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REHYDRATION AT FIXED CENTERS IN DEVELOPING COUNTRIES

A Manual Based on the Mali Experience

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I. SUMMARY

About one of every ten children born in developing countries dies from the effects of diarrhea before they reach their fifth year. Eighty per cent of these deaths occur during the first two years of life. In the Sahel alone an estimated 20,000 children die each year from dehydration due to acute large scale losses of water and electrolytes from the body beyond tolerable limits, usually reached at 10% loss of body fluid. Replacement of these losses through oral rehydration therapy (ORT), containing a scientific mix of water, sodium, potassium, chloride, bicarbonate and glucose or sugar, has been widely advocated because of its comparative simplicity, effectiveness, widespread availability and low cost. Although mainly designed for treatment of dehydrated children, where diarrhea is no longer a self-limiting disease but has entered the vicious cycle of diarrhea, acidosis and vomiting, it can also be used for preventive purposes. Its levels of application range from the individual village household to the national teaching hospitals, depending upon available resources. However, in spite of these convincing facts, actually functioning oral rehydration units (ORU's) are extremely rare, especially in Francophone Africa. One of the reasons for this is the virtual absence of detailed field reports about line item budgeting, managerial problems and epidemiology. This report, which is a combination manual and case study, addresses those issues and thus tries to close, in part, the literature gap and to serve as a guide for future ORU's in the Sahel and elsewhere.

One of the logical starting points for ORU's are the mother-child health clinics and pediatric wards of large urban hospitals, especially when they have also a training program, because that is where the largest accumulation of dehydrated children occurs, where per capita cost benefits

are highest and, perhaps most important, where the medical profession can be convinced and taught by practical demonstrations. For these reasons the ORU in Mali was opened in 1981 at the Gabriel Toure National Hospital, and later a second one at the Central Mother-Child Health Clinic in Bamako, Mali.

An epidemiological survey showed that about 94 out of 100 children with signs of dehydration were able to take oral rehydration, including two with nasogastric feeding, during 1-3 hours of clinic observation. Only half of them returned for a follow-up visit with either no, or vastly improved, signs of dehydration. Fifty-six percent of all dehydrated children were severely malnourished.

The managerial aspects are complicated and offer many surprises, but are not unsurmountable. A room of about 15 M2 and a nurse or auxilliary under medical supervision is all it needs as an infra-structure.

Total capital investment was about 448,000 FM (224,000 FCFA or Dols. 800 U.S. at the Dols. 1 US/560 FM exchange rate) and recurrent costs per single oral/nasogastric rehydration amounts to approximately 20 FM (10 FCFA, Dols. 0.03 US) when I.V. fluids, salaries and utilities are excluded.

Thus the ORU is a health service fully applicable to LDC's and the Sahel. Our suggestion for Sahelian planners is to limit the initial installation of ORUs to national and regional hospitals and to extend them gradually to the health centers and rural dispensaries. For the village household level we suggest, at least in the initial stage, preventive interventions such as the salt and sugar method through mass media and existing health workers. We hope that our manual/case study will provide useful references for planners and field workers in setting up similar ORU's in the Sahel and elsewhere.

II. EPIDEMIOLOGY

The principal aim of an ORU is to reduce mortality rates of severely dehydrated children by using a method which is by far cheaper and simpler than intravenous infusions, but equally effective in all degrees of dehydration except clinical shock or where severe and continuous vomiting interferes with oral intake. It is also a much safer method in countries such as Mali and some other Francophone African countries, where the subclavicular vein transfusion is the almost exclusively preferred route of intravenous transfusions in children under five. Under these circumstances, iatrogenic (doctor/medical personnel inflicted) mortality rates are probably very high: the author himself encountered two deaths out of eight known subclavicular infusions during his one week implementation and training phase at the ORU. Pneumothorax and air emboly (due to the fact that the subclavicular vein is not very collapsible due to ligaments which keep it open) are the most frequent causes of death.

The crucial epidemiological issue in ORU's is to define the right target population: up to what degree of dehydration is OR purely preventive or even unnecessary (because it can be replaced with effective health education on continuous fluid intake)?

Second, beyond what degree of dehydration is OR ineffective and i.v. infusion continues to be the treatment of choice?

And third, what is the success rate in those rehydrated children, whose degree of dehydration falls between the ones described above: too advanced for health education only but not yet advanced enough for i.v. fluid? How much does vomiting interfere with OR? What percentage of the dehydrated children, who formerly received i.v. fluids, can be treated as effectively with OR?

The answer to these questions has a profound impact on recurrent costs, management and output measurements. For this purpose, we conducted a survey among 100 children admitted to the ORU. This survey lasted for about 6 weeks and required practically no additional resources since the survey cards were handmade (cutting and writing). This is also an example of simple, relatively easy and cheap epidemiological research, which is built into the service. Although its results are limited in pure scientific terms, it is useful insofar as it gives an idea whether a program achieves its goal or not.

