Community Case Management of Childhood Diarrhea in a Setting with Declining Use of Oral Rehydration Therapy: Findings from Cross-Sectional Studies among Primary Household Caregivers, Kenya, 2007

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Abstract. We sought to determine factors associated with appropriate diarrhea case management in Kenya. We conducted a cross-sectional survey of caregivers of children < 5 years of age with diarrhea in rural Asembo and urban Kibera. In Asembo, 61% of respondents provided oral rehydration therapy (ORT), 45% oral rehydration solution (ORS), and 64% continued feeding. In Kibera, 75% provided ORT, 43% ORS, and 46% continued feeding. Seeking care at a health facility, risk perception regarding death from diarrhea, and treating a child with oral medications were associated with ORT and ORS use. Availability of oral medication was negatively associated. A minority of caregivers reported that ORS is available in nearby shops. In Kenya, household case management of diarrhea remains inadequate for a substantial proportion of children. Health workers have a critical role in empowering caregivers regarding early treatment with ORT and continued feeding. Increasing community ORS availability is essential to improving diarrhea management.

INTRODUCTION

Jones and colleagues[1] have estimated that universal use of oral rehydration therapy (ORT) for diarrhea could prevent almost 1.5 million deaths per year, or 15% of all under-5 deaths. Of all treatment interventions evaluated for major causes of child mortality, ORT was the single most effective, reducing the number of deaths by almost three times the next most effective intervention (antibiotics for sepsis and pneumonia); by comparison, treatment with zinc was estimated to prevent 4% of deaths, and rotavirus vaccine, although promising, lacked enough information on which to be assessed in this analysis. Diarrhea causes about 1.9 million deaths annually among children < 5 years of age, especially in resource-poor countries.[2] The Integrated Management of Childhood Illness (IMCI) guidelines advise use of ORT, along with continued feeding, and zinc for appropriate diarrhea case management,[3] though zinc has yet to be introduced at scale in most resource-limited countries.

Oral rehydration therapy is broadly defined as the provision of oral rehydration solution (ORS), recommended home fluids such as sugar-salt solution (SSS), or increased fluids during a diarrhea episode. The IMCI guidelines specifically recommend ORS as the fluid of choice for diarrhea accompanied by dehydration and continued feeding for all diarrhea.[3] Despite recommendations and proven life-saving potential, only 38% of children < 5 years of age received ORT and continued feeding during diarrhea episodes globally in 2008.[4] An evaluation of global trends in diarrhea management from 1986 to 2003 showed minimal progress in ORT use and a decrease in the proportion of children with diarrhea given continued feeding.[5]

A 2007 analysis of the two most recent Demographic and Health Surveys (DHS) conducted in 34 countries found declines in ORT use for children < 3 years of age with diarrhea in 68% of those countries. Kenya and Nigeria showed the steepest declines at 32% each.[6] Moreover, the proportion of children who had fluids withheld during diarrhea increased in 91% of the countries included in the analysis.[6]

In Kenya, use of ORT among children with diarrhea declined from 69% in 1998 to 51% in 2003; ORS use rates declined from 37% to 29%.[7,8] Using quantitative and qualitative methods, we sought to understand the factors associated with appropriate household diarrhea case management, including ORS and ORT use and continued feeding, in urban and rural settings in Kenya. This work presents the findings of the quantitative research, and a companion paper by Blum and colleagues reports on the qualitative research completed among caregivers of children with diarrhea.

METHODS

In 2007, we conducted a cross-sectional survey of primary household caregivers of children < 5 years of age in 33 rural villages in the Asembo area of Nyanza Province in western Kenya and in two urban villages in Kibera, a Nairobi slum. The eligibility criteria for inclusion in the study were 1) diarrhea in a child < 5 years of age living in the household, and 2) availability of the primary caregiver for interview.

In the 2003 Kenya DHS, Nyanza Province was found to have the lowest rate of ORT use (36%). Since 2004, the Kenya Medical Research Institute (KEMRI) and the Centers for Disease Control and Prevention (CDC) have conducted population-based infectious disease surveillance in Asembo. All households under surveillance reporting diarrhea in a child < 5 years of age during the week before the surveillance worker's visit were asked to participate and were queried about treatment of diarrhea episodes that had begun up to 2 weeks earlier.

