Community Health Worker Performance in the Management of Multiple Childhood Illnesses: Siaya District, Kenya, 1997–2001

Jane M. Kelly, MD, Benta Osamba, CHNFP, Renu M. Garg, MD, Mary J. Hamel, MD, Jennifer J. Lewis, MPH, Samantha Y. Rowe, MPH, Alexander K. Rowe, MD, MPH, and Michael S. Deming, MD, MPH

Objectives. To characterize community health worker (CHW) performance using an algorithm for managing common childhood illnesses in Siaya District, Kenya, we conducted CHW evaluations in 1998, 1999, and 2001.

Methods. Randomly selected CHWs were observed managing sick outpatient and inpatient children at a hospital, and their management was compared with that of an expert clinician who used the algorithm.

Results. One hundred, 108, and 114 CHWs participated in the evaluations in 1998, 1999, and 2001, respectively. The proportions of children treated "adequately" (with an antibiotic, antimalarial, oral rehydration solution, or referral, depending on the child's disease classifications) were 57.8%, 35.5%, and 38.9%, respectively, for children with a severe classification and 27.7%, 77.3%, and 74.3%, respectively, for children with a moderate (but not severe) classification. CHWs adequately treated 90.5% of malaria cases (the most commonly encountered classification). CHWs often made mistakes assessing symptoms, classifying illnesses, and prescribing correct doses of medications.

Conclusions. Deficiencies were found in the management of sick children by CHWs, although care was not consistently poor. Key reasons for the deficiencies appear to be guideline complexity and inadequate clinical supervision; other possible causes are discussed. (*Am J Public Health.* 2001;91:1617–1624)

In rural areas of developing countries, several reasons support the use of community health workers (CHWs) as a complement to health facilities as a source of medical care for children. Compared with health facilities, CHWs are geographically closer and available when health facilities are closed; moreover, CHWs are community members, and therefore cultural and linguistic barriers that may be present at health facilities are overcome.

In addition, CHWs can help ensure that treatment at home is appropriate. For example, studies from several countries documented that when a child had a febrile illness, mothers frequently treated their children with an antimalarial at home rather than seeking care at a health facility.[1–3] Although treatment was often begun promptly, the dose administered was incorrect (usually too low) 70% to 88% of the time. Providing care through CHWs could improve the dosing of antimalarials administered at home, an approach consistent with World Health Organization (WHO) recommendations.[4]

CHWs who use simple diagnostic algorithms based on a small number of clinical signs can detect and treat pneumonia,[1,5–8] malaria,[2,9] and dehydration secondary to diarrhea.[10] Some studies have documented that CHWs trained to manage a single disease can reduce childhood mortality.[8–11] The single-disease approach is limited, however, because children frequently have symptoms indicating more than one illness.[11–14] Studies of CHWs taught to manage multiple diseases suggest that, 1 to 4 years after initial training, CHWs retain some of their clinical competency, and that children in the populations served by the CHWs are more likely to be treated for the illnesses targeted by the CHW intervention.[15,16] However, these studies have important limitations, such as small sample size, nonrepresentative samples of CHWs, and no evaluation of CHW performance in the treatment of actual patients.

In 1995, CARE Kenya addressed the need for more comprehensive care at the community level by initiating the Community Initiatives for Child Survival in Siaya project in approximately 200 villages in Siaya District, Kenya. The mortality rate for children younger than 5 years in Nyanza Province, which includes Siaya District, was estimated to be 199 per 1000 live births in 1998.[17] The goals of this project, now implemented in 332 villages covering approximately 140 000 persons, are (1) to improve child survival by training and supporting unpaid CHW volunteers, who are literate and selected by their communities; (2) to provide care for children with acute respiratory infections, diarrhea, and malaria; and (3) to refer severely ill children to health facilities. In addition, CHWs counsel caregivers on the continued care of their sick children at home and on behaviors related to health and disease prevention (e.g., immunizations, family planning, and preventing HIV infection).

CHWs were trained to use a simplified version of WHO's Integrated Management of Childhood Illness (IMCI) guidelines.[18] IMCI is a global strategy designed to strengthen health systems, implement clinical guidelines in health facilities, and implement community-based interventions that might include care by CHWs. The algorithm for CARE CHWs (available from N. Kukreja at kukreja@care.org) relies on clinical signs and requires minimal equipment (a watch with a second hand) to guide a CHW to a diagnostic classification and an effective treatment. A representative page of the algorithm is shown in Figure 1. Like IMCI, CARE uses separate algorithms for children younger than 2 months and aged 2 to 59 months.

