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How much oral rehydration solution is actually administered during home-based therapy?

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Summary

In some parts of the world up to one-half of all deaths in young children are attributable to dehydration associated with diarrhoea. As a countermeasure, mothers in underdeveloped countries are being successfully taught to give oral rehydration solution at home. There are, however, serious doubts as to whether mothers give their children enough. The focus of our investigation was a methodology capable of establishing the exact quantity of fluid administered by unsupervised mothers at home. Accurate quantitative data are essential for programme planning and evaluation.

In our sample of 44 cases, only two children received more than $90 \text{ ml kg}^{-1} \text{ day}^{-1}$. The mean observed value was $44 \text{ ml kg}^{-1} \text{ day}^{-1}$ (SD 28.4); well below the recommended dosage. Preliminary data were also gathered on natural consequences which may discourage use of ORS such as vomiting, increased frequency of watery stools, and distaste for the solution.

Introduction

During the first 2 years of life a child's small body is susceptible to rapid and potentially deadly dehydration (Black 1984). In most developing countries diarrhoeal disease and associated dehydration is recurrent throughout childhood. It accounts for 3 to 6 million deaths among children each year (Snyder & Merson 1982; WHO 1984, p. 3) representing half of all infant deaths in some areas (Rohde 1984). Worldwide, mothers in developing countries

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are being encouraged to carry out home-based oral rehydration therapy to prevent devastating consequences of diarrhoeal disease (Merson 1986; WHO 1986).

Home-based oral rehydration requires that the child's mother or caretaker engage in unfamiliar behaviours. Once having recognized the problem, the mother must obtain ORS materials, prepare the rehydration solution properly and administer an adequate quantity of the liquid. Efforts to initiate these behaviours in the mothers of sick children have met with real success (de Zoysa *et al.* 1984; Elder *et al.* 1988; Hornick *et al.* 1986; Thane Toe *et al.* 1984). There is nonetheless a universal concern that unsupervised mothers may not give their sick children enough oral rehydration fluid. The meagre evidence available supports this belief (Snyder *et al.* 1982; Cutts 1988).

Although the question of ORS consumption appears easy to answer, few observations have been done in the home during actual diarrhoeal episodes. The quantity of ORS which mothers administer over the important first 24 h of treatment has not been reported. The child's weight at the time of the diarrhoeal episode and the exact quantity of ORS given are rarely accessible to investigators. Without these data the $\text{ml kg}^{-1} \text{ day}^{-1}$ dose cannot be established.

The most common method of collecting information on the quantity of ORS used is to question mothers about their child's last illness. The contact may occur from a few days to several months after treatment. Interview based data on health-related behaviour can, however, be unreliable. Stanton *et al.* (1987) found that field information gathered by interview and questionnaire was not consistent with

data obtained by direct observation and concluded that quantitative interview data are at best suggestive and at worst misleading. Many mothers in developing countries have no experience with standard volume measures needed to quantify the amount of ORS given.

In contrast, direct observations are more precise but can be costly and present logistical problems. Observations can occur only at the home of a child who is currently ill with diarrhoeal disease. The presence of an observer could influence the mother to behave atypically, and placing skilled observers in more than a few homes for long enough to establish the daily rate of consumption of ORS is unrealistic in view of the limited resources available.

Accurate consumption data are, nonetheless, essential to determine whether quantities of ORS used in home treatment are adequate. Quantitative data are also necessary to determine whether the amount given is a function of variables expected to influence mothers' treatment behaviours. The purpose of this study was to field test the practicality of a direct measurement protocol to obtain consumption data in the home. The emphases were to simplify the logistics of a direct assessment, obtain an accurate measure of the volume of solution administered and to minimize the influence of the observers. The results of the field test are reported below.

Methods

Children with signs and symptoms of dehydration require intensive treatment to replace water and electrolyte losses promptly and adequately. This should be conducted under the supervision of trained medical personnel and normally requires 4 h or less. When dehydration signs are no longer present, WHO guidelines suggest that 'maintenance therapy should continue until the diarrhoea stops' because 'it is important to replace the ongoing abnormal losses of fluid and electrolytes that are associated with continuing diarrhoea'. The amount suggested is '100 ml/kg body weight per day until diarrhoea stops'. WHO 1939, pp. 10, 11).

Several sets of instructions to mothers have been used by different programmes around the world. A common approach is to tell mothers to give 1 litre of ORS in a 24-h period (Honduras, Pakistan, Nepal). The other popular method is a replacement-based system which instructs mothers to give one cup (100–200 ml) of ORS solution after each loose stool (Egypt, Indonesia, Senegal, Lesotho). The methodology tested in this field trial was designed to determine whether unsupervised mothers actually gave their children about 100 ml/kg of ORS daily.

