WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTE

DIARRHOEAL DISEASES CONTROL PROGRAMME

WHO/CDD/SER/86.9

ORIGINAL: ENGLISH

ORAL REHYDRATION THERAPY FOR TREATMENT OF DIARRHOEA IN THE HOME

The approach to early home treatment of diarrhoea varies widely and is influenced by many factors, including cultural attitudes and practices, and socioeconomic status. For example, antidiarrhoeal drugs and antimicrobials are commonly used by persons with higher incomes, while those with lower incomes more often rely on folk remedies which often include different types of liquids available in the home (e.g., cereal gruels, herbal teas).

The effectiveness and safety of Oral Rehydration Salts (ORS) solution* for the treatment of dehydration due to diarrhoea both in health facilities and at the community level has been well documented (1, 2, 3). That ORS can be used successfully to maintain normal hydration status in the vast majority of cases following the treatment of dehydration suggests that it should also be effective for early use at home to prevent dehydration. However, as ORS is not necessary for early home therapy in most cases, and is currently available to only one-third of the people living in the developing world (4), other approaches to the preparation of oral rehydration solutions in the home for use early in diarrhoea have been sought. These generally involve the education of mothers to give fluids that are either normally available at home or can be prepared with ingredients at hand. These fluids can be grouped into the following categories:

- Sugar-salt solution (SSS)
- Food-based solutions
- Commercial beverages and other fluids.

This paper reviews the information available on the use of these solutions and provides recommendations for selection of a solution by national Diarrhoeal Diseases Control (CDD) programmes. The paper does not discuss information available on the use of ORS which, as indicated above, is viewed primarily as a solution for the treatment of dehydration.

1. SUGAR-SALT SOLUTION (SSS)

Salt water was used in treatment of cholera patients as early as 1834 in the UK (5). In the late 1940s/early 1950s a carbohydrate (e.g., glucose) was added to oral salt solutions being used to treat diarrhoea, to improve their taste and to provide calories (6, 7). It was in the mid-1960s that glucose-mediated sodium absorption in the intestine was first described and subsequently found to remain largely intact during diarrhoea (8, 9, 10). Because of its carrier function, there is universal agreement that glucose (or a disaccharide or polysaccharide that yields glucose when hydrolysed) should be included in any oral rehydration solution. Sucrose (table sugar) has been widely used as a practical and effective source of glucose.

1.1 Effectiveness of SSS

SSS can correct adequately the fluid volume deficits due to non-cholera diarrhoea in

*ORS solution contains (in grams per litre): sodium chloride 3.5, trisodium citrate, dihydrate 2.9 <u>or</u> sodium bicarbonate 2.5, potassium chloride 1.5, and glucose 20.0.

children and adults (11) though it is inadequate for the correction of accompanying hypokalaemia and corrects acidosis slowly. SSS is also inadequate for the treatment of dehydration and replacement of electrolyte losses in cholera (12). That it may be effective in preventing most cases of dehydration is suggested by its ability to correct fluid volume deficits in non-cholera diarrhoea. However, no studies have directly addressed this question. When SSS was used by village health workers in Egypt (13) and India (14, 15) for primary treatment of diarrhoea, diarrhoea-associated mortality rates declined significantly. However, in the Egyptian study ORS packets were available free from health facilities and health workers or at subsidized prices from shops and pharmacies; and in the Indian study, a pharmacy-prepared mixture containing sodium and potassium chloride, to which sodium bicarbonate and sugar were added at home, was available for those with marked dehydration. In addition, in both studies, repeated home visits undoubtedly led to earlier recognition of diarrhoea cases. Thus, it is not certain whether the fall in mortality rates in these studies was due to the use of SSS at home to prevent dehydration and/or treat mildly dehydrated cases, the use of ORS in more severely dehydrated cases, or the repeated home visits by health workers, or a combination of these.