1. Methods of survey. The first 100 outpatients with clinical signs of dehydration who were referred to the ORU,were chosen for the survey (2 cases who were in shock and sent directly to the i.v. treatment room were included in the sample). For each a card was filled out, bearing the following information: date of admission, first time and followup visits , name, age, sex, body weight upon 1st admission, residence, case history of diarrhea (defined as passing liquid stools six or more times/day) and vomiting, fever, clinical marasmus, other clinical signs of diseases, the two general degrees of dehydration in accordance with clinical signs as described in the WHO manual (WHO/CDD, SER 80/2): moderate or severe; in addition to that 3 degrees of dehydration (normal, moderate, severe) for each of the (examination points (anterior fontanella, eyes, mouth/tongue/lips, skin elasticity and peripheral pulse) were recorded as well as the response to oral, nasogastric or i.v. treatment and, finally, the reasons for OR failure such as continued vomiting,

deteriorating state, or simply lack of personnel time for nasogastric infusions.
The definition of a positive response was: vomiting stopped, general clinical improvement (signs of alertness) and improvement of the 5 examination points during the 1-3 hours stay at the ORU as well as on the follow-up visit.
Unfortunately the more objective measurement of a child's weight increase after the ORU session and upon the followup visit next day could not be performed because of the relative inaccuracy of the weighing scale (± 300 gr, and not, as required ± 50 gr).
A negative response was defined as: continued vomiting (after 30 minutes of carefully administered rehydration) and no improvement or even deterioration of clinical signs of dehydration.
All selected children were examined, diagnosed, recorded, referred and supervised by the same person, namely the Médecin-Chef of the Pediatric ward, who is a professor of pediatrics and well versed in the WHO dehydration classification. All rehydrations, weighing and followup visits were performed by the same nurse trained by the author by using the standard WHO formula. (See Annex: Instruction Manual, p. 21).

2. Results

2:1. Number, sex, mean age

Total Number: 100
Male: 66%
Female: 34%
Note: The low female attendance rate is typical for Muslim countries such as Mali.
Mean age: 9.5 months
Median age: 8.6 months, ranging from 1 month to 3 years, with 73% being between 6 months and 18 months.
Note: Age was obtained by questioning the mother and, therefore, subject to errors. But, most children in Bamako are registered at birth and since mothers usually remember their child's age until 1 1/2 years, (although "clustered" around the 3 or 6 months interval) it is believed that errors in age are of minor importance.

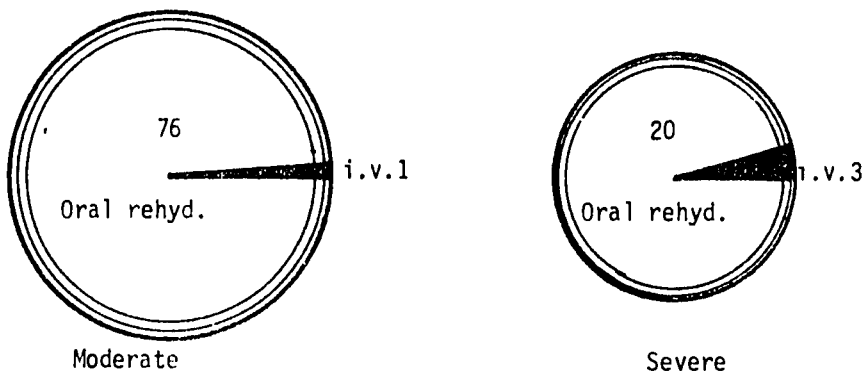
Whether the age of around 9 months represents the average weaning age of our dehydrated children and its well known links to diarrhea and malnutrition, could not be determined by this survey. It remains however a strong possibility because of its comparability to the weaning age of other, similar LDC's in Africa.

2:2. Therapeutic response in relation to degrees of dehydration

Table 1.

Degree of dehydration	Total	Nr. of childrens response to therapy		
		Oral	Nasogastric	i.v.
Moderate	77	74	2	1
Severe	23	20	-	3
Total	100	94	2	4

Note: 4 out of 100 dehydrated children received i.v. fluid; of them, one was moderately and 3 were severely dehydrated. 96% of all surveyed children responded positively (see above definition) to oral/nasogastric rehydration as illustrated in the following graph.



Since one of the definitions of positive response is the marked clinical improvement and the cessation of vomiting on next days followup visit, a high followup rate (return next day, as the mothers were told) is important. Unfortunately, almost half of our children never returned to the ORU.

2: 3 Followup and dropout in relation to degrees of dehydration

Table 2.

Degree of dehydration	Nr. treated	Nr. present on 1st day after treatment	Nr. Present within one week after treatment	Not returned after treatment
Moderate	77	34	9	33
Severe	23	10	2	12
TOTAL	100	44	11	45

Note: 45 out of 100 never returned to the ORU; of them, 33 were moderately and 12 severely dehydrated, which represents 43% of all moderate and 52% of all severe dehydration cases. The weekend, which meant a one day service interruption, since the ORU was closed on Sunday, seemed to play no significant role: only 3 of the 45 dropouts came on a Saturday. The majority either came back next day (44 out of 100) or not at all, regardless of the weekend, (42 out of 100).