PROCEDURE

Research staff contacted participants at a state-sponsored primary care clinic in Northern Mexico. The area served was accessible only by a poorly maintained dirt road used almost exclusively by supply trucks. Houses were typically one-room shacks without running water or waste disposal. There were approximately 1000 children registered in the clinic's well baby programme (newborn to 5 years) at the time of the study. The clinic did not have facilities or staff to carry out in-patient rehydration therapy. Standard WHO-ORS packets were used for the duration of the study.

Observation started with the registration of each child presenting with diarrhoeal disease. Each mother was instructed in the use of ORS. Mothers then prepared 1 litre of oral rehydration solution under staff supervision. About 24 h later, staff made a home visit to determine how much ORS remained after the first day of treatment.

Research staff trained three clinic aides to register participants, instruct mothers and conduct home visits. A member of the research team produced Spanish data-collection forms and supervised all day-to-day activities. Our intent was to study ORS therapy under optimal conditions. Clinic staff instructed mothers in mixing and administration of ORS with great care. The first batch of ORS was always properly prepared.

The study covered a 10-week period from mid-July to the end of September, a time associated with high incidence of diarrhoeal disease in this region. We planned to collect 80–100

observations during this period. The incidence of diarrhoeal disease was, however, much lower than expected. Access was limited to this period and we were able to collect only 50 observations.

When a child presented at the clinic with mild dehydration secondary to diarrhoeal disease, staff collected intake data on the family and child including date, time, clinic case number, the physician or service provider handling the case, the name and age of the child, parents and siblings, the location of the family residence, and the child's weight and length. The mother was asked whether she would allow clinic staff to visit her home and observe the child. Permission was obtained in all cases. Staff then provided each mother with a clean 1-litre container of local origin. Clinic personnel instructed the mother in mixing ORS. They then supervised the mother as she prepared the initial dose, using a WHO 1-litre packet. A plastic cap was placed on the bottle to prevent spillage on the telephone. The final step at the clinic was to instruct each mother carefully in administration procedure. The staff emphasized continued feeding and continued ordinary liquids. The administration instructions were to give the child 'a cupful of ORS for each loose stool'. Each mother was asked if she understood the instructions. In the few cases where a mother said she did not, instructions were repeated and elucidated until she responded positively to the inquiry.

About 24 h after the clinic contact, an observer visited the home of the sick child. The observer carried a graduated liquid measure and emptied the remaining ORS into it taking care to carry out the procedure on a level surface. The observer recorded the location, time of day and quantity of ORS remaining, as well as interview data about the person who gave the ORS solution, whether the child rejected the solution or found it palatable, other liquids given, food consumed, whether the child vomited, whether stooling had increased, decreased or remained the same, and any other perceived change in the child's condition during the last 24 h. Before leaving, the clinic worker disposed of the remaining ORS, gave the mother additional ORS packets as needed and supervised her as

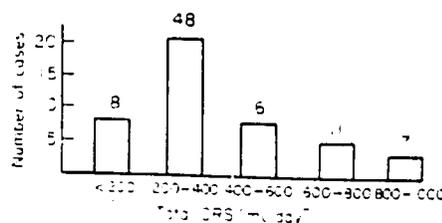


Figure 1. Distribution of the total quantity of ORS given. Figures above bars are percentages.

she mixed a fresh batch. The intake interview, measurement of the child, follow-up visit and exit interview occupied the observer for an average of about 2 h per case.

Results

Fifty children diagnosed by clinic staff as mildly dehydrated with diarrhoeal disease were registered. The 31 males and 19 females ranged in age from 2 to 58 months (mean 14.5). All of the children had diarrhoea of one or more days duration. The families lived 2 to 30 (mean 15.3) min walk from the community clinic. The children weighed from 5 to 19.5 (mean 10) kg and heights ranged from 57 to 113 (mean 75.3) cm. Forty-five were in the 24-month and under highest-risk age range in which we were interested. Five children were 6 months or more above the target age range. One case was dropped because the mother supplied contradictory information. The 44 cases reported were evenly distributed across the target age range. Mean age was 11.4 months with a standard deviation of 6.2. There were 25 males and 19 females. Mothers' ages range from 14 to 43 (mean 26.3) years. The number of siblings ranged from 1 to 10 (mean 2.3).

Staff located the home of every child registered and measured the ORS remaining. The amount of ORS consumed was, in most cases, well below what was available (Figure 1). The mean quantity used in the first 24 h of therapy was 387 ml, with a standard deviation of 246. There was broad scatter across the 0-1000 ml range. Two mothers gave all of the ORS fluid available to them, two gave none, and the other 40 mothers varied widely between.