1.2 Composition of SSS

Assuming that SSS is effective in preventing dehydration, it would be useful to have data on the optimum concentrations of the sugar (glucose or sucrose) and salt (sodium). In a recent study, Santosham et al. (16) demonstrated that solutions containing 30, 50, and 90 mmol/l of sodium were equally safe and effective in treating diarrhoea cases with no or mild dehydration. Snyder et al. (17) compared serum sodium concentrations in children receiving ORS or a labon (salt)-gur (molasses) solution (see section 1.4) containing 90 mmol/l of sodium for primary treatment of diarrhoea in a community-based study in Matlab, Bangladesh, and found very low rates of electrolyte abnormalities in both groups. This type of information led WHO and UNICEF to recommend that home-made oral fluids should have sodium and glucose concentrations of 50-100 mmol/l (18). The lower limit was considered to be the minimum concentration required to prevent most cases of dehydration and to treat mildly dehydrated cases, and the upper limit was felt to be at the highest level of safety.

1.3 Preparation of SSS

In 1972, Church (19) recognized the need for a simple method to enable mothers to prepare SSS at home. He recommended mixing two "thumb and 2-finger pinches" of salt and one "4-finger scoop" of sugar in a pint of water which gives a solution containing 34 mmol/l of sodium and 175 mmol/l of glucose. Since then, many other recipes have been proposed, along with various simple measuring instruments (e.g., teaspoons, bottle caps). Table 1 lists some of these recipes and indicates their sodium and glucose concentrations*. Many of the recipes are outside the 50-100 mmol/l range. About one-third of the recipes include a recommendation to add lemon or orange juice, coconut water, or potassium chloride tablets (as a source of potassium) or baking soda (as a source of bicarbonate). Similar data have recently been tabulated for solutions used in 11 African countries (20).

Potential difficulties in using the "pinch-and-scoop" method were initially demonstrated in a study (21) in which the mean weight of a pinch of refined salt was recorded as 0.42 g (± 0.12) for mothers in the UK, 0.96 g (± 0.52) for mothers in Trinidad and Tobago, and 2.27 g (± 1.65) for mothers in India (numbers in parentheses are ± S.D.). For the latter group, a pinch of crude salt weighed 1.63 g (± 0.96). In another study in Calcutta, a scoop was found to deliver 15-20 g of sugar and a pinch 0.8-2.7 g of salt (22). In a study in Nepal, about 25% of the solutions had greater than 90 mmol/l of sodium when prepared by the pinch-and-scoop method (23). In contrast, the Bangladesh Rural Advancement Committee (BRAC) has reported a consistently acceptable range of concentrations of sodium (30-100 mmol/l) and glucose (40-178 mmol/l) using the pinch-and-scoop method when training and supervision were intensive, the salaries of trainers were related to the quality of the performance of trainees, and the fluids were prepared in containers provided for mixing (24).

*A. Voight of the Centers for Disease Control, Atlanta, USA, provided many of these recipes.

Recognizing the differences in size of available teaspoons and in the amounts delivered by pinches and scoops, Hendrata (25) designed a double-ended plastic spoon to measure salt and sugar for mixing in a cup (200 ml) of water which yields a concentration of 77 mmol/l of sodium and 58 mmol/l of glucose. Morley has widely promoted, through the Teaching Aids at Low Cost (TALC) programme of the Institute of Child Health, London, UK, a similar spoon of durable plastic, on which are written instructions in nine different languages.

Levine et al. (26) compared in American nurses the pinch-and-scoop, household-spoon, and double-ended-spoon methods for measuring sugar and salt and found large intra- and inter-person variability in the first two methods. The double-ended spoon gave the most consistent results. Ransome-Kuti (27) observed that only 34% of 217 Nigerian women could prepare SSS correctly using teaspoons and proposed the use of a simple plastic measuring device which, if manufactured on a large scale, would be inexpensive. Harland et al. (28) found that the osmolality of SSS prepared by 7 Jamaican mothers was more accurate when the double-ended plastic spoon was used than when it was mixed by other hand-mixing methods learnt through health personnel and radio and television messages. In contrast to these results, a study in Mozambique (29) found the pinch-and-scoop to perform better than the double-ended plastic spoon when the sugar and salt were damp and lumpy, making measurement by level spoonsful difficult. Similarly, in a study in Zimbabwe, de Zoysa et al. (30) found more reliable results when SSS solutions were prepared with domestic teaspoons than with the double-ended spoon, although the reason for this could not be identified.

