aid recall and also examined prescriptions and dispensed drugs when these were available.

Use of CMDs increased in the intervention arm, suggesting that CMDs who can treat pneumonia, in addition to malaria, increase uptake of their services. However, overall CMD use is still quite low and private clinics and drug shops are still preferred. Nevertheless, CMDs may have greater effect in districts where private clinics and drug shops are less numerous. Because most children in our study sought care from other sources, especially private clinics, interventions to improve the management of malaria and pneumonia should

be introduced in the private sector. Malaria treatment was much better among CMD users than non-CMD-users, whereas no difference could be seen in the treatment of self reported pneumonia symptoms. However, prompt and appropriate treatment of malaria and pneumonia is poor and mainly caused by inappropriate drug use. The CMDs are championing the use of effective antimalarial drugs and antibiotics in a situation in which children continue to receive ineffective medicines.

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APPENDIX 1: APPROPRIATE MEDICINES FOR MALARIA AND PNEUMONIA TREATMENT

Medicines were considered appropriate for malaria treatment if the child was treated with artemether–lumefantrine, 1 tablet twice a day for children less than 3 years of age or 2 tablets twice a day for children 3–5 years of age for 3 days; artesunate plus amodiaquine, 4 mg/kg and 10 mg/kg of body weight, respectively, per day for 3 days; dihydroartemisinin plus piperaquine, 2–4 mg/kg/day plus 16–18 mg/kg/day, respectively, for 3 days; quinine, 10 mg/kg, 3 times a day for 7–10 days.[26] The weights of children used for evaluation of the doses were estimated according to age by using the Ugandan standard growth chart.[26]

Medicines were considered appropriate for pneumonia treatment if the child received amoxicillin, 125 mg twice a day for children less than 12 months of age, 250 mg twice a day for children 12–35 months of age, 375 mg twice a day for children 36–59 months of age for 3 days if the treatment was from community medicine disteributors[27] or 15–25 mg/kg every 8 hours for 5days if treatment was given by other health providers; erythromycin, 10–15 mg/kg every 6 hours for 5 days; azithromycin, 10 mg/kg/day for 3 days; ampicillin, 25–50 mg/kg plus cloxacillin, 25–50 mg/kg every 6 hours for at least 5 days; gentamicin at a dose of 2.5 mg/kg every 12 hours plus ampicillin at a dose of 25–50 mg/kg every 6 hours for at least 5 days; benzyl penicillin, 50,000 IU/kg every 6 hours, which could be changed to oral amoxicillin to complete 5 days of treatment with antibiotics; procaine penicillin fortified for at least 3 days plus amoxicillin to complete at least 5 days of treatment with antibiotics; chloramphenicol, 25 mg/kg every 6 hours for 5–10 days and cotrimoxazole, 24 mg/kg twice a day for 5 days;[26] cefuroxime, 125–250 mg twice a day for 5 days; amoxicillin plus clavulanate, 15–25 mg/kg based on amoxicillin 2–3 times a day.[28]