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A DECISION PROCESS FOR ESTABLISHING POLICY ON FLUIDS FOR HOME THERAPY OF DIARRHOEA[1,2]

Table of Contents

[1] The reader is encouraged to refer to an earlier WHO CDD Programme document entitled Oral rehydration therapy for treatment of diarrhoea in the home (WHO/CDD/SER/86.9).

[2] This document was prepared by the World Health Organization, Diarrhoeal Diseases Control Programme through a contract with A.C.T. International, 3776 LaVista Road, Tucker, Georgia 30084 USA.

INTRODUCTION

A solution of Oral Rehydration Salts (ORS) in water is the fluid recommended by the World Health Organization (WHO) for the treatment of dehydration from diarrhoea. In all developing countries, a major effort is being made to provide the whole population with access to ORS for the treatment of dehydration.

While ORS solution may also be used to prevent dehydration, it may be more convenient, less costly, and nearly as effective to use other fluids, such as cereal gruels, soups, or salt-and-sugar solutions. It is important that such fluids be given to children to drink as soon as diarrhoea starts. This early home therapy should prevent most cases from becoming dehydrated.

The critical action is to give the child with diarrhoea more fluids. However, some fluids are preferable, and thus should be recommended.

This document describes a simple, rational process for determining the best fluid(s) to be used for early treatment of diarrhoea. It will help the managers of national diarrhoeal diseases control programmes (CDD programmes) to establish a policy on home therapy for diarrhoea that is suited to conditions in their country.

TYPES OF FLUIDS SUITABLE FOR HOME THERAPY

The following types of fluids may be considered for home therapy:

* Food-based fluids: These include cereal gruels[1], soups, diluted yogurt-like drinks, and other fluids that may be commonly prepared in homes. These contain some salt and a source of glucose, either a complex carbohydrate (such as starch) or sucrose. They may also contain legumes, which are a source of complex carbohydrates and proteins. If their composition is appropriate for preventing dehydration, these food-based fluids should be prepared according to the traditional method. In some cases, however, the method of preparation may need to be slightly modified (for example, by diluting the mixture or adding salt).

* Salt-sugar solution (SSS): There are many recipes for SSS, proposing different ways of measuring table salt and some form of sugar to be added to water.

* ORS solution: This is typically made from a packet containing glucose and salts[2] mixed in water. ORS solution is the recommended fluid for the treatment of dehydration; it can also be used to prevent dehydration.

DECISION PROCESS

Initially, a few fluids should be identified that are reasonable candidates for home therapy of diarrhoea. This is done by considering what potentially suitable food-based fluids are commonly prepared in homes, and what containers, measuring devices, and ingredients are commonly available.

Each candidate is then assessed to see if it satisfactorily meets the criteria for a home fluid to prevent dehydration. Namely, is it a safe, effective, affordable fluid that people will make and use correctly and regularly?

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[1] Cereals such as rice, wheat, maize, sorghum, oats, rye, or barley in ground or powdered form may be used. To prepare gruel, ground cereal is boiled in water; more water is then added as needed to make the fluid drinkable. Before it is given to very young children, the gruel can be strained through a clean cloth to remove the grains.

[2] ORS solution contains (in grams per litre): sodium chloride 3.5, trisodium citrate, dihydrate 2.9 or sodium bicarbonate 2.5, potassium chloride 1.5, and glucose 20.0.

The criteria for an ideal home fluid, explained in detail in this document, can serve as a guideline for the assessment. In some cases information will need to be obtained from investigations and research to judge whether a fluid meets the criteria.

Because it is unlikely that an ideal home fluid will be readily identified, the selection of a fluid may not be straightforward. To reach a decision, it will be necessary to consider the extent to which each fluid meets the various criteria and to weigh the advantages and disadvantages of each fluid. The fluid that best meets the criteria would be selected.

In countries where there are regional differences in culture, availability of ingredients, or other characteristics, separate recommendations may be needed for different regions.

CRITERIA FOR AN IDEAL HOME FLUID

Ideally, a home fluid should meet the following criteria:

(1) The composition should be very safe, and effective in preventing dehydration. The variations in composition that are likely to result when different individuals mix the fluid should be within a safe range.

(2) The necessary ingredients and utensils should be widely available and affordable.

(3) The fluid should be easy for mothers to prepare correctly. (It is best if mothers already know how to make the fluid.)

(4) The fluid should be one that mothers are likely to use when needed. The likelihood of use may be depend on such factors as:

- the "appeal" of the fluid as a therapy.
- whether or not the fluid fits into cultural norms about the treatment of diarrhoea and suitable foods for young children, particularly when they are ill.
- the taste of the fluid.