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The Kibera slum in Nairobi has been cited as one of the largest contiguous informal urban settlements in sub-Saharan Africa[9]; the 2003 DHS reported an ORT use rate of 66% for Nairobi. Two Kibera villages (Kisumu Ndogo and Raila) were selected because of their proximity to the KEMRI/CDC's active syndromic surveillance area. We used systematic random sampling to identify study participants by visiting every fourth household to identify children < 5 years of age who had experienced diarrhea in the preceding 2 weeks.

In both Asembo and Kibera we interviewed the primary household caregiver, typically the mother, of the child with diarrhea. Trained fieldworkers conducted interviews in Dho-Luo, Kiswahili, or English, per the respondent's preference. We inquired about care-seeking behavior and hydration and feeding practices during the recent diarrhea episode. We assessed perceptions regarding diarrhea severity, utility of various treatments, and access to and affordability of treatments such as ORS and oral drugs.

Sample size calculations were based on the following assumptions derived from the literature: 1) 60% of caregivers would use ORT for diarrhea treatment, and 2) 50% of those who used ORT and 20% of those who did not use ORT would report seeking care from a health worker.[10–12] We sought to enroll 400 caregivers at each site, giving us sufficient statistical power to detect an odds ratio (OR) of 2.5 for care-seeking behavior. In the two study sites, we continued data collection until we exceeded our desired sample size.

Our primary outcomes of interest were 1) use of ORS packets, 2) use of ORT, and 3) continued feeding for diarrhea treatment. Oral rehydration therapy was defined as ORS packets, SSS, or increase in the amount of or introduction of breast milk, porridge, or other fluids. Continued feeding was defined as continuation or increase of breastfeeding, porridge, or soft or solid foods. Local informants indicated that porridge is a watery gruel but contains the nutritive properties of a weaning food; thus, we counted it as both ORT and continued feeding.

We explored for significant associations between explanatory variables and ORT and ORS use. Caregivers were assigned to socioeconomic status (SES) quartiles based on asset scores, determined by principal components analysis.[13] Multivariate analysis was performed using multiple logistic regression for each outcome of interest by including variables found to be associated with the outcome at the 0.05 significance level on bivariate analysis. Missing and "don't know" answers for potential explanatory variables were recorded as "no" for the multivariate analysis of factors associated with ORT and ORS.

Written informed consent was obtained from all study participants. This study was approved by the institutional review boards of KEMRI, CDC, and the University at Buffalo, New York.

RESULTS

Asembo. *Demographics, perceptions of diarrhea and its treatments.* We interviewed 428 primary caregivers of children with reported watery diarrhea in Asembo. Those interviewed inadvertently included five caregivers of children 5 years of age, and 52 caregivers whose children had fewer than three loose stools during a 24-hour period. Thus, we conducted all analyses using data only from the 371 caregivers who had children < 5 years of age with three or more loose stools in a 24-hour period during the diarrhea episode. Caregivers' mean age was 29 years and 88% were mothers. Ninety-nine percent of respondents were of Luo ethnicity, and 80% completed at least primary school. The mean age of children with diarrhea was 1.6 years, 46% were female and 59% were breastfeeding the week before illness; children had a median of four maximum stools per day (range 3–28).

Half of the caregivers reported knowing at least one child who had died because of diarrhea. Most had heard of ORS packets and believed them to be beneficial (Table 1). Frequently cited benefits of ORS included that it gives energy, helps fight infection, and rehydrates the child. A smaller proportion (7%) believed it would stop diarrhea and improve appetite (12%). A majority of caregivers reported knowing how to prepare ORS and SSS.

Treatment of diarrhea: ORT use and continued feeding. Among all diarrheal episodes, care was sought from outpatient facilities (34%), chemists (31%), inpatient facilities (25%), herbalists (20%), and community health workers (CHWs) (9%), with some seeking care from multiple providers (Table 2). Only 12% of caregivers did not seek care from any source. Advice regarding diarrhea treatment was obtained from multiple sources, most frequently spouses and mothers-in-law. Common forms of treatment were oral drugs (77%), ORS packets (45%), herbs (42%), and any fluids other than ORS that were prepared at home (41%). About 12% of caregivers reported giving fluids specifically containing sugar and salt and prepared at home (SSS). Oral drugs included antimicrobial and antimotility agents and any other oral medications.