In another study in Vellore, India (31), use of both the pinch-and-scoop method and the double-ended plastic spoon by village health workers resulted in solutions ranging from 25-120 mmol/l of sodium and 25-140 mmol/l of glucose; both of these ranges were felt by the investigators to be acceptable from the point of view of safety and efficacy, though they are wider than those recommended.

In another study in Zimbabwe (32), mothers were taught to prepare SSS by mixing 6 level teaspoons of sugar and half a level teaspoon of salt in 750 ml of water. The results were encouraging in that, after a period of 11-26 days, recall of the method taught was correct 64% of the time and 84% of mothers prepared fluid that had salt and sugar concentrations within the defined range of 30-100 mmol/l of sodium and 50-149 mmol/l of glucose. Eighty-eight per cent of mothers had available a 750-ml bottle, a teaspoon, sugar, and salt. This report registers one of the most satisfactory experiences with the preparation of SSS.

To prevent the use of solutions containing a high salt content, some workers have advised mothers to make sure that SSS does not taste "more salty than tears" (33). However, as the sodium content of tears varies from 108-176 mEq/l (34), this advice may not be appropriate. Its reliability also is doubtful.

1.4 Availability of ingredients and utensils

Although published reports are few, surveys and informal enquiries in some Asian and African countries (e.g., Bangladesh, India, Mali, Nigeria, Senegal) have revealed that non-availability of salt and sugar or mixing utensils (e.g., spoons) can create operational problems in the use of SSS. In a study in Nepal (23), less than 50% of the homes were found to have sugar and any kind of teaspoon. In many countries sugar is expensive, particularly when purchased in small amounts, and its market price and availability vary according to the season. Even when available, the crystal size, degree of refinement, and moisture content of the sugar and salt can cause difficulty in measurement, as mentioned above. In rare cases, impurities have been found in salt and sugar in the market.

Because of its cost and occasional non-availability, alternatives to the usual cane sugar have been sought. For example, "gur" - a crude, brown, lumpy sugar made by concentrating sugar-cane juice - has been promoted in Bangladesh as a replacement for sugar (35). It has a sucrose content which varies from 52 to 81%, a potassium concentration of about 7 mmol/l, and a variable amount of bicarbonate (usually $<$10 mmol/l). Honey, 70-80% of which is composed of glucose and fructose in about equal proportions, has also been recommended as a substitute for sugar (50 ml yields about 110 mmol/l of glucose) and has been tried in place of glucose in ORS (36). However, it is generally expensive, varies considerably in quality and is not as widely available as is generally thought.

Teaspoons are usually available in the homes of families of middle to high socioeconomic status, though they may vary considerably in size. In poorer homes they may be found less often. However, in one country (Nigeria), mothers are being educated in the national programme to use a widely available plastic 3-ml spoon for preparing SSS (37). The special double-ended plastic spoons recommended by Morley are certainly more practical, but they may be relatively expensive, especially if made locally, and can be misplaced or used for other purposes. In a study in Nepal, the spoons could be found in only 17 of 50 homes two weeks after their free distribution (38). Similar spoons recommended by Hendrata (25) are at present being evaluated in India and the Philippines.

Recommendations on the amount of salt and sugar to be dissolved must be related to the volume of water; unless a widely available container of an appropriate size is identified, it is not possible to formulate a meaningful recommendation for the preparation of SSS. However, this aspect of SSS preparation is often neglected. Studies in Egypt (39) and India (40) have found that even the concentration of ORS solution made from pre-packaged ORS may be inaccurate if a suitable mixing container is not identified. Empty soft drink and beer bottles have frequently been used. In countries where no such container has been identified, some national programmes have provided a standard mixing vessel to one person in each community, who in turn calibrates containers in neighbours' homes.