(1) Recommended composition

To prevent dehydration, the body needs to maintain normal levels of sodium and water. In the healthy intestine glucose carries sodium across the intestinal wall so that it can be used by the body. This mechanism continues to function during diarrhoea. Thus, a home fluid should contain sodium and a source of glucose (e.g., sucrose or a complex carbohydrate).[1] The fluid should not contain too much sodium, or hypernatraemia may result. The fluid should yield a high enough concentration of glucose to effectively transport the sodium; however, its concentration should not be so high that its high osmolality causes osmotic diarrhoea, which may in turn also lead to hypernatraemia.

Annex 1 gives a brief explanation of the need for appropriate osmolality in a home fluid. Ideally, the osmolality should be less than that of blood plasma, that is, less than 300 mOsm/kg H_2O.

The concentration of sodium in a home fluid should be in the range of 30-80 millimoles per litre (mmol/l) to correct sodium deficits. This concentration would result from dissolving about 1.5 - 3.0 grams of table salt in one litre of water. For optimal absorption of sodium, the ratio of sodium to glucose concentrations should be between 1:1 and 1:1.4. For example, if the sodium concentration is 60 mmol/l, the glucose concentration should be between 60 and 84 mmol/l. If the sodium and glucose concentrations meet these criteria, a safe and effective osmolality will be assured.

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[1] Amino acids (for example, from the protein in legumes) are also useful in a home fluid, as they too can carry sodium across the intestinal wall.

When a fluid contains a complex carbohydrate, such as the starch in many cereals, it will have a lower osmolality than a fluid containing glucose or sucrose of equal concentration. This is because complex carbohydrates break down into glucose gradually, and glucose absorption through the intestinal wall is rapid. Thus, the osmolality of the fluid in the intestine remains at a safe level. As a practical guide, the amount of the carbohydrate used should be such that the home fluid is thin enough to drink easily (usually $\leq$ 50 grams of carbohydrate/litre).

A similar situation exists when a fluid contains proteins, such as in legumes. The proteins break down into amino acids slowly, and the amino acids are absorbed quickly, so that the osmolality of the fluid in the intestine remains safe.

Caution: Commercial beverages (such as soft drinks and concentrated fruit juices) should not be used for home therapy because of their high osmolality.

When any recipe for a home fluid is followed by different individuals, the compositions of the resulting mixtures will vary to some extent. The selection of a home fluid should be based on an assessment of the range of compositions made by mothers, rather than the theoretical composition of the fluid made under ideal conditions. This assessment can be done through an observational survey. A sample size of at least 100 mothers will be necessary. Surveyors should observe how the women make the home fluid. They should also weigh the amount of table salt used (and sugar, if sugar is used). The results can be analysed using tables such as those in Annex 2[1], which convert grams of salt and sugar to concentrations of sodium and glucose in water.

To select a safe home fluid, the results of the survey should show that at least 90% of the fluids made by mothers do not exceed the recommended upper limit for sodium (and for glucose, if relevant). No more than 2% of the fluids should have sodium concentrations above 120 mmol/l. This conservative recommendation reflects a concern that home fluids should be safe as well as effective. The probability that a home fluid would be dangerous is determined almost entirely by the risk that it contains too much sodium or has an excessive osmolality.

Summary of Recommended Composition of Home Therapy Fluids[2]

	Recommended range	
Osmolality	< 300 mOsm/kg H_2O	
Sodium concentration	30 - 80 mmol/l	with a ratio of sodium to glucose between 1:1 and 1:1.4.
Glucose concentration*	30 - 112 mmol/l	

*If the fluid contains a complex carbohydrate, the glucose range is not relevant. The fluid should be thin enough to drink easily.

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[1] Alternatively, a laboratory analysis can be done to determine sodium concentrations (and, if relevant, sucrose concentrations and the glucose equivalents).

[2] The recommended compositions discussed in this section apply to food-based fluids and SSS. As indicated on page 2, ORS can also be used as a home therapy fluid. However, it has a slightly higher osmolality and sodium and glucose concentrations than that recommended here (see footnote at bottom of page 2). These slightly higher values are compensated for by the fact that, in contrast to food-based fluids and SSS, the individual ingredients in ORS are premeasured accurately. Hence, the slightly higher values of ORS do not prevent it from being used as a home fluid.

(2) Availability and affordability of ingredients and utensils

Home fluids are most likely to be prepared and used if the necessary ingredients and utensils are already available in the home or can be easily obtained. This is most likely to be the case with commonly prepared food-based fluids.

SSS requires that salt, sugar, and uniform measuring utensils be available and affordable. ORS solution requires a packet and a container for measuring the correct amount of water.