TABLE 1

Perceptions of childhood diarrhea treatment by primary caregivers in Asembo and Kibera, Kenya, 2007

Variable	Asembo (*N* = 371), %	Kibera (*N* = 389), %
Diarrhea can cause dehydration	99	100
Believe watery diarrhea can cause death	98	95
Have known child who died of diarrhea	52	55
Heard of ORS*	96	84
Believe ORS is beneficial	96	96
Gives energy	72	68
Helps fight infection	59	81
Rehydrates child	51	74
Improves appetite	12	6
Stops diarrhea	7	0
Treatments believed to be beneficial		
Intravenous fluid	93	86
Glucose or dextrose packets	91	90
Injected medication	86	83
Oral medication	85	88
Sugar-salt solution	84	88
Herbs	71	31
Prayer	17	45
Felt like child could die during this episode	71	52
Self-efficacy†		
Felt she knew which treatments to give	53	25
Felt she knew how to prepare treatments	25	11
Felt she knew how to prepare packaged ORS	85	77
Felt she knew how to prepare sugar-salt solution	87	90
Felt she knew where to obtain treatments	89	79

* ORS = oral rehydration solution.
† Questions regarding self-efficacy were worded, for example, as "Did you feel like you knew which treatments to give?"

TABLE 2

Symptoms and care-seeking during this episode of diarrhea as reported by primary caregivers in Asembo and Kibera, Kenya, 2007*

Variable	Asembo (N = 371) %	Kibera (N = 389) %
Symptoms		
Loss of appetite	83	85
Fever	81	76
Increased thirst	78	81
Dry mouth	61	59
Inability to drink	54	43
Sunken eyes	51	55
Vomiting	42	48
Loss of consciousness	23	27
Care-providers†		
Outpatient facility	34	54
Chemist	31	36
Inpatient facility	25	12
Herbalist	20	5
Community health worker	9	2
Kiosk	9	3
Spiritual or traditional healer	5	4
Did not seek care from any professional source	12	16
Advisors		
Spouse	60	58
Mother-in-law	48	6
Neighbor	28	39
Co-wife	23	2
Mother	8	11
Medications/treatments		
Oral medications (other than herbs or ORS)	77	81
ORT	61	75
ORS	45	43
Herbs	42	12
Other fluid prepared at home‡	41	37
Injected medication	24	28
Home-prepared sugar-salt solution	12	31
Intravenous fluids	8	7
Prayer	8	17

* ORS = oral rehydration solution; ORT = oral rehydration therapy.
† Denominator includes all respondents, not just those who sought formalized care.
‡ Other fluid prepared at home could have included any ingredients; respondents were specifically asked if fluid included sugar, salt, or herbs.

TABLE 3

Type of ORT, continued feeding, and fluids reported by primary caregivers in Asembo and Kibera, Kenya, 2007*

Variable	Asembo (N = 371) %	Kibera (N = 389) %
ORT (type listed below)†	61	75
ORS	73	57
Other fluid prepared at home‡	44	47
Home-prepared sugar-salt solution	20	41
Porridge (increased or started)	10	15
Breastfeeding (increased or started)	8	16
Fluids other than breast milk or porridge (increased or started)	18	29
Continued feeding†	64	46
Breastfeeding (increased, kept same, or started)	60	50
Porridge (increased, kept same, or started)	60	41
Soft/solid food (increased, kept same, or started)	60	37
Breastfeeding during week before illness	59	54
Continued breast milk§	95	74
Increased¶	9	25
Kept same	59	28
Decreased	32	47
Fluids other than breast milk or porridge week before illness	88	69
Continued fluids§	91	82
Increased¶	10	31
Kept same	47	22
Decreased	42	47
Porridge week before illness	90	64
Continued porridge§	91	64
Increased¶	5	13
Kept same	41	18
Decreased	54	69
Soft or solid food week before illness	83	72
Continued food§	90	63
Increased¶	5	6
Kept same	41	23
Decreased	54	70