In 1997, 336 CHWs received 3 weeks of initial training from project staff and job aids (clinical registers and flow sheets); in 1998

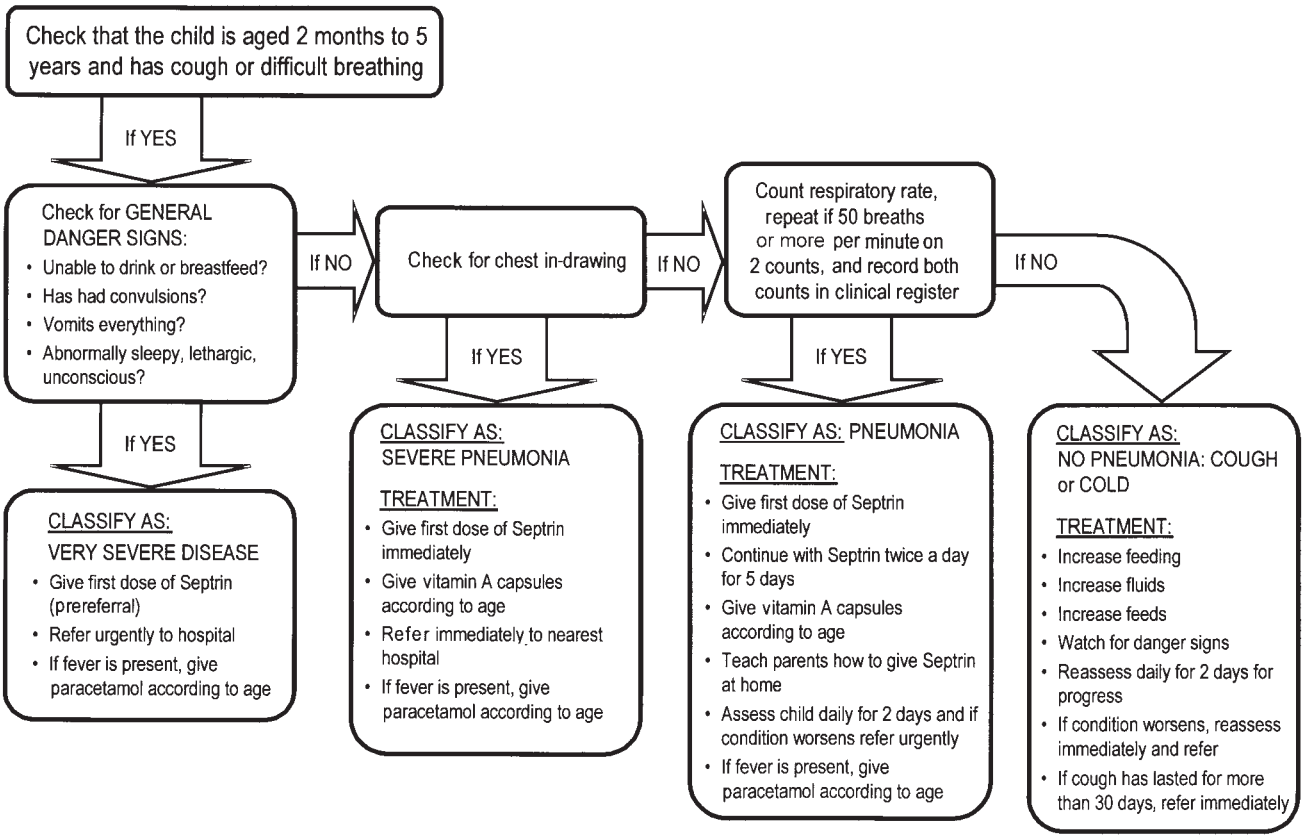

FIGURE 1—Section of the community health worker algorithm on the management of cough or difficult breathing for children aged 2 months to 5 years: Siaya District, Kenya.

and 2000, CHWs received refresher training; and throughout the project, CHWs have been supervised. Refresher training lasted for 1 week, was conducted in groups of 8 to 10 CHWs, and included lectures, role-playing, reviewing videotaped examination findings, and clinical preceptorship at Siaya District Hospital. Note that some changes were made in the algorithm after the start of the program. For example, in 1998, the criteria for the dehydration classifications were revised. Also, the original algorithm provided treatment guidelines (now excluded) if referral was not considered possible. Treatment and counseling job aids were also modified several times.

During the project, 3 surveys of CHW performance were conducted to identify clinical skills needing reinforcement during refresher training and to evaluate the project as a whole. Because little has been published on the ability of CHWs to follow a clinical algorithm addressing multiple illnesses, we present results of these evaluations. Experience with programs in which CHWs manage multiple illnesses is particularly relevant today as more countries consider including CHW interventions in their community component of IMCI.

METHODS

Study Design and Data Collection

The study consisted of 3 cross-sectional, hospital-based evaluations in February 1998 (7–13 months after initial training), November 1999 (8–12 months after the first refresher training), and February and March 2001 (3–5 months after the second refresher training). In each evaluation, 120 active CHWs were selected by systematic sampling. In the second evaluation, CHWs were selected from a list of those who had attended the first refresher training (289 of the 336 CHWs initially trained). In the third evaluation, the sampling frame included all 259 CHWs who were active in February 2001, regardless of their participation in refresher training. Selected CHWs were invited to the Siaya District Hospital, the site of the evaluation, and asked to manage up to 4 ill children. CHWs who were unable to make their initial appointment were rescheduled up to 2 times, and CHWs who never appeared for an evaluation were not replaced. Four methods were used for collecting data: (1) observation of consultations

using a checklist; (2) CHW documentation of the assessment findings, classifications, and treatments for each sick child on a standard form (i.e., the CHW encounter form) with the same layout as the CHW clinical register used in their home communities; (3) standardized exit interviews with caregivers (usually the mother) to assess the caregiver's understanding of treatment instructions; and (4) repeat examination of children by a study clinician with demonstrated expertise in the CARE algorithm. Additionally, 15 CHW supervisors were evaluated by the same protocol.