(3) Ease of preparation

Because mothers already know how to prepare them, and may prepare them frequently, suitable food-based fluids may be very convenient for home therapy. However, if the fluids need cooking, their preparation requires fuel and may be inconvenient.

If an unfamiliar recipe that requires precise measurements must be followed, the fluids will more often be prepared incorrectly. For example, numerous studies have shown that mothers often do not remember how much salt, sugar, and water to mix for SSS, and that measurements of a pinch, scoop, teaspoon, 1/2 teaspoon, litre, etc. are frequently inconsistent. Even modifying a familiar recipe (e.g., by adding a certain amount of salt) may lead to inaccurate measurements.

In general, the fewer precise measurements are required, the more accurate a preparation will be. ORS solution requires measurement only of water. SSS requires 3 accurate measurements, thus increasing the risk of error.

(4) Likelihood of use

Fluids are more likely to be used if they have some appeal as a therapy. That appeal may come from a similarity to a "special medicine" or "special drink". Food-based fluids may lack this appeal; SSS may have somewhat more appeal; and ORS solution may have the most appeal. On the other hand, if a food-based fluid is already favoured for use during illness, it may have great appeal as a therapy for diarrhoea.

The fluid must also fit into cultural norms about the treatment of diarrhoea and about foods suitable for young children. For example, diarrhoea may be considered a "hot" disease which must be treated with "cold" fluids. Certain foods may be thought dangerous for young children, and thus would never be used in a home fluid.

The taste of the fluid should be acceptable to the sick child.

ADVANTAGES AND DISADVANTAGES OF POSSIBLE HOME FLUIDS FOR PREVENTION OF DEHYDRATION

TYPE OF FLUID	ADVANTAGES	DISADVANTAGES
Suitable food-based fluids commonly prepared in homes	Variable but safe composition Widely available Mothers already know how to prepare May already be used during diarrhoea Often involves boiled (sterile) water Not dependent on a delivery system	Effectiveness may vary Spoilage (e.g., from fermentation of gruels) necessitates frequent preparation May lack "appeal" as a therapy May be misunderstood to be a substitute for food Boiling takes time and consumes fuel
Food-based fluids made suitable with minor modification (such as adding salt or diluting)	Those listed above, plus: Effectiveness may be increased Modification may enhance "appeal" as a therapy	Those listed above, plus: May be difficult to change a current preparation method Composition may vary more. If too much salt is added to the solution, it may be dangerous (can cause hypernatraemia).
Salt-sugar solution (SSS)	Salt and sugar are often available in homes Has some of the appeal of a special therapy Not dependent on a delivery system No boiling needed	Requires 3 accurate measurements Widely variable and potentially dangerous composition due to inaccurate measurements: - Too much salt is dangerous (can cause hypernatraemia) - Too much sugar can lead to osmotic diarrhoea (and consequent hypernatraemia) Utensils may not be available for measuring correct amounts of salt, sugar, and water Sugar may be costly or unavailable Recipes are difficult to teach, learn, and remember

TYPE OF FLUID	ADVANTAGES	DISADVANTAGES
ORS solution	Easy to prepare, if there is an appropriate container	Container for measuring an appropriate amount of water may not be available
	Requires measurement of only one ingredient, water. Composition consistently safe unless water is incorrectly measured	Requires instruction on how to mix and administer
	No boiling needed	Must be obtained from a health worker or purchased, thus creating dependence
	May be less expensive for families than currently used remedies	It will be expensive to provide ORS for every case of diarrhoea
	Will probably prevent dehydration more effectively	There may not be enough ORS supplies nationally for use in prevention as well as treatment
	Has the appeal of a special therapy	In most cases, is unnecessary for prevention of dehydration

The preceding chart listed general advantages and disadvantages of the possible types of home fluid. In each country, some investigation or research may be required to determine which fluids to recommend. Examples of questions for investigation or research are provided below. (The answers to certain questions may already be common knowledge, in which case no investigation of those questions is needed.)

After the questions have been answered, there may be several possible fluids that could be used for home therapy. One can use a worksheet such as the one on page 10 to compare these fluids and select the best for the country.

Where none of the possible food-based fluids, SSS, or ORS is an attractive choice, the policy should be to recommend any safe fluid (e.g., teas) and to put more emphasis on the referral of cases to health workers or facilities.

EXAMPLES OF QUESTIONS FOR INVESTIGATION OR RESEARCH PRIOR TO ESTABLISHING POLICY ON FLUIDS FOR HOME THERAPY

Food-based fluids

Are there commonly prepared cereal gruels, soups, or other food-based fluids that may be appropriate for preventing dehydration? What are they? (Note: This question and others may have different answers in different regions or cultures within a country. If so, different home therapy recommendations may be needed.)