* ORT = oral rehydration therapy; ORS = oral rehydration solution.
† Percentages listed for various types of ORT and continued feeding represent the proportion of all those who received ORT or continued feeding that received each component; sums to greater than 100% as respondents could list multiple types.
‡ Other fluid prepared at home could have included any ingredients; respondents were specifically asked if fluid included sugar, salt, or herbs.
§ Of those who were giving the fluid or food source the week before child's illness.
¶ Of those who continued offering the fluid or food source during illness.

Overall, ORT was provided to 227 (61%) children; of these, 73% were provided ORS; some received more than one type of ORT (Table 3). Children ≤ 1 year of age were more likely to receive ORT than older children (relative risk [RR] 1.2, 95% confidence interval [CI] = 1.0–1.4, $P = 0.04$); the same trend held true for ORS, but was not statistically significant at the $P = 0.05$ level. Continued feeding was provided to 236 (64%) children (Table 3). Children ≤ 2 years of age were more likely to receive continued feeding than older children (RR 1.3, 95% CI = 1.0–1.6). Of the 59% of children who were breast-fed before becoming ill, 95% continued to be breastfed during illness; however, among those, 32% were offered breast milk fewer times per day than before illness (Table 3). Most children (88%) were taking fluids other than breast milk or porridge before illness and of those, approximately half were offered less fluid or had fluid discontinued. The majority (83%) of children were taking soft or solid foods before becoming ill, with almost two-thirds offered less or no food during illness

Accessibility and affordability of treatments. Among all caregivers, ORS was reported to be available most frequently at hospitals (94%), outpatient facilities (94%), and chemists (71%), with CHWs (29%) and kiosks (16%) cited much less frequently. Oral medications were believed more readily available than ORS from all sources. The median cost for one packet of ORS was estimated by caregivers to be 12 Kenyan shillings (KES)/$0.16 (range 2–35 KES/$0.03–0.47); 38% of caregivers who responded did not know the cost of a packet of ORS. For those who reported knowing the cost, 36% felt that price was not affordable if purchasing three packets during the illness. Over half (57%) of respondents purchased oral medications during their child's recent episode of diarrhea, with a mean reported cost of 87 KES/$1.17 (range 1–500 KES/$0.01–6.75) for treatment of the whole diarrhea episode; 38% felt this was not an affordable price.

Multivariate analysis of factors associated with ORS packet use and ORT use. Factors associated with ORS packet use in Asembo were seeking care at an outpatient facility (OR_{adj} = 2.6, 95% CI = 1.6–4.3) or at an inpatient hospital (OR_{adj} = 3.9, 95% CI = 2.2–6.7), caregiver belief that s/he knew how to prepare ORS (OR_{adj} = 2.5, 95% CI = 1.3–4.8), belief that herbs are ineffective or harmful for treating diarrhea (OR_{adj} = 2.2, 95% CI = 1.2–3.9), and having a child who exhibited sunken eyes during illness (OR_{adj} = 1.7, 95% CI = 1.1–2.7) (Table 4). The factors significantly associated with ORT use were similar: care at an outpatient facility (OR_{adj} = 2.9, 95% CI = 1.7–4.8) or an inpatient hospital (OR_{adj} = 4.8,

Table 4

Factors associated with use of oral rehydration solution (ORS) packets for childhood diarrhea treatment by primary caregivers in Asembo and Kibera, Kenya, 2007—results based on multivariate analysis

Asembo (N = 371), 45% reported use of ORS					Kibera (N = 386*), 43% reported use of ORS				
Variable	% Of ORS users (N = 166)	% Of ORS non-users (N = 205)	P value	OR$_{adj}$	Variable	% Of ORS users (N = 166)	% Of ORS non-users (N = 220)	P value	OR$_{adj}$
Sought care at outpatient facility	42%	27%	0.0001	2.6	Sought care at outpatient facility	76%	38%	< 0.0001	4.4
Sought care at hospital	38%	15%	< 0.0001	3.9	Sought care at hospital	19%	6%	< 0.0001	5.1
Believed she knew how to prepare ORS	90%	76%	0.0050	2.5	Believed she knew how to prepare ORS	92%	66%	< 0.0001	6.2
Believed herbs have no effect or are harmful	26%	14%	0.0072	2.2	Treated child with oral medications	96%	69%	0.0002	5.7
Reported child had sunken eyes during illness	62%	43%	0.0186	1.7					

* ORS use information missing for 3 Kibera respondents.