1.5 Ability of mothers to learn, retain, and use knowledge

Even when the ingredients and utensils are available, preparation of a safe and effective SSS requires that the mother learn the skill and remember it when needed. As noted above, de Zoysa et al. in Zimbabwe (32) recorded satisfaction with the recall performance of mothers 11-26 days after they had received training. However, in a follow-up, nationwide study undertaken two years later, it was found that while 72% of mothers with children having diarrhoea in the past six months were aware of SSS, only 21% could recite the correct formula (41).

Chowdhury, reporting on the BRAC project in Bangladesh mentioned earlier, observed that 89% of the mothers prepared satisfactory SSS by the pinch-and-scoop method six months after instruction (42). In a more recent review of the national CDD activities in Bangladesh, it was found that 59% of episodes of diarrhoea occurring in BRAC programme areas during the previous two weeks were reported by mothers to have been treated with lobun-gur solution as compared with 15% of episodes in non-BRAC areas (43). However, in the most recent evaluation of the BRAC programme, problems in preparing the solution accurately and using it correctly were identified to a "greater extent than ever expected" (44).

In The Gambia (45), mothers were taught through the nationwide Mass Media for Infant Health (MMIH) project to mix SSS using bottle caps and soft drink bottles, to recognize when to take the child for medical care, to continue feeding during diarrhoea, and to adopt hygienic practices to prevent diarrhoea. After two years of intensive educational activities, more than 70% of all mothers could describe the SSS formula. However, while half of all diarrhoea cases were reported to have been treated with properly made SSS at the end of the campaign, only 15% were treated by a family member fully conversant with the clearly defined five-point procedure for mixing and administration. In a follow-up survey done one year later, less than 10% of mothers could recite how to properly mix and administer SSS and only 25% reported using it for the most recent episode of diarrhoea in their children (46).

A six-month campaign similar to that in The Gambia was undertaken in Swaziland to promote the home use of SSS. In an evaluation of the project (47), the proportion of those who reported using SSS during the most recent diarrhoea episode was 36% before the campaign when 47 different formulations were taught; after the campaign, the proportion of users increased to about 48% and, more significantly, more than half of them used one of two different formulations, one of which was taught during the campaign. The percentage of mothers who could describe the formula correctly increased from 8% to 26% after the campaign. About 4% before and 17% after the campaign said that they both used SSS and knew the amounts of sugar, salt, and water of the formula. However, 54% of mothers described formulae with unacceptably high salt concentrations, which appeared to be due to difficulties in understanding the message about adding salt to the solution. An innovative objective element for evaluation was to look during home-visits for the rehydration kit that had been promoted in the radio message; about 38% of the respondents had heard of the kit, but only 6% reported owning such a kit, and only half of them could show it to an interviewer.

In a more recent community survey conducted in Rwanda, an analysis was made of SSS prepared by mothers following advice received through various health workers. Fifty-four different recipes for preparation of SSS were described by 469 mothers with a child who had diarrhoea during the past month. An analysis of 63 solutions revealed sodium concentrations ranging from 9 to 1057 mmol/l; only 21% had a concentration of 50-99 mmol/l, 9% were less than 50 mmol/l, and the remainder more than 100 mmol/l. Furthermore, it was found that the volume of fluid given by mothers varied from 3 to 325 ml/kg with a mean of only 31 ml/kg (48).

1.6 Summary

From this review it is evident that the different approaches advocated for preparing SSS have met with varying degrees of success, and that the following factors can influence the composition of SSS: availability, size of crystals, and moisture content of the salt and sugar; dexterity in the use of the fingers; size of the spoons and mixing containers; and ability of mothers to learn, retain, and apply the knowledge and skill.

The review has also shown that the education of mothers to prepare and administer properly a reasonably acceptable SSS is a task requiring considerable time and reinforcement. Evidence to date suggests that it is increasingly more difficult for mothers to understand a message on the preparation of SSS, to remember the message, to prepare SSS accurately, and to administer it properly when required.