Which of these fluids are made most frequently in the home?

Which fluids are made in most parts of the country?

Which fluids, if any, are already used in times of illness?

Are any of the fluids unsuitable because of customs that would prevent their being given to young children with diarrhoea?

Which fluids have ingredients that are available throughout the year? Which are the cheapest?

Which involve boiling (making the water sterile)? Would the time and fuel required for cooking make mothers less likely to prepare the fluid?

Which fluids are least likely to spoil quickly?

Fluids that seem to be good candidates for home therapy should be assessed to determine their actual compositions when made by different mothers under normal conditions (as compared with the composition of the ideal recipe). Which of these fluids are most likely to be made with an appropriate sodium concentration (30-80 mmol/l)? Which of the fluids contain a source of glucose in an appropriate amount? (Note: If the glucose will come from a complex carbohydrate, determining the concentration of the carbohydrate is not necessary. As long as the fluid is drinkable, it will not contain too much carbohydrate. If the source of the glucose is table sugar, the sugar can be weighed to determine whether the equivalent glucose concentration is appropriate. See Annex 2.)

If there are no food-based fluids that have a suitable composition when prepared in the traditional manner, are there some that would be suitable if modified slightly (e.g., by diluting or adding salt)? How difficult would it be to get people to change the preparation method? Would confusion result from the use of these two preparation methods, one as a food and one as a fluid for treating diarrhoea?

Salt-sugar solution (SSS)

Is sugar in any form commonly available in homes? How difficult is it to obtain?

How expensive is sugar? Is it affordable?

What measuring utensils and containers with a uniform volume are commonly available in homes?

What are the difficulties of increasing the availability of sugar and appropriate measuring utensils (if they are not already available)?

Can mothers be trained to make and use SSS properly? If so, what are the costs?

Do the costs of training mothers to make and use SSS (and the costs of reinforcing training at regular intervals) exceed the costs of providing sufficient ORS for use in preventing dehydration? (See questions below).

Are mothers likely to use SSS as a therapy?

ORS

How many packets of ORS are or will be available in the country?

Are ORS supplies sufficient for use in prevention as well as treatment of dehydration? What percentage of cases would be likely to use ORS for prevention if ORS is the recommended home fluid? (ORS supplies will need to be increased accordingly.)

Could more ORS be obtained to allow its use for preventing dehydration? What would this cost the programme?

Where would families be able to obtain ORS for use in preventing dehydration? What would it cost them? Are they likely to buy and store it for convenient use?

Have mothers successfully learned to mix ORS solution for treatment purposes?

Are containers for measuring appropriate amounts of water available in homes? Could they be made available?

What would the additional costs be, if any, of teaching mothers to use ORS for prevention as well as treatment of dehydration?

Would reliance on ORS for home therapy create an undesirable dependence on the health care system?

WORKSHEET FOR DECIDING ON HOME FLUIDS FOR PREVENTION OF DEHYDRATION

Instructions: Make notes in the boxes about the degree to which each criterion is met for each fluid. Compare the results for all fluids to rank them in order of suitability for home therapy.

Possible home fluids for preventing dehydration	Efficacy and safety of composition	Availability/ affordability of ingredients and utensils	Ease of preparation/ ease of teaching and learning to mix	Likelihood of use: appeal, cultural appropriateness, taste	Ranking

ANNEX 1

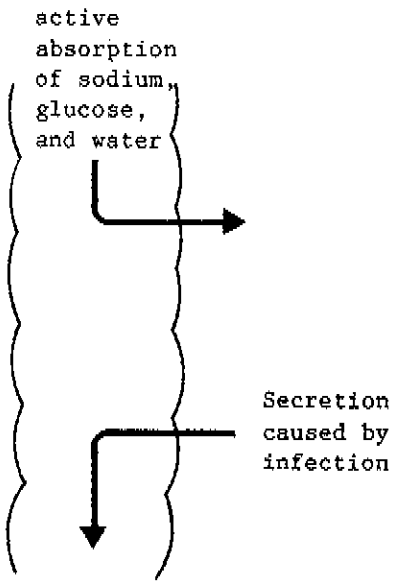
THE NEED FOR APPROPRIATE OSMOLALITY IN A HOME FLUID

Osmolality is a measure of osmotic pressure, which is the pressure exerted by a substance dissolved in water, when it is separated from another fluid by a membrane such as the intestinal wall. Osmolality is expressed in milliosmols per kilogram of water, abbreviated as mOsm/kg H_2O.