95% CI = 2.6–8.7); caregiver beliefs that s/he knew how to prepare ORS (OR$_{adj}$ = 1.9, 95% CI = 1.0–3.4), that herbs are ineffective or harmful for diarrhea treatment (OR$_{adj}$ = 1.9, 95% CI = 1.0–3.5), and that the child could have died of the diarrhea (OR$_{adj}$ = 1.7, 95% CI = 1.0–2.8) (Table 5).

Kibera. *Demographics, perceptions of diarrhea and its treatments.* We interviewed 462 primary caregivers of children with watery diarrhea in Kibera. Those interviewed inadvertently included 26 caregivers of children 5 years of age, and 73 caregivers whose children had fewer than three loose stools during a 24-hour period. Thus, we conducted all analyses using data only from the 389 caregivers who had children < 5 years of age with three or more loose stools in a 24-hour period during the diarrhea episode. Caregivers' mean age was 26 years and 94% were mothers. Forty-nine percent of respondents were of Luo and 32% were of Luhya ethnicity; 87% completed at least primary school. The mean age of children with diarrhea was 2.0 years, 49% were female and 55% were breastfeeding the week before illness; children had a median of four maximum stools per day (range 3–20). Over half of caregivers reported knowing at least one child who had died because of diarrhea. Most had heard of ORS and believed it to be beneficial (Table 1). Frequently cited benefits of ORS included that it helps fight infection, rehydrates the child, and gives energy, with fewer mentioning it would improve appetite. A majority of caregivers reported feeling knowledgeable about how to prepare ORS and SSS.

Treatment of diarrhea: ORT use and continued feeding. Among all diarrheal episodes, care for the child's diarrhea was most frequently sought from outpatient facilities (54%)

and chemists (36%) in Kibera, with some seeking care from multiple providers (Table 2). Only 16% of caregivers did not seek care from any source. Advice regarding diarrhea treatment was obtained from multiple sources, most frequently spouses and neighbors. The most common treatments used were oral drugs (81%), ORS (43%), fluids other than ORS that were prepared at home (37%), and home-prepared SSS (31%). Overall, ORT was provided to 293 (75%) children, with ORS (57%) being the most common form of ORT provided; some received more than one type of ORT (Table 3). In Kibera, neither ORS nor ORT use varied by child's age. Continued feeding was provided to 179 (46%) children. Children ≤ 2 years of age were more likely to receive continued feeding than older children (RR 2.0, 95% CI = 1.5–2.7). Of the 54% of children breastfeeding before the diarrhea, 74% continued to be breastfed during illness; for 47% of children who continued breastfeeding, breast milk was offered fewer times than usual (Table 3). Among 69% taking fluids other than breast milk before illness, over half were offered less fluid or fluid was discontinued. Soft or solid food was decreased or discontinued for the majority of those who were receiving food before becoming ill.

Accessibility and affordability of treatments. Most Kibera caregivers reported that ORS packets were available at hospitals (85%), outpatient facilities (84%), and chemists (60%), with relatively few citing kiosks (10%) and CHWs (7%). Oral medications were reportedly more available than ORS from all sources. The median cost for one packet of ORS was estimated by caregivers to be 13 KES/$0.18 (range 1–90 KES/$0.01–1.21); 45% of caregivers who responded did not

Table 5

Factors associated with use of oral rehydration therapy (ORT) for childhood diarrhea treatment by primary caregivers in Asembo and Kibera, Kenya, 2007—results based on multivariate analysis*