2. FOOD-BASED SOLUTIONS

Various food-based solutions are traditionally used in many cultures for early home treatment of diarrhoea. However, they have received much less promotion and attention than SSS and consequently there have been far fewer studies of their preparation, use, and effectiveness. The information that is available is summarized below.

In a study in Calcutta (49), mothers were advised to use a traditional SSS (Sarbat), rice water, soaked puffed-rice water, soaked pressed-rice water, green coconut water, or butter-milk for early home therapy. Evaluation carried out monthly over two years amongst a 10% sample of randomly selected homes showed that 75% of families used one of the above-mentioned fluids, 27% sought ORS packets from village-based health workers (compared with 60% in an early study when home therapy was not promoted), and 50% of cases receiving the fluid did not seek further treatment; however, a similar percentage (38%) of cases who did not receive these fluids also did not seek further treatment. In rural Thailand (50), rice water with salt was compared with SSS, tea with salt, and ORS as early home fluids and all four preparations were found to be equally effective in preventing dehydration. However, the number of cases in each group was small. In Khmer refugees (51), an educational campaign to use rice water with salt for early treatment of diarrhoea is reported to have led to a significant decline in the number of diarrhoea cases coming for treatment and with severe dehydration, and in the malnutrition rate (however, no figures were given).

Those searching for alternatives to glucose in a home solution have taken advantage of the fact that the large molecules in rice-starch release glucose gradually, glucose then being absorbed rapidly, so that rice starch can be given in relatively large amounts without risk of inducing an osmotic diarrhoea. Studies in Calcutta and Dhaka have shown that children and adults receiving rice-powder-based ORS for the treatment of dehydration have significantly lower stool volume and ORS requirements than those receiving standard ORS (52). WHO-supported research projects being carried out in six countries, and projects under way at the International Centre for Diarrhoeal Disease Research, Bangladesh, are now evaluating cereals like rice, maize, wheat, millet, and sorghum as a source of glucose. The results of these studies will help to identify cereal-based solutions that are appropriate for home use in areas where such cereals are a basic food.

In fact, some research on the use of starch-based home solutions has already yielded interesting results. In New Delhi, Bhan et al. (53) compared the acceptability of SSS, a solution containing powdered puffed rice with added salt, and moong dal (lentil soup) with added salt in young children with diarrhoea over a three-month period. They found that 87% of 158 cases used SSS, 50% of 112 cases rice solution, and 34% of 130 cases moong dal. Most of the study population preferred the taste of SSS and mothers' preference for the same was related to the ease of preparation. More recently, Rahman et al. (54) reported the results of a feasibility study in Bangladesh on the use of a home-made rice-salt solution mixed by mothers using 2 handfuls of rice (or 60-70 g of rice powder) and 1 level teaspoonful of salt in a litre of water. After training, which included demonstrations, over a period of two months, weekly home visits were made during a four-month period to collect data on the type of treatment provided and the outcome. One hundred and fifty randomly collected samples were found to have sodium concentrations ranging from 2 to 250 mmol/l, 57% had concentrations of 71-110 mmol/l, and 28% had concentrations of 111-250 mmol/l. When taste was used as the main criterion for assessing salt content, more solutions had sodium concentrations above 120 mmol/l. The difficulties of adding the correct amount of salt to a home solution, even where supervision is extensive, are further substantiated by this study.

In a study at Singapore General Hospital (55), paediatric diarrhoea cases with no or mild dehydration treated with rice water with no added salt were found to have a lower number of stools than cases treated with ORS. This study raises the theoretical possibility that rice gruel without salt may be effective in preventing dehydration and reducing diarrhoea losses by promoting reabsorption of endogenous sodium and water excreted into the bowel during diarrhoea, though whether it would be adequate for children with more than mild diarrhoea is not known. It is interesting to note that rice gruel with a little salt and lemon added to taste has been customarily used by rice-eating populations in many parts of the world as a home remedy for diarrhoea, as have similar fluids or gruels made from fermented maize or cassava in Africa.