Observer training continued until the agreement of practice results of observers and study investigators was greater than 95% (1–3 days). The same 2 study clinicians participated in all 3 evaluations; one clinician (investigator B.O.) was the CHW training officer and the other was a medical assistant selected for her expertise in using the algorithm. For each evaluation, agreement in their clinical examination findings was greater than 90%. Exit interviewers were nurses who were fluent in the local language (Luo). Observers were CARE staff.

Each CHW was evaluated with 1 or 2 outpatients and 1 or 2 inpatients, depending on the availability of sick children. Because few inpatients were available, the same child frequently was seen by more than one CHW.

Definitions

Definitions for correct classification, treatment, and referral were based on the CARE algorithm. Because the criteria for some classifications changed between evaluations, for each evaluation, we used definitions that corresponded to the guidelines in use at the time of the evaluation. Danger signs were inability to drink or breastfeed, convulsions, "vomiting everything," and lethargy or unconsciousness. "Gold standard" classifications and treatments were generated with a computer program that applied the CARE guidelines to the assessment findings from the study clinician's repeat examination.

Treatment was defined as "recommended" (all indicated medications were selected and children with a severe classification were referred) or "adequate" (antibiotic, antimalarial, or oral rehydration solution, as indicated, was selected, plus referral for severe classifications).

Data Analysis

Data from questionnaires were double entered into an electronic database and verified with Epi Info.[19] Indicators of health care quality, which were usually proportions (e.g., the proportion of children with a severe classification who were referred), were estimated with SAS.[20] Precision of proportions was estimated with 95% confidence intervals via SUDAAN,[21] which adjusts for the potential correlation of CHW performance among the children managed by any specific CHW. Confidence intervals were estimated for all proportions presented in this report and are available from the authors.

RESULTS

In the first, second, and third evaluations, 100, 108, and 114 CHWs were evaluated and 200, 216, and 414 consultations were observed, respectively. In the first 2 evaluations, each CHW was evaluated with 1 outpatient and 1 inpatient. In the third evaluation, CHWs managed 1 or 2 outpatients and 1 or 2 inpatients. To adjust for undersampling, consultations of the 36 CHWs in the third evaluation who were observed managing only 1 outpatient and consultations of the 6 CHWs who managed only 1 inpatient were assigned a weight of 2; all other consultations were assigned a weight of 1.

CHW performance varied depending on the task (Table 1). For example, the sensitivities for obtaining a history of cough or difficult breathing for the 3 evaluations ranged from 80.0% to 88.2%; by contrast, the sensitivity for detecting a slow skin pinch ranged from 17.1% to 25.0%. Although we could not draw conclusions about trends for most tasks because of small numbers of children, in some cases performance appeared to improve or worsen from the first to the third evaluation. Trends were not consistent over time, however.

By the third evaluation, CHWs missed identifying many children with severe classifications (lowest sensitivity=0% for severe dehydration; highest sensitivity=57.3% for very severe disease) and moderate classifications (lowest sensitivity=24.0% for some dehydration; highest sensitivity=63.9% for malaria) (Table 2). Similarly, few CHWs provided recommended treatments (Table 3). The proportion of children who were adequately treated was somewhat better, ranging from 0% (severe dehydration) to 58.8% (severe pneumonia) for severe classifications and from 50.0% (pneumonia) to 90.5% (malaria) for moderate classifications.

Recommended and adequate treatments, defined as correct drug selection, did not consider drug dosing. When both correct drug selection and dosing were required for treatment to be considered correct, treatment scores were lower. For example, the proportion of children with malaria who received adequate treatment (90.5%) decreased to 66.7% when correct dosing was required, and the proportion receiving recommended treatment decreased from 60.5% to 29.9%. The proportion of caregivers who were able to recall recommended medication instructions for malaria was still lower (9.5%).

To understand the causes of case management problems, we examined the ability of CHWs to process the information they collected (i.e., assessments) into classifications and then to use their classifications to make treatment and referral decisions. In the third evaluation, CHWs correctly processed their assessment findings into classifications for 87.5% of children whose CHW assessments were consistent with a moderate classification; the proportion for children with at least 1 serious classification was 79.7%. Of children given at least 1 severe classification by the CHW, 75.3% received adequate medication for all severe classifications assigned and 83.0% were referred. Of those given at least 1 moderate (but no severe) classification by the CHW, 96.4% received adequate treatments for all moderate classifications assigned.