A dropout rate of almost half of all the cases (45%) is of course a disturbingly high figure. It makes it almost impossible to evaluate the efficacy of the ORU. Among the ones seen, vomiting had stopped and only 3 needed further rehydration treatment. Because of this one may assume that, at least among the moderately dehydrated children, death after the treatment was not the cause for failing to come for followup.

Proportionally less of the severely dehydrated patients came for re-treatment but this difference could well have been arisen by chance. As partial reason for these high dropout figures we found that more than half of the dropouts (25 out of 45) had the hospitalization mark on their cards, i.e. they came and, most likely, went back to their wards. Due to lack of coordination and communication between the ORU and the rest of the pediatric ward mothers might have been dismissed, (once the child looked better or after next day's ward round) regardless of the ORU's return order.

Another reason for this high figure of non-returnees might have been distance and, consequently, money for transportation.

2.4 Drop out rate in relation to the distance between ORU and patient's homes.

Table 3.

Distance between patients home and ORU	Total treated	Appeared for follow up	Drop outs
Less 3 Km (walking distance)	30	22	8
More than 3 Km	68	31	37
TOTAL	98*	53	45

* The distance to the home of two children was not noted.

Whereas only 8 out of 30children within the 3 Km "walking distance" range never returned, 37 out of 68 children who lived further than 3 Km away never came back The dropout rate among the group which had to use some means of transportation was significantly higher than the ones within walking distance ($p < 0.05$).

Money certainly was an important factor since a taxi for a 5 Km return fare costs about $ 0.60 US per person, which is not a negligible amount for a family whose head earns something like $50 to $60 a month.

Average (mean) distance was 4.6 Km, which is much for urban hospital attendants. But then, again, about 60% of all our surveyed children came from the hospital wards which tends to have patients from more distant homes and only 40% from the daily outpatient ward.

There was no significant difference between the moderate or severe categories of dropouts and in their relation to distance.

2.5 Nutrition and dehydration.

ORU's are often "dumping grounds" for severely malnourished children due to several reasons differential diagnosis is often difficult since both a dehydrated skin and the lack of subcutaneous fat gives a very similar skinfold; general appearance is often similar too (sunken eyes, listlessness). Since generally no service other than (often useless) medicine is offered to the severely malnourished ones, the ORU services are

offered instead. On the other hand, the correlation between malnutrition and diarrhea is well known. But, just how much of it leads to actual dehydration is less clear.

Table 4. Relationship between malnutrition and dehydration.

Malnutrition	Dehydration		TOTAL
	Moderate dehydration	Severe dehydration	
3rd degree* malnutrition without marasmus	21	3	24
Clinical marasmus	26	6	32
Total	47	9	56

* defined as below 60% of the Harvard standard for weight/age.

Note: Although the precise age might have been subject to some error (see page 5), the weighing scale was in order and adjusted daily. All children were weighed undressed. No adjustment was made for the (5-12%) weightloss due to dehydration.

More than half of all surveyed children were severely malnourished, one third of them marasmic. No Kwashiorkor was observed. None of the children reached the (100%) Harvard standard (HS) and only 8% were equal to or above the 80% HS: all of those were below 8 months of age. A close correlation between diarrhea/dehydration and malnutrition, as well as a generally high malnutrition rate among all children attending the pediatric ward can be assumed, but cannot be proven since no relevant data outside the ORU exist.

Since possible misdiagnosis of dehydration among severely malnourished children (especially diminished skinelasticity and sunken eyes), can be excluded in our study, it suggests that severe malnutrition with its frequently associated chronic diarrhea causes mainly moderate dehydration, whereas severe dehydration is a more acute event (1-2 days) as a consequence of diarrhea and vomiting, thus less associated with

severe malnutrition. Vomiting was recorded in all cases except 9 moderate and 3 severely dehydrated cases. Vomiting can therefore be regarded as the crucial factor leading to the vicious cycle of diarrhea, acidosis, vomiting, mineral and water depletion and finally death.

2:6 Dehydration and the role of antibiotics

"Parenteral" diarrhea, i.e. diarrhea caused by an infection outside the gastro-intestinal tract is sometimes given as a justification for antibiotic treatment in diarrheas. Amongst our sample of 100 children there were 2 cases of measles, 3 with pneumonia and 5 suspect cases of otitis media (although not verified by an otoscope). They were the only ones who received disease specific antibiotics.
No "invasive" diarrhea such as shigellosis or cholera was identified although no specific laboratory tests were performed. This type of diarrhea and the diagnosed underlying diseases of the parenteral diarrhea are the only ones which require antibiotic treatment. Otherwise routine antibiotics such as sulfaguanidine (under the brand name of ganidan), have no place in the treatment of common diarrheas

2:