Other home fluids which may be useful but have not been well evaluated include home-made soups of vegetables, fish, or chicken. In one study, De Menibus et al. (56) claimed that a soup made from 500 g of carrots and an equal volume of water, which yielded a concentration of about 58.5 mmol/l of sodium (possibly because of added salt), 27 mmol/l of potassium, and 2 g/l of glucides in addition to some protein, fat, dextrine-maltose, and calcium, was as effective as ORS in the treatment of dehydration. This approach with different vegetables and foods deserves more attention.

3. COMMERCIAL BEVERAGES AND OTHER FLUIDS

Non-alcoholic and non-caffeine-containing drinks are often promoted as beneficial for the prevention of dehydration and even for symptomatic relief during diarrhoea. However, the composition of generally available soft drinks and commercial soups and juices (Table 2) indicates that most are unsuitable because of their high osmolality (57). All have a very low sodium content, except for the soups whose concentrations are too high.

Among the fluids listed in Table 2, breast-milk is the most important for young infants because of its unique immunological and nutritive properties. Its low sodium content also makes it an excellent fluid for the prevention of hypernatraemia. Diluted cow's milk is also appropriate in non-breast-fed infants, except in rare cases with clinically apparent lactose intolerance; however, it contains more sodium than breast-milk. Green coconut water (58) contains glucose and potassium, but is expensive and contains very little sodium; its osmolality varies from 255 to 333 mosm/l. Tea without the addition of salt and sugar provides only water and a little potassium and is not likely to be useful in preventing dehydration.

4. Conclusions and Recommendations

4.1 ORS has been proved to be highly effective for the treatment of dehydration. It is very likely also to be effective for the prevention of dehydration, though even if used from the onset of diarrhoea, it would not prevent all cases of dehydration, especially those of cholera-like severity. However, as ORS is not needed to prevent dehydration in most diarrhoea cases and its availability often cannot be assured, alternative solutions for early home therapy to prevent dehydration have been sought.

4.2 Research has been undertaken to identify alternatives to ORS for early home therapy. The possible options are (a) sugar-salt solutions (SSS), or (b) food-based solutions.

4.3 SSS is currently the most widely promoted home-made fluid. As it is reasonably effective in replacing fluid losses in dehydration and is the alternative for the treatment of dehydration when ORS is not available, it should also be effective in preventing most cases of dehydration. However, considerable problems have been associated with its preparation and use, which include the uncertain availability and variable quality of sugar, and at times also of salt, the lack of suitable utensils for measuring the ingredients and water, and, most importantly, the difficulty in educating mothers to learn, retain, and use the skills required for its proper preparation and administration. The errors in preparation have been found to lead to a solution which is often ineffective and/or unsafe.

4.4 There has been much less experience with the systematic promotion and use of food-based solutions for early treatment of diarrhoea. Their potential advantage is that mothers in many areas are familiar with their preparation and the solutions themselves are made from ingredients and with utensils usually available in the home. Examples of traditional fluids that are commonly used in homes and may have a sound physiological basis (i.e., contain acceptable concentrations of starch and sodium - see 4.6) include cereal gruels, and certain soups. Proper and effective use of these solutions also requires training of mothers, particularly if the traditional recipe requires modification - e.g., if more salt than normally used must be added to the solution. Whether there is any difference in the effectiveness of such solutions prepared either in the traditional way or in a modified manner (e.g., with added salt) to make them physiologically more appropriate has still to be determined. Much attention is at present being focused on the use of cereal-based home solutions, but some important questions remain to be answered before their use can be widely recommended. These concern their digestibility in young infants, the problem of their fermentation, the risk of their being confused with weaning foods, and the potential danger that mothers will assume that concurrent feeding during diarrhoea is not required.