Counseling about home care, which is required for all children without severe illness, varied by the type of counseling message. In the third evaluation, 62.2% of caregivers were counseled to increase fluids, feeds, or both, 50.5% to return if the child became sicker, and 13.8% to return the next day for

TABLE 1—Sensitivity[a] of Community Health Workers (CHWs) in the Clinical Assessment of Sick Children: Siaya District, Kenya, 1997–2001

Assessment Finding	First Evaluation n/N	First Evaluation % (95% CI)	Second Evaluation n/N	Second Evaluation % (95% CI)	Third Evaluation (Weighted) N	Third Evaluation (Weighted) % (95% CI)
Danger signs						
Child unable to drink	6/15	40.0 (13.6, 66.4)	3/3	100 . . .	3	33.3 (0, 83.6)
Child vomits everything	6/12	50.0 (24.2, 75.8)	1/5	20.0 (0, 55.1)	9	22.2 (0, 49.4)
Convulsions during this illness	12/13	92.3 (78.0, 100)	26/35	74.3 (59.8, 88.8)	37	51.3 (34.8, 67.8)
Child is lethargic or unconscious	4/9	44.4 (12.0, 76.9)	2/4	50.0 (1.0, 99.0)	2	0 . . .
Other assessments[b]						
Cough or difficulty breathing	157/178	88.2 (84.2, 92.2)	151/175	86.3 (81.6, 90.9)	265	80.0 (75.4, 84.7)
Fast respiratory rate	68/110	61.8 (53.4, 70.2)	74/112	66.1 (58.2, 74.0)	108	40.6 (30.7, 50.5)
Chest in-drawing present	30/50	60.0 (45.9, 74.1)	7/37	18.9 (6.0, 31.8)	16	52.9 (28.0, 77.9)
Child has diarrhea	40/60	66.7 (54.6, 78.7)	47/64	73.4 (62.8, 84.1)	132	83.1 (76.8, 89.4)
Child has bloody stool	5/9	55.6 (23.1, 88.0)	3/9	33.3 (2.5, 64.1)	11	53.3 (21.6, 85.0)
Skin pinch is slow	1/5	20.0 (0, 55.1)	2/8	25.0 (0, 53.7)	33	17.1 (4.5, 29.8)
Child drinks thirstily, eagerly, or poorly	3/6	50.0 (10.0, 90.0)	4/15	26.7 (2.8, 50.5)	19	4.5 (0, 13.4)
Child is irritable or restless	1/2	50.0 (0, 100)	0/5	0 . . .	5	0 . . .
Child feels hot or has history of fever	153/175	87.4 (83.0, 91.9)	170/192	88.5 (83.8, 93.3)	301	88.7 (84.9, 92.5)
Summary measure: CHW recognizes ≥1 sign of severe illness in children with ≥1 sign of severe illness (a danger sign or fever in children aged <2 months)	27/43	62.8 (49.0, 76.5)	29/43	67.4 (53.6, 81.3)	71	54.7 (43.0, 66.3)

Note. CI = confidence interval.
[a]Sensitivity equals the number of children with an assessment finding according to the study clinician for whom the CHW identified the assessment finding (n) divided by the number of children with an assessment finding according to the study clinician (N).
[b]For the third evaluation, sensitivities of assessment tasks other than danger signs are generated only for sick children who do not have a sign of severe illness present.

a follow-up visit. Counseling for correct medication dosing varied by drug and classification. For example, no CHWs gave correct instructions on making and administering oral rehydration solution to caregivers whose child had diarrhea but no dehydration; analogous results for administering cotrimoxazole (for pneumonia) and paracetamol (for malaria) were 33.3% and 74.7%, respectively. One reason for the low counseling scores was that CHWs did not select the correct medication in the first place and therefore did not provide information on that medication. Furthermore, failure to select the correct medication may ultimately be the result of 1 or more CHW errors in the treatment, classification, or assessment task step. However, their treatment was usually consistent with the classifications they made; for example, when their classification was pneumonia, CHWs taught the caregiver how to give cotrimoxazole 80.4% of the time.

In general, CHW supervisors did not perform substantially better than the CHWs for the assessment of children with at least 1 danger sign (65.0%), classification of children with at least 1 severe classification (55.6%), classification of children with at least 1 moderate classification (66.0%), recommended treatment for children with at least 1 severe classification (55.6%), and recommended treatment for children with at least 1 moderate and no severe classification (48.9%).

DISCUSSION

In Siaya District, we found deficiencies in the management of sick children by CHWs, although care was not consistently poor. The deficiencies were a result of errors both in performing assessments and in using assessments to choose classifications and treatments. Considering that these CHWs were trained and supported with job aids, refresher training, and supervision for 4 years, why did these errors occur and how could they be remedied?

The first reason why CHWs may have had difficulty managing sick children was the complexity of the guidelines. The guidelines were 6 pages long, contained ambiguities in the clinical algorithm, and had discrepancies between the drug dosing chart and the algorithm; they required CHWs to perform up to 21 assessment tasks per child and contained 14 classifications (although any single child could have had a maximum of only 5 classifications). Furthermore, the guidelines changed twice during the years covered by this study. Not surprisingly, in focus groups conducted before the third evaluation, CHWs commented that inconsistencies in the guidelines confused them. The reason the guidelines were complex is that CARE staff wanted children in the project

TABLE 2—Sensitivity[a] of Community Health Workers in the Classification of Childhood Illnesses: Siaya District, Kenya, 1997–2001