The child's weight recorded at registration and the consumption data collected 24 h later,

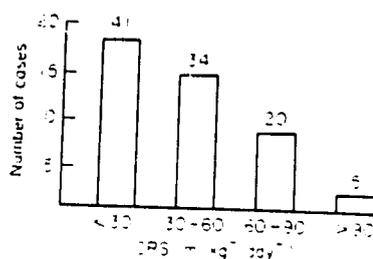


Figure 2. Distribution of the ORS dose given. Figures above bars are percentages.

established the ml kg⁻¹ day⁻¹ ratio. The mean value was 44 ml kg⁻¹ day⁻¹ (Figure 2); but few children actually received this amount (Table 1). The standard deviation was again high, at 28.4. Only two of the 44 children received more than 90 ml kg⁻¹ day⁻¹, approximating the WHO 100 ml kg⁻¹ day⁻¹ recommended maintenance dose.

There was a decrease in dose with increase in age. The 0-6-month group mean was 53.9 ml kg⁻¹ day⁻¹; the 7-12-month group averaged 42.1; the 13-18-month group 42.2, and for those 19-24 months of age the average was 34.5. Six mothers (14%) did not give additional liquids. Thirty-eight (86%) reported giving milk, juice, soup, water or other fluids in addition to ORS. The quantity of these supplements could not be estimated with useful levels of confidence and accuracy.

Discussion

Giving insufficient ORS will render the therapy ineffective (Snyder *et al.* 1982). During the study reported here quality was eliminated as a variable. Every mother initiated home treatment with 1 litre of liquid mixed exactly to specification. The sole focus of the investigation was the volume of ORS delivered to the sick child at home. Quantitative data which we believe to be very accurate were obtained for every case registered.

Personnel effort, while considerable, was not unreasonable and should not prevent use of this methodology in studies of larger cohorts. Clinic staff who participated did so with enthusiasm despite the added burden which the study imposed on them. They welcomed the opportunity to get follow-up information. We believe

increased investment to obtain accurate data is appropriate. Quantity given is a critical element of the only rehydration treatment available to sick children in many parts of the world.

In addition, preliminary data were gathered on natural consequences which may discourage appropriate use of ORS such as vomiting, stool volume, and distaste for the solution. The limited scope of this study prevents general conclusions about the relationship between quantity of ORS delivered and perceived benefits or problems associated with its use. The data collected, however, demonstrate the feasibility of obtaining measures of ORS use and mothers' impressions simultaneously, during therapy at the peak of salience. The direct measurement and immediate-recall approach is viable even within severe financial and time constraints.

Oral rehydration fluids were, as expected, administered by the child's mother in most cases (84%). A sibling gave the solution in 11% of the cases and grandmothers accounted for the remaining 4%. A smaller than expected number of these individuals reported that the sick children found the salty flavour of ORS fluid distasteful. Most children (80%) readily accepted the properly prepared ORS solution. Vomiting was reported in only 20% of the children. In those cases where vomiting did occur, 78% of the mothers said that the initiation of ORT reduced vomiting and the others found no change. These findings lend little support to the notion that inadequate oral fluid therapy is attributable to the child's refusal of the fluid or increased vomiting.

When questioned concerning watery stools, 46% of the mothers reported a reduction in the first 24 h after the initiation of fluid therapy and 27% reported no change. Only 27% of the study mothers indicated that watery stools increased when ORS was administered. Mothers of the ten children who received the highest ml kg⁻¹ doses of ORS reported increased stooling in five cases and decreases in four (Table 1).

WHAT INFLUENCES THE QUANTITY GIVEN?

A recommended maintenance dose for mild diarrhoea is 100 ml kg⁻¹ day⁻¹ until the

Table 1.

Age (months)	Sex	Weight (kg)	ORS (ml)	ORS ml kg ⁻¹	Gave other liquids	Stools		Vomit		Tastes bad
						more	less	same	less	
10	F	7.5	0	0.0	x					
24	M	12.0	0	0.0	x					
13	F	11.0	75	6.8	x					x
12	M	11.1	100	9.0	x		x			
3	F	6.5	75	11.5			x			
19	F	10.9	200	18.3	x		x			
4	M	8.7	175	20.1	x	x				
13	M	10.2	225	22.1	x					
11	F	12.9	300	23.3	x					
10	M	11.8	275	23.3	x	x				x
5	M	7.1	175	24.6	x					x
24	M	13.0	325	25.0	x		x			x
7	M	8.9	225	25.3	x		x			
7	M	7.5	200	26.7		x				
14	F	10.0	275	27.5	x		x			
19	F	11.8	325	27.5	x					
19	F	11.0	325	29.5	x		x		x	
5	M	6.7	200	29.9		x			x	x
8	M	9.8	325	33.2	x		x			
14	F	9.0	300	33.3	x		x			
18	F	10.5	375	35.7	x		x			
12	F	11.0	425	38.6		x			x	
12	M	7.5	300	40.0	x		x		x	x
19	F	10.8	450	41.7	x				x	x
2	M	3.5	150	42.9	x					
3	M	7.4	325	43.9	x				x	
10	M	8.5	375	44.1	x		x			
7	F	7.9	350	44.3	x		x			
4	M	7.5	350	46.7	x	x			x	
16	M	11.0	515	46.8	x		x			
13	M	10.5	500	47.6	x	x			x	
4	M	5.7	275	48.2	x		x			
22	F	10.2	575	56.4	x					
10	F	6.9	425	61.6	x		x			
9	M	8.9	575	64.6	x		x			
24	M	11.0	850	77.3	x	x				x
16	M	9.8	760	77.6	x	x				
10	F	9.9	775	78.3	x		x			
3	M	5.0	400	80.0			x			
9	M	8.4	675	80.4	x		x			
11	F	9.2	750	81.5	x	x				
17	F	12.0	1000	83.3	x					
6	M	6.8	750	110.3	x	x			x	x
5	F	7.4	1000	135.1		x				