Asembo (N = 371), 61% reported use of ORT					Kibera (N = 389), 75% reported use of ORT				
Variable	% Of ORT users (N = 227)	% Of ORT non-users (N = 124)	P value	OR$_{adj}$	Variable	% Of ORT users (N = 293)	% Of ORT non-users (N = 96)	P value	OR$_{adj}$
Sought care at outpatient facility	40%	24%	< 0.0001	2.9	Sought care at outpatient facility	59%	36%	0.0006	2.4
Sought care at hospital	34%	12%	< 0.0001	4.7	Knew a child that died of diarrhea	59%	42%	0.0099	1.9
Believed she knew how to prepare ORS	87%	75%	0.0345	1.9	Received advice from mother	13%	3%	0.0179	4.4
Believed herbs have no effect or are harmful	23%	13%	0.0422	1.9	Access to oral medications from CHW	8%	18%	0.0136	0.4
Believed child could die	76%	62%	0.0381	1.7					

* ORS = oral rehydration solution.

know the cost of a packet of ORS. For those who reported knowing the cost, 46% felt that price was not affordable if purchasing three packets. Over half of the respondents (60%) purchased oral medications during their child's last episode of diarrhea, with an average cost of 164 KES/\$2.26 (range 5–850KES/\$.07–11.65) for treatment of the whole diarrhea episode; 39% felt this was not an affordable price.

Multivariate analysis of factors associated with ORS packet use and ORT use. Factors associated with ORS packet use in Kibera were seeking care at an outpatient facility (OR_{adj} = 4.4, 95% CI = 2.6–7.5) or inpatient hospital (OR_{adj} = 5.1, 95% CI = 2.3–11.2), treating with oral medications (OR_{adj} = 5.7, 95% CI = 2.3–14.0), and caregiver belief that s/he knew how to prepare ORS (OR_{adj} = 6.2, 95% CI = 3.1–12.4) (Table 4). Factors associated with ORT use included care at an outpatient facility (OR_{adj} = 2.4, 95% CI = 1.5–3.9), knowing a child who died of diarrhea (OR_{adj} = 1.9, 95% CI = 1.2–3.1), and advice on treatments from the caregiver's mother (OR_{adj} = 4.4, 95% CI = 1.3–15.0) (Table 5). Having access to oral medications from a CHW was negatively associated with ORT use (OR_{adj} = 0.4, 95% CI = 0.2–0.8).

DISCUSSION

In Kenya, where diarrhea remains the third leading cause of childhood mortality,[14] we found that household case management of diarrhea (ORS and ORT use and continued feeding) is inadequate for a substantial proportion of children. Care-seeking from health workers, heightened risk perception regarding death from diarrhea, caregiver's ability to prepare treatments, and receipt of advice from the caregiver's mother were all positively associated with ORS and ORT use, while the ability to access oral medications from a CHW was negatively associated. Prior breastfeeding, young age of the child, caregiver educational status, and a belief that herbs are beneficial for diarrheal treatment were positively associated with continued feeding. These findings may inform multidimensional interventions to improve diarrhea case management in Kenya.

We detected a higher rate of ORT use in 2007 than did the 2003 Kenya DHS (51%), with a rate similar to the 1998 Kenya DHS (69%)[8] and the 2008–09 Kenya DHS (72%).[15] Differences between the 1998/2008 DHS and the 2003 DHS may reflect a variation in wording of quantity of fluids ("offered" in 2003 versus "given" in 1998 and 2008) and/or a prompt in 2008 to include breast milk in the consideration of how much the child was given to drink. Our study in 2007 asked about whether the child was "offered" various rehydration fluids, similar to the 2003 DHS survey, but we asked about each type of fluid separately. The difference in estimates between our findings and those of the 2003 DHS might be explained by our more comprehensive definition of ORT as a result of asking about each fluid type separately. It is also possible that diarrhea treatment had actually improved between 2003 and 2008.

In our study, one-quarter of Kibera children and one-third of Asembo children with watery diarrhea did not receive recommended potentially life-saving therapy. Just over 40% of children received ORS, the form of rehydration therapy specifically recommended for all watery diarrhea in children < 5 years of age by the Kenyan Ministry of Public Health and Sanitation (Kenya MOPHS) in 2010.[16] Homemade SSS is expressly discouraged by the Kenya MOPHS because of well-documented challenges in making safe, appropriate fluid. This

underscores the importance of ORS use, specifically, for dehydration prevention and treatment.