Classification[b]	First Evaluation		Second Evaluation		Third Evaluation (Weighted)	
	n/N	% (95% CI)	n/N	% (95% CI)	N	% (95% CI)
Very severe disease	28/43	65.1 (52.6, 77.6)	27/43	62.8 (48.0, 77.6)	71	57.3 (46.1, 68.6)
Severe pneumonia	11/37	29.7 (13.8, 45.6)	5/28	17.8 (3.8, 31.9)	16	52.9 (28.0, 77.9)
Pneumonia	17/51	33.3 (21.3, 45.3)	36/66	54.5 (43.9, 65.2)	97	31.5 (21.9, 41.2)
No pneumonia: cough or cold	10/54	18.5 (8.1, 29.1)	24/52	46.1 (33.2, 59.0)	152	39.3 (31.2, 47.3)
Severe dehydration	NA	. . .	0	. . .	14	0 . . .
Some dehydration	NA	. . .	2/8	25.0 (0, 53.7)	20	24.0 (4.6, 43.4)
Dehydration	2/5	40.0 (0, 82.9)	0	. . .	0	. . .
No dehydration	4/39	10.3 (0.6, 19.9)	19/40	47.5 (32.0, 63.0)	75	40.2 (29.5, 50.9)
Malaria	55/133	41.3 (33.8, 48.9)	103/152	67.8 (61.2, 74.3)	299	63.9 (58.3, 69.4)
Summary measures						
All severe classifications[c] correctly identified among children with ≥1 severe classification	41/83	49.4 (39.3, 59.5)	34/76	44.7 (33.4, 56.0)	122	51.1 (42.4, 58.9)
All moderate classifications[c] correctly identified among children with ≥1 moderate classification	63/139	45.3 (37.8, 52.8)	115/156	73.7 (66.9, 80.5)	308	66.7 (61.3, 72.0)

Note. NA = not applicable because these classifications did not exist in the first evaluation; CI = confidence interval.

[a]Sensitivity equals the number of children with the classification according to the study clinician for whom the community health worker identified the classification (n) divided by the number of children with the classification according to the study clinician (N).

[b]Very severe disease = presence of any 1 of 4 danger signs or, for children younger than 2 months, presence of fever; for children aged 2 to 59 months, severe pneumonia = cough *and* a respiratory rate of more than 50 breaths a minute *and* chest in-drawing; for children younger than 2 months, severe pneumonia = cough *and either* a respiratory rate of more than 60 breaths a minute *or* chest in-drawing; pneumonia = cough *and* respiratory rate of more than 50 breaths a minute among children aged 2 to 59 months; no pneumonia: cough or cold = cough with none of the above abnormal signs present; dehydration = slow skin pinch *or* irritability in children younger than 2 months; severe dehydration = presence of at least 2 signs of dehydration (irritable or restless, slow skin pinch, or drinks eagerly); some dehydration = presence of 1 sign of dehydration in children aged 2 to 59 months; no dehydration = skin pinch that does not return slowly in alert children with diarrhea; malaria = fever (by history or the child currently feels hot) with no current measles or history of measles in the last 3 months.

[c]For the first evaluation, severe classifications are very severe disease, complicated measles or measles, severe pneumonia, persistent diarrhea, bloody diarrhea, and dehydration; moderate classifications are pneumonia and malaria. For the second and third evaluations, severe classifications are very severe disease, complicated measles, severe pneumonia, persistent diarrhea, bloody diarrhea, dehydration, and severe dehydration; moderate classifications are pneumonia, malaria, measles, and some dehydration.

area to benefit from IMCI-like care being delivered in their home communities; thus, the guidelines preserved much of the complexity of IMCI. Although simpler guidelines would reduce complexity, mistakes occur even when guidelines are simple. In studies of acute respiratory infection treatment programs (i.e., single-disease programs), CHWs recognized chest in-drawing in 80% of children,[6] made correct classifications for 81% to 83% of children,[6,22] and chose correct treatments for only 71% to 81% of children.[7]

A second problem concerned supervision. According to supervisory records, fewer than half of CHWs had received one-on-one clinical supervision at a health facility in the past year (results not shown). We have little information on the nature and frequency of other supervisory contacts. We also found that CHW supervisors did not perform substantially better than CHWs in assessments and treatments. These results underscore the importance of monitoring supervisors' skills and providing better support for supervisors.

Third, in focus groups, CHWs expressed concern about criticism from both caregivers and health facility staff if they misclassified a moderate condition as a severe one and unnecessarily referred a child to a health facility. As a result, when CHWs are in doubt, they may tend to choose a less severe classification or decide not to recommend referral even when they assign a severe classification. Although it may be difficult to overcome the natural tendency to avoid situations that may lead to criticism, support from community leaders and supervisors for the CHW who refers when uncertain may prevent mismanagement of life-threatening illnesses. Similarly, it may help to form an alliance with health facility staff and ask them to reassure CHWs, telling them that if they are in doubt, they should refer.