4.5 Strategies to prevent dehydration must be a component of all national CDD programmes. However, in the absence of information on the proportion of childhood diarrhoea cases that become dehydrated without the use of any home fluid, and on the effectiveness of various solutions in preventing dehydration, it is not possible to formulate precise global recommendations on a choice of home solution. Countries should select the approach that is safest, most effective, and most practical in their particular circumstances. As a general guide, solutions should be used that are physiologically appropriate (see 4.6), easy to prepare accurately, and for which the ingredients and utensils are widely available. Solutions which require that mothers learn and carry out <u>new instructions</u> for their preparation and use - be they SSS or food-based solutions to which more salt than usual is added - should be recognized as being more difficult to prepare and use accurately. The choice of solution may require operational research and should take into account such factors as the traditional practices for diarrhoea treatment, knowledge or beliefs about the cause of diarrhoea, the composition and availability of common food-based solutions, the availability and cost of salt and especially sugar, the availability of standard measuring utensils, and the ability of the national CDD programme to provide essential training for health workers and ORS supplies to treat cases with dehydration. The WHO Diarrhoeal Diseases Control Programme is currently preparing guidelines to assist countries in selecting the appropriate home solution. Whichever home solution is chosen, no single channel of communication should be used to convey instructions for its preparation and administration; mass media and trained health workers should be used together to educate mothers in the recommended approach.

4.6 In the light of the difficulties of preparing and using home solutions accurately, as reviewed above, it may be appropriate to revise the WHO/UNICEF recommendations for the <u>sodium</u> concentrations of such solutions from a range of 50-100 mmol/l to a range of 30-80 mmol/l, although a solution of up to 100 mmol/l may still be considered safe. In areas where breast-feeding is common, one may wish to recommend the use of solutions at the upper end of this range as the sodium content of breast-milk is very low and its concurrent consumption therefore reduces the risk of hypernatraemia in young infants. In other areas, it may be preferable to recommend solutions with sodium concentrations towards the middle of this range. To ensure maximum absorption of sodium, the <u>glucose</u> concentrations of home solutions should be 1-1.4 times the sodium concentration. For solutions containing cereal, because of their low osmolality, as a guide one may use up to the maximum concentration compatible with an easy-to-drink solution (this is usually 50 grams/l).

4.7 Whether SSS or a food-based solution is recommended, in many situations the first action that a mother may need to take when diarrhoea occurs is to give the most readily available, unharmful fluid (this will often be breast-milk and may even be water). Breast-feeding of infants during diarrhoea should always be promoted because breast-milk has valuable nutritional and immunological properties, decreases stool volume, and prevents hypernatraemia. To avoid the risk of osmotic diarrhoea, the use of commercial beverages, including commercially-prepared, concentrated fruit juices, should be discouraged.

4.8 No matter what approach to home solutions is chosen, a child cannot be said to have full access to oral rehydration therapy unless this includes access to ORS. Thus, in addition to promoting the use of a home solution, all programmes need to emphasize the distribution of ORS, the training and supervision of health staff to ensure its correct use, and the education of mothers to make them aware of the signs of dehydration that require its use. The goal should be to use home solutions and ORS in sequence and not as alternatives (59).

Table 1: Recommendations for preparation of sugar-salt solutions.