Seeking care at a health facility was positively associated with both ORS and ORT use in both sites. In the 1980s, similar findings were reported from Haiti and Nicaragua.[17,18] Despite the two decades that have passed since those earlier studies, caregivers have not become empowered to, or have chosen not to, use ORT, particularly packaged ORS, at home early in the course of the diarrheal illness without the recommendation of a health worker (Blum L, personal communication). In the in-depth interviews and group discussions, caregivers revealed that they felt the need to consult with a health worker before using ORS. Nurses and clinical officers taking part in group discussions indicated that caregivers should not initiate ORS without health worker consultation (Blum L, personal communication).

In Kenya, there have been no recent social marketing or other large-scale promotional efforts to encourage ORS use. Thus, caregivers and the public health system rely on health workers to act as promoters of appropriate household diarrhea case management. Understanding what prevents health workers from consistently recommending ORS is important because their messaging around ORS may be expected to promote caregiver-initiated ORS use at home early in the course of the diarrhea episode.

Risk perception has been shown to increase ORT use in our study and others.[19,20] The belief that a caregiver's child could die of the diarrhea or having known a child who had died of diarrhea were associated with ORT use in both of our study sites. With already widespread awareness of the dangers of diarrhea, the messages delivered to caregivers to improve household diarrhea case management must now be more personalized. Caregivers must understand that their own children are at risk for death when they become ill with watery diarrhea and that the power to prevent dehydration and death is largely within their own hands with early treatment at home.

Translating risk perception into action to protect the child from diarrhea-related complications requires caregiver self-efficacy, or the belief that her actions, and the ability to perform them, have an effect on the situation in question. We found belief in the ability to prepare ORS, an indicator of self-efficacy, to be positively associated with ORT use. It is possible, of course, that a mother might report knowing how to prepare ORS because she had the recent experience of doing so. Self-efficacy and the practice of a desired behavior have been shown to be mutually reinforcing.[19] In Kenya; a caregiver's self-efficacy can be enhanced by empowering her to recognize when to initiate diarrhea treatment at home and when to seek care, as well as how to prepare ORS correctly and to continue feeding. Interestingly, in Kibera, receiving advice on diarrhea treatment from the caregiver's mother was associated with ORT use, possibly indicating the beneficial effect of support and caregiver confidence in the ability to treat the illness. This may also reflect the fact that ORT was more aggressively promoted in the past, resulting in an earlier generation of women more informed about its benefits.

Very importantly, only a minority of caregivers reported being able to obtain ORS from community locations, such as at kiosks that sell household goods; this has been confirmed by our work in these communities (Ram PK, personal communication). Ensuring that ORS is actually available throughout

the community is critical to increasing caregiver empowerment for early use of ORS at home.

Caregivers must also be empowered with accurate information regarding the functions of ORS and the likely outcomes of ORS use. Respondents attributed benefits to ORS beyond its true physiological effects. Inappropriate expectations of ORS to reduce the duration or volume of diarrhea and fight infection can lead to disappointment and frustration, potentially contributing to subsequent failure to use ORS. Health workers in Asembo and Kibera may be contributing to these inappropriate expectations on the part of caregivers (Patel K, personal communication). Ellis and colleagues[19] describe the inherent tension between promoting ORS's ability to prevent dehydration and death and avoiding creation of expectations that ORS will stop diarrhea. Unlike ORS, zinc has been shown to reduce the duration and volume of diarrhea,[21] but cannot treat dehydration. As zinc is scaled up for diarrhea treatment in Kenya and other sub-Saharan African countries,[22,23] behavior change communications should promote the need to address dehydration with ORS and to decrease the diarrhea with zinc. Experiences from Asia indicate that ORS use can be improved alongside zinc promotion.[24]

Surprisingly, SES and cost of ORS were neither positively nor negatively associated with ORS use. Still, among caregivers who reported knowing the cost of an ORS packet, one-third in Asembo and nearly one-half in Kibera felt that the cost was unaffordable, and this should be taken into account as planning around increasing the promotion and availability of ORS in the community goes forward.