When two solutions are separated by a membrane such as the intestinal wall, water tends to move across the membrane towards the solution of higher osmolality. (You can think of the water as trying to achieve a balance of osmolality.) For this reason, a home therapy fluid should not have a higher osmolality than that of blood plasma. If water from blood plasma crosses the intestinal wall towards the fluid in the intestinal lumen, that water will be lost as diarrhoea. This is called "osmotic diarrhoea". It is as though the fluid in the intestine is "stealing" water from the blood, actually worsening dehydration. When water is lost in osmotic diarrhoea, the sodium concentration in the body becomes higher as well. This can cause hypernatraemia, another serious problem.

The diagrams below may help to explain the need for appropriate osmolality in a home fluid. (The wavy lines represent the intestinal wall.)

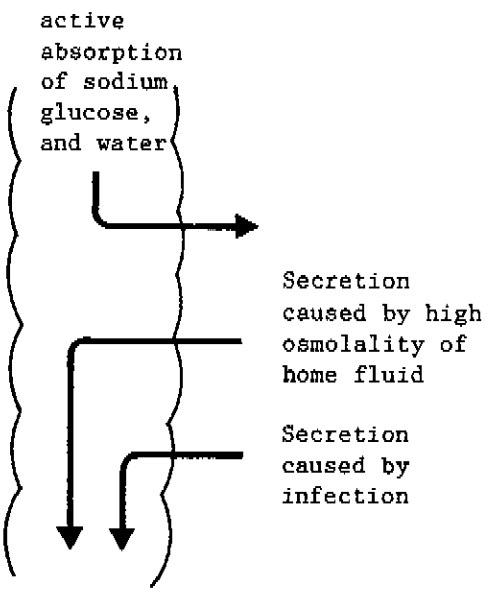
<u>Correctly composed home fluid</u>



Diarrhoea, with maintenance of hydration

Secretion caused by infection is balanced by absorption of home fluid.

<u>Home fluid with osmolality higher than blood plasma</u>



Increased diarrhoea and worsening dehydration

Water from plasma is "stolen" by home fluid of high osmolality and increases diarrhoea.

ANNEX 2

TABLES FOR CALCULATING CONCENTRATIONS OF SODIUM AND GLUCOSE

SODIUM CONCENTRATION (MMOL/L)

Salt (sodium chloride) (grams)	Water (mls)													
	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
0.5	43	29	21	17	14	12	11	10	9	8	7	7	6	6
1.0	86	57	43	34	29	24	21	19	17	16	14	13	12	11
1.5	128	86	64	51	43	37	32	29	26	TOO DILUTE 23	21	20	18	17
2.0	171	114	86	68	57	49	43	38	34	31	29	26	24	23
2.5	214	143	107	86	71	61	54	48	43	39	36	33	31	29
3.0	257	171	128	103	86	73	64	57	51	47	43	40	37	34
3.5	300	200	150	120	100	86	75	RECOMMENDED CONCENTRATION 67	60	54	50	46	43	40
4.0	342	228	171	137	114	98	86	76	68	62	57	53	49	46
4.5	385	257	193	154	128	110	96	86	77	70	64	59	55	51
5.0	428	285	TOO CONCENTRATED 214	171	143	122	107	95	86	78	71	66	61	57
5.5	471	314	POTENTIALLY DANGEROUS 235	188	157	135	118	105	94	86	78	72	67	63
6.0	514	342	257	205	171	147	128	114	103	93	86	79	73	68
6.5	557	371	278	223	186	159	139	124	111	101	93	86	80	74
7.0	599	400	300	240	200	171	150	133	120	109	100	92	86	80

GLUCOSE CONCENTRATION (MMOL/L)

Cane sugar (grams)	Water (ml)													
	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
5	73	48	36	29	24	21	18	16	15	13	12	11	10	10
10	145	97	73	58	48	41	36	32	29	26	TOO DILUTE 24	22	21	19
15	218	145	110	87	73	61	55	48	44	39	36	33	31	29
20	290	193	145	116	97	83	73	64	58	53	48	45	41	39
25	363	242	181	145	122	104	90	RECOMMENDED CONCENTRATIONS 81	73	66	60	56	52	48
30	435	TOO CONCENTRATED 290	218	174	145	124	109	97	87	79	73	67	61	58
35	508	POTENTIALLY DANGEROUS 338	254	203	169	145	127	113	102	92	85	78	73	68
40	580	387	290	232	193	165	145	129	116	106	97	89	83	77
45	653	435	328	261	218	186	163	145	131	119	109	100	93	87
50	725	483	363	290	241	206	181	161	145	132	121	112	104	97