Recommendation numbers a	Advised domestic measures:			Concentration: b g/1		mmol/1	
	Salt	Cane sugar	Water	Salt	Cane sugar	Sodium	Glucose
7	1 tsp	1 tsp	1 pint	10.0	10	171	29
8	2 tsp	4 tbsp	1 litre	10.0	60	171	175
11	1 tsp	6 tsp	750 ml	6.6	40	113	117
9	1/4 tsp	2 tsp	1 cup	6.3	50	107	146
28	5.3 g	50 g (molasses)	1 litre	5.3	33	91	96
16	3.5 g	40 g	1 litre	3.5	40	90 c	111
22	1 tsp	8 tsp (glucose)	1 litre	5.0	80	86	222
1	1 level tsp	4 heaped tsp	1 litre	5.0	28	86	82
6	1 tsp	4 tsp	1 litre	5.0	20	86	58
17	1 level tsp	8 level tsp	1 litre	5.0	40	86	117
26	1 level tsp	6 tsp	1 litre	5.0	30	86	88
4	1/2 tsp	4 tsp	1 pint	5.0	40	86	117
20	1/2 tsp	4 tsp	500 ml	5.0	40	86	117
30	1 tsp (3 ml)	10 tsp (3 ml)	650 ml	4.6	46	79	134
29	0.9 g	4 g	200 ml	4.5	20	77	58
27	3.5 g	30 g	1 litre	3.5	30	60	88
23	1 level bottle top	8 level bottle tops	900 ml	3.3	27	56	79
21	1 tsp	8 tsp (glucose)	1.5 litres	3.3	53	56	147
24	1/2 level tsp	6 level tsp	750 ml	3.3	40	56	117
32	1/3 tsp	4 tsp	580 ml	3.0	35	51	102
3A	tip of tsp	1 level tsp	1 glass	3.0	25	51	73
12A	1/2 tsp	10 tsp or 2 handfuls (4 f) or 50 g	1 litre	2.5	50	43	146
2	1 pinch	2 cubes or	1 cup	2.5	50	43	146
	1 pinch	1 scp (3 f)	1 cup	2.5	125	43	365
15	1/2 tsp	2 level tbsp (or honey)	1 litre	2.5	30	43	88
12B	2 g or 4 pinches (th & 2 f)	10 tsp or 2 handfuls (4 f) or 50 g	1 litre	2.0	50	34	146
13	2 pinches	1 handful (4 f)	1 pint	2.0	50	34	146
31	2 pinches	1 scp (4 f)	1 pint	2.0	60	34	175
25	2 pinches	1 scp (4 f)	1 pint	2.0	60	34	175
33	1/4 tsp	4 tsp	650 ml	1.9	30	33	88
18	2 pinches	2 fistful	1 litre	1.0	50	17	146
3B	1 pinch	1 scp (3 or 4 f)	1 pint	1.0	60	17	175
14	1 pinch	1 scp (4 f)	1 pint	1.0	60	17	175
5	1 pinch	5 cubes or 1 small handful	1/2 litre	1.0	50	17	146
19	1 pinch (3 f)	2 scp (4 f)	500 ml	1.0	120	17	351
10	1 pinch	3 cubes or 3 tsp	1 litre	0.5	15	9	44

a Sources of recommendations are available from the Diarrhoeal Disease Control Programme, World Health Organization, Geneva

b The following calculations have been used to convert recommended domestic measures into concentrations in grams per litre:

1 cube of sugar = 5 g
1 level or unqualified (4-5 ml) teaspoon (tsp) = 5 g
1 tsp (3 ml) = 3 g; tip of tsp = 0.6 g
1 heaped tsp = 7 g
1 tablespoon (tbsp) = 15 g
1 level bottle top = 3 g
1 pinch of salt (3 finger or thumb & 2 finger) = 0.5 g
1 scoop of sugar (scp) (4 finger) = 30 g
1 handful or fistful (small or unqualified) or 3 f scp of sugar = 25 g
1 pint = 500 ml
1 cup or glass = 200 ml

c Including Na+ from added $NaHCO_3$

Table 2: Sodium and potassium content of fluids often used for home treatment+

Fluid	Concentration (mmol/l)		Osmolality
	Sodium	Potassium	(mOsm/kg H_2O)
Commercial soups (chicken, beef)	114 - 251	2.2 - 17	290 - 507
Commercial juices			
Apple	0.1 - 3.5	24 - 30	654 - 734
Grape	1.3 - 2.8	28 - 32	1167 - 1190
Lemon	9.0 - 10.0	27 - 29	485 - 506
Orange	0.6 - 2.5	41 - 65	542 - 710
Carbonated beverages			
Coca-cola	1.7	0.1	601
Pepsi-cola	1.3	0.1	591
7-Up	5.0 - 5.5	1.0 - 2.0	523 - 548
Canada dry	0.8 - 2.7	0.1 - 1.5	515 - 557
Water			
Tap	0.0 - 1.0	0.0 - 0.5	48 - 50
Coconut*	0.0 - 5.4	32.6 - 53.5	255 - 333
Tea	0.0	5.0	-
Milk			
Breast	7.0	13.0	-
Cow's	22.0	35.0	-

+Table contents taken in part from reference (57)

*Glucose content was found to vary between 100 and 139 mmol/l by the hexokinase method (58)

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