It may be important to engage other local sources of information and care in the effort to improve diarrhea case management. These alternate care providers include chemists, CHWs, and herbalists, who are widely sought for diarrhea treatment. Interestingly, the availability of oral medications from a CHW negatively impacted caregivers' use of ORT, possibly because this availability reinforced the perception that oral medications are a superior form of treatment to ORT and render ORT unnecessary. In group discussions, caregivers emphasized that CHWs are an important health resource and could be used more effectively to deliver information regarding diarrhea treatment (Blum L, personal communication). Periodic refresher training may be needed to improve and maintain CHWs' ability to appropriately advise on diarrhea case management.[25]

Herbal medicines and care-seeking from herbalists were common for children with diarrhea in Asembo, and there was an inverse relationship between positive beliefs about herbs and ORT use. Use of herbs for diarrhea treatment is prevalent throughout sub-Saharan Africa.[19] As Ellis eloquently states, rather than trying to replace herbs with ORS and other treatments based in the allopathic tradition, use of ORS, continued feeding, and zinc should be encouraged alongside herbal remedies.[19]

While ORT is essential for prevention and treatment of dehydration, continued feeding is critical for preventing the adverse nutritional consequences of diarrhea.[26–28] Continued nutrition during diarrhea, and increasing nutrition during the recovery period, decrease the risk of growth faltering resulting from the diarrhea episode.[26] Feeding was not continued for one-third to one-half of children in the two study sites, with breastfeeding discontinued for over one-quarter of Kibera breastfed children, placing them at risk for nutritional

consequences such as wasting and stunting, already prevalent in these areas (KEMRI-CDC, unpublished data). The high rate of stoppage or decrease in feeding, particularly breastfeeding, in both study sites is of particular concern. A decreased ability to suckle or chew, because of lethargy or dehydration, may influence the baby's ability to feed successfully. However, we measured feeding behavior with respect to the number of times food or breast milk was *offered* by the mother, rather than the number of times a child actually ate or breastfed. These findings indicate the pressing need to emphasize continued feeding, and certainly breastfeeding, in efforts to improve diarrhea case management in Kenya. Continued feeding still receives little attention in messages about diarrhea case management offered to parents or health workers. A forthcoming analysis by our group will examine barriers to continued feeding by caregivers and factors associated with health worker recommendations to continue feeding in Asembo and Kibera.

LIMITATIONS

We used self-reported information regarding treatment of children with diarrhea. There is a possibility of courtesy bias in self-report, and perhaps, given the in-depth nature of our questionnaire, respondents exaggerated reports of ORT use. Second, we collected data in only two sites in Kenya where there has been a long-standing presence of KEMRI/CDC activities within or adjacent to the communities. Moreover, most of our respondents represented only two of Kenya's major ethnic groups. It is possible that our findings are culturally mediated. However, findings with respect to the influence of health workers and lack of widespread availability of ORS do point to systemic deficiencies that are likely to affect much of Kenya more than culturally mediated barriers, which might only be relevant in limited geographic areas.

CONCLUSIONS

For a treatment approach that has been proven effective, is relatively inexpensive, and has been available for over 30 years, significant gaps still exist in ensuring universal use of ORT and continued feeding for diarrhea case management.[22,23] Our findings on the importance of appropriate and consistent guidance by health workers, empowerment of the caregiver, and reliable access to ORS in community locations can be incorporated into programs to address the existing gaps in diarrhea case management. Efforts directed toward capacity building by educating institutional and community healthcare providers, improving accessibility and availability of supplies like ORS and zinc, and empowering communities and caregivers to take charge of diarrheal disease will address many of the needs identified by this study. Financial resources wisely applied to these areas may be expected to yield significant results. With the establishment of such an enabling environment, caregivers may substantially improve household diarrhea case management and reduce deaths from diarrhea in Kenya. The findings of this study were presented to the Kenya Ministry of Public Health and Sanitation and to the representatives of international and national organizations within Kenya, to serve as input to strengthened diarrhea case management as part of an integrated program for childhood diarrhea prevention and treatment.[16]

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