diarrhoea stops (WHO 1984, p. 11). In the population studied only 5% of the children received 90 ml kg⁻¹ or more. Indeed, only 25% of the children received 60 ml kg⁻¹ or more in the first 24 h. These data confirm the suspicion that the quantity of ORS given in home-based therapy is often far less than guidelines recommend. The reason for the discrepancy is not clear. The wide-ranging absolute and

ml kg⁻¹ day⁻¹ values did not suggest a trend or cause. Underdosing was, however, severe enough to trivialize the intervention in many instances.

The most obvious explanation for noncompliance is that mothers did not understand or agree with the instructions. This study was not intended to determine which instructional systems or guidelines may work best. We accepted

those currently in use and made instructions and quality of the solution constants. The observation technique, however, readily lends itself to the study of comparative instructional approaches and other influential variables in the future.

Another possible explanation for underdosing is that mothers did follow the instructions but that a cup of ORS per loose stool did not approximate $100 \text{ ml kg}^{-1} \text{ day}^{-1}$. Quantity of ORS is intentionally linked to the child's elimination frequency by the 'one cupful per loose stool' instruction. This direction may not produce the desired $\text{ml kg}^{-1} \text{ day}^{-1}$ dose because of infrequent or unobserved stools. We were unable to estimate the impact of the frequency of watery stools on quantity of ORS given. An accurate measure of this variable has proved virtually impossible to obtain in the home without 24-h surveillance of the child.

Mothers may have judged the child's illness not severe enough to warrant giving the recommended quantity of rehydration solution or applied alternative treatment (Chowdhury *et al.* 1988). Clinic staff diagnosed all of the children selected for the study as suffering from mild dehydration and all had been ill for 1-2 days prior to their clinic visit. Alternative treatment was given in 24 of 44 cases (54%), but mothers gave some ORS in 95% of the cases. These mothers were aware that staff would be conducting a follow-up visit. In a study which shared this feature, Thane Toe and colleagues (1984) found a similarly high 96% of all children with diarrhoeal disease under age 5 were treated with ORS in six Burmese villages where health workers made daily surveillance rounds and replaced used ORS packets. If the expectation of a follow-up visit by clinic staff increased the use of ORS, quantities given where there is no follow-up could prove even lower than those which we observed.

Finally, the high correspondence between the total volume of ORS given and $\text{ml kg}^{-1} \text{ day}^{-1}$ ($r=0.91$) in our study suggests that mothers might do better if they had a concrete quantitative target. The available data do not suggest that this element alone will alleviate underdosing. Snyder and colleagues (1982)

used fixed-dose instructions and subsequently concluded that 'only about one fourth of the persons treated took appropriate volumes of ORT'.

Conclusion

The simplicity and reliability of home-based ORT is more apparent than real. The treatment requires that mothers behave in ways which are unfamiliar and with which they may have no prior experience of success. The verbal instructions typically expected to be sufficient to establish and maintain the required behaviour pattern in mothers may be inadequate. Informal discussions with mothers suggested, for example, that administration may be hindered by the 'one cupful per loose stool' instruction. This advice can disrupt natural opportunities and prompts for giving liquids such as when the child requests them, at bedtime, mealtimes, on waking, and so on.

In both underdeveloped and developed countries, health promotion efforts are increasingly focused on specific behaviours related to health and disease. Often those responsible rely solely on questionnaires and other indirect indices of health-related behaviours to plan and evaluate programmes. This study, although limited in scope and sample size, offers direct evidence that a currently favoured approach does not consistently produce suitable internal behaviour. In many Third-World clinics treatment is initiated under less exemplary conditions than those which we established. If our study group is at all representative, home-based rehydration programmes will not reliably deliver the needed quantity of ORS until further field research refines our understanding of variables which support and dissuade proper administration. The problem of delivering an adequate quantity of ORS cannot be disregarded if home-based oral rehydration therapy is to have the hoped-for impact on the survival of young children in developing countries.

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