Fourth, CHWs may have lacked confidence in the guidelines. In particular, the ability of CHWs to obtain an accurate history of convulsions declined in successive evaluations; in focus groups, CHWs said they had difficulty because mothers use the term *oriere*, the Luo word for "convulsions," when a child was only shivering or startled. Thus, CHWs might have dismissed caregivers' history of convulsions. This, too, is a difficult problem to solve because the best translation for a word like "convulsions"

TABLE 3—Evaluation of the Management of Sick Children by Community Health Workers: Siaya District, Kenya, 1997–2001

Classification and Treatment[a]	First Evaluation		Second Evaluation		Third Evaluation (Weighted)	
	n/N	% (95% CI)	n/N	% (95% CI)	N	% (95% CI)
Very severe disease						
Recommended treatment (referral *and* cotrimoxazole *and* paracetamol if fever and child is aged ≥2 months *and* ORS if diarrhea *and* vitamin A if diarrhea and child is aged ≥6 months)	20/43	46.5 (32.5, 60.5)	18/43	41.9 (34.5, 56.4)	71	30.7 (19.9, 41.5)
Adequate treatment (referral *and* cotrimoxazole *and* ORS if diarrhea)	23/43	53.5 (38.3, 68.7)	23/43	53.5 (46.1, 68.0)	71	41.3 (29.8, 52.8)
Severe pneumonia						
Recommended treatment (referral *and* cotrimoxazole *and* vitamin A if child is aged ≥6 months)	22/37	59.5 (43.8, 75.1)	3/28	10.7 (4.9, 22.1)	16	47.1 (21.8, 72.3)
Adequate treatment (referral *and* cotrimoxazole)	22/37	59.5 (43.8, 75.1)	3/28	10.7 (4.9, 22.1)	16	58.8 (34.5, 83.2)
Pneumonia (with no severe classification)						
Recommended treatment (cotrimoxazole *and* vitamin A if child is aged ≥6 months)	28/48	58.3 (45.6, 71.1)	38/66	57.6 (52.3, 67.9)	92	39.4 (29.0, 49.8)
Adequate treatment (cotrimoxazole)	28/48	58.3 (45.6, 71.1)	43/66	65.1 (59.8, 75.6)	92	50.0 (39.1, 60.8)
Some dehydration (with no severe classification)						
Recommended treatment (ORS *and* vitamin A if child is aged ≥6 months)	NA	. . .	5/8	62.5 (43.4, 100)	20	60.0 (37.6, 82.4)
Adequate treatment (ORS)	NA	. . .	6/8	75.0 (60.3, 100)	20	84.0 (68.9, 99.1)
Malaria (with no severe classification)						
Recommended treatment (SP *or* cotrimoxazole *and* paracetamol if child is aged ≥2 months *and* vitamin A if child is aged ≥6 months)	38/95	40.0 (29.6, 50.4)	86/124	69.3 (65.5, 76.9)	262	60.5 (54.6, 66.5)
Adequate treatment (SP *or* cotrimoxazole)	39/95	41.0 (30.6, 51.5)	115/124	92.7 (90.3, 97.4)	262	90.5 (86.9, 94.1)
Summary measures						
All severe classifications[b] correctly treated in children with ≥1 severe classification						
Recommended treatment (referral and recommended drugs)	49/90	54.4 (45.0, 63.8)	22/76	28.9 (23.8, 39.0)	122	30.5 (22.4, 38.6)
Adequate treatment (referral and adequate drugs)	52/90	57.8 (48.1, 67.4)	27/76	35.5 (30.2, 46.0)	122	38.9 (30.3, 47.5)
Recommended drug(s)[c]	56/83	67.5 (58.1, 76.8)	46/72	63.9 (58.2, 75.0)	120	52.7 (43.5, 61.9)
Adequate drug(s)[c]	60/83	72.3 (63.4, 81.2)	52/72	72.2 (67.0, 82.3)	120	63.6 (54.7, 72.5)
Referral	63/90	70.0 (60.9, 79.1)	32/76	42.1 (36.5, 53.0)	122	52.7 (44.1, 61.2)
All moderate classifications[b] correctly treated in children with ≥1 moderate classification and no severe classifications						
Recommended drug(s)	28/101	27.7 (18.6, 36.8)	71/128	55.5 (51.4, 63.5)	271	48.4 (42.4, 54.3)
Adequate drug(s)	28/101	27.7 (18.6, 36.8)	99/128	77.3 (73.8, 84.3)	271	74.3 (68.7, 79.9)

Note. CI = confidence interval; ORS = oral rehydration solution; NA = not applicable; SP = sulfadoxine pyramethamine.
[a]At the time of the first evaluation, vitamin A was not listed on the algorithm as a medication to be given for any classification, and community health workers were taught that SP, but not cotrimoxazole, was to be given to treat malaria.
[b]For the first evaluation, severe classifications are very severe disease, complicated measles or measles, severe pneumonia, persistent diarrhea, bloody diarrhea, and dehydration; moderate classifications are pneumonia and malaria. For the second and third evaluations, severe classifications are very severe disease, complicated measles, severe pneumonia, persistent diarrhea, bloody diarrhea, dehydration, and severe dehydration; moderate classifications are pneumonia, malaria, measles, and some dehydration.
[c]Only among children with symptoms of cough, diarrhea, or fever according to the study clinician.

might have a low positive predictive value. However, defining the term more precisely in the guidelines would be helpful (e.g., "If a caregiver says the child has *oriere*, verify that she did not mean shivering or startled").

Finally, CHWs may not be getting enough practice using the guidelines. Some CHWs told us the watch they received during the initial training had broken, making it impossible to practice counting respiratory rates. Also, certain signs, such as chest in-drawing, are uncommon. In Papua New Guinea, researchers documented that only 63% of CHWs maintained clinical competency 1 to 4 years after completing training and attributed this loss to a lack of opportunities to practice.[15] The project staff of Community Initiatives for Child Survival in Siaya tried to address this problem by holding the second refresher training at the district hospital to provide CHWs with an opportunity to see

sicker children on the inpatient ward; however, the ability to recognize dehydration, fast respiratory rate, and chest in-drawing did not improve throughout 3 evaluations.

This study has several limitations. First, the evaluation process might have introduced a bias: the unfamiliar hospital setting could have made CHWs nervous, leading to errors; in contrast, being observed might have motivated CHWs to work more carefully than usual. In addition, although they were instructed to provide treatment as though they were in their home community, CHWs might not have documented the need for referral, because the evaluation was conducted in the hospital setting. Second, the skills of CHWs in some areas could not be meaningfully evaluated because of the small number of children with certain classifications (e.g., severe dehydration). Finally, when data were missing, CHW performance may have been underestimated because a failure to document was interpreted as an error; this problem was especially common in our analysis of drug dosing.

CONCLUSIONS

In addition to bringing health services to communities with high child mortality rates, the CARE project has provided an opportunity to examine the strengths and weaknesses of a well-supported CHW intervention. We found serious deficiencies in CHW clinical skills. Our evaluation suggested a number of possible causes, but we are unable to say which is the most important. CHW performance might have been better if their supervisors had mastered the guidelines. Alternatively, with the same supervision, CHW performance might have been better with simpler guidelines. Because frequent, effective CHW supervision may often be difficult to sustain, it would be helpful to test the effectiveness of CHW guidelines that are substantially simpler than those used by CHWs in the CARE project. Such guidelines, for example, might avoid clinical assessment tasks that are difficult for even more experienced clinicians (e.g., chest indrawing). Treatment guidelines might be reduced to the following: "If fever, give an antimalarial; if fast breathing, give an antibiotic; if diarrhea, give oral rehydration solution." Similarly, referral guidelines might be reduced to the following: "If there is any other problem, send the child to a health facility; if the child is not better the next day, send the child to a health facility; if the child looks very sick, send the child to a hospital immediately."

A better understanding of the determinants of CHW performance would help address deficiencies such as those identified in this study. Once we know why CHWs perform well or poorly, we can more effectively target efforts to improve their performance.

The deficiencies in CHW skills that we found should be put in perspective. CHW interventions in other settings have been shown to improve child survival, even if CHW classification and treatment were not always accurate.[6,8,10,13,23] In our study, the adequate treatment by CHWs of malaria, the most common condition affecting child morbidity and mortality in Siaya District, was relatively high, at 90.5%. The gaps we found between the clinical performance of CHWs and the CHW algorithm should be seen as part of the broader challenge of ensuring that in both developing and developed countries, health workers in different levels of preservice training adhere to clinical guidelines. For example, wide gaps between practice and guidelines in the care provided have been documented for health workers (including physicians) at health facilities in Benin,[24] for IMCI-trained, facility-based health workers in Kenya,[25] and for physicians in the United States.[26,27]

For a full understanding of the role of multiple-disease CHW interventions in the public health systems of developing countries, important questions remain to be answered. To what extent are CHWs truly providing care that children would not otherwise receive, as opposed to providing care that is more convenient? Of the children who would go to a health facility in the absence of CHW care, how many would receive recommended or adequate treatment by the health workers there? And what is the cost-effectiveness of CHW programs compared with the value of increasing access to and the quality of care at health facilities? ■

About the Authors

Jane M. Kelly, Renu M. Garg, Mary J. Hamel, Samantha Y. Rowe, Alexander K. Rowe, and Michael S. Deming are with the Division of Parasitic Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Ga. Jane M. Kelly is also with the Epidemic Intelligence Service, Centers for Disease Control and Prevention, Atlanta, Ga. Benta Osamba is with CARE Kenya, Siaya, Kenya. At the time of the study, Jennifer J. Lewis was with the Department of International Health and the Department of Epidemiology, School of Public Health, University of Alabama at Birmingham.

Requests for reprints should be sent to Jane M. Kelly, MD, Centers for Disease Control and Prevention, Mail Stop F22, 4770 Buford Hwy, Atlanta, GA 30341-3724 (e-mail: azk9@cdc.gov.

This article was accepted June 5, 2001.

Contributors

All authors helped plan the study. J.M. Kelly, B. Osamba, R.M. Garg, M.J. Hamel, J.J. Lewis, and S.Y. Rowe conducted the fieldwork. All authors worked on the analysis, and J.M. Kelly, A.K. Rowe, and M.S. Deming cowrote the paper.

Acknowledgments

This research was funded by a grant from the R.W. Woodruff Foundation to CARE and the CDC Foundation, as part of the CARE–CDC Health Initiative.

The authors thank the project staff of the Community Initiatives for Child Survival in Siaya and Ms Olewnya Sabenzia for their assistance in these evaluations.

References

1. Deming MS, Gayibor A, Murphy K, Jones TS, Karsa T. Home treatment of febrile children with antimalarial drugs in Togo. *Bull World Health Organ.* 1989; 67:695–700.

2. Ruebush TK, Kern MK, Campbell CC, Oloo AJ. Self-treatment of malaria in a rural area of western Kenya. *Bull World Health Organ.* 1995;73:229–236.

3. Foster S. Treatment of malaria outside the formal health services. *J Trop Med Hyg.* 1995;98:29–34.

4. *Implementation of the Global Malaria Control Strategy.* Geneva, Switzerland: World Health Organization; 1993:1–14. Technical Report Series no. 839.

5. Shann F, Hart K, Thomas D. Acute lower respiratory tract infection in children: possible criteria for selection of patients for antibiotic therapy and hospital admissions. *Bull World Health Organ.* 1984;62: 749–753.

6. Zeitz PS, Harrison LH, López M, Cornale G. Community health worker competency in managing acute respiratory infections of childhood in Bolivia. *Bull Pan Am Health Organ.* 1993;27:109–119.

7. Fagbule D, Parakoyi DB, Spiegel R. Acute respiratory infections in Nigerian children: prospective cohort study of incidence and case management. *J Trop Pediatr.* 1994;40:279–284.

8. Sazawal S, Black RE. Meta-analysis of intervention trials on case-management of pneumonia in community settings. *Lancet.* 1992;340:528–533.

9. Kidane G, Morrow RH. Teaching mothers to provide home treatment of malaria in Tigray, Ethiopia: a randomized trial. *Lancet.* 2000;356:550–555.

10. Kumar V, Kumar R, Khurana JL. Assessment of the effect of training on management of acute diarrhoea in a primary health care setting. *J Diarrhoeal Dis Res.* 1989;7:70–76.

11. Pandey MR, Daulaire NMP, Starbuck ES, Houston RM, McPherson K. Reduction in total under-five mortality in western Nepal through community-based antimicrobial treatment of pneumonia. *Lancet.* 1991;338: 993–997.

12. Pandey MR, Sharma PR, Gubhaju BB, et al. Impact of a pilot acute respiratory infection (ARI) control programme in a rural community of the hill region of Nepal. *Ann Trop Paediatr.* 1989;9:212–220.

13. Delacollette C, Van der Stuyft P, Molima K. Using community health workers for malaria control: experience in Zaire. *Bull World Health Organ.* 1996;74: 423–430.

14. Fagbule D, Kalu A. Case management by community health workers of children with acute respiratory infections: implications for national ARI control programme. *J Trop Med Hyg.* 1995;98:241–246.

15. Ashwell HES, Freeman P. The clinical competency of community health workers in the Eastern Highlands Province of Papua New Guinea. *Papua New Guinea Med J.* 1995;38:198–207.

16. Curtale F, Siwakoti B, Lagrosa C, LaRaja M, Guerra R. Improving skills and utilization of community health volunteers in Nepal. *Soc Sci Med.* 1995;40: 1117–1125.

17. *Kenya Demographic and Health Survey 1998.* Calverton, Md: National Council for Population and Development, Central Bureau of Statistics, and Macro International Inc; 1999.

18. Gove S. Integrated Management of Childhood Illness by outpatient health workers: technical basis and overview. WHO Working Group on Guidelines for Integrated Management of the Sick Child. *Bull World Health Organ.* 1997;75(suppl 1):7–24.

19. Dean AG, Dean JA, Coulombier D, et al. *Epi Info, Version 6: A Word Processing, Database, and Statistics Program for Public Health on IBM-Compatible Microcomputers.* Atlanta, Ga: Centers for Disease Control and Prevention; 1995.

20. *SAS/STAT User's Guide, Version 8.* Cary, NC: SAS Institute Inc; 1999.

21. Shaw BV, Barnwell BG, Bieler GS. *SUDAAN User's Manual, Release 7.5.* Research Triangle Park, NC: Research Triangle Institute; 1997.

22. Mehnaz A, Billoo AG, Yasmeen T, Nankani K. Detection and management of pneumonia by community health workers—a community intervention study in Rehri village, Pakistan. *J Pak Med Assoc.* 1997;47: 42–45.

23. Khan AH, Khan JA, Akbar M, Addiss DG. Acute respiratory infections in children: a case management intervention in Abbottabad District, Pakistan. *Bull World Health Organ.* 1990;68:577–585.

24. Rowe AK, Onikpo F, Lama M, Cokou F, Deming MS. Management of childhood illness at health facilities in Benin: problems and their causes. *Am J Public Health.* 2001;91:XXXX–XXXX.

25. Centers for Disease Control and Prevention. Health worker performance after training in Integrated Management of Childhood Illness, Western Province, Kenya, 1996–1997. *MMWR Morb Mortal Wkly Rep.* 1998;47:998–1001.

26. Ellerbeck EF, Jencks SF, Radford MJ, et al. Quality of care for Medicare patients with acute myocardial infarction: a four-site pilot study from the Cooperative Cardiovascular Project. *JAMA.* 1995;273:1509–1514.

Demakis JG, Beauchamp C, Cull WL, et al. Improving residents' compliance with standards of ambulatory care: results from the VA Cooperative Study on Computerized Reminders. *JAMA.* 2000;284:1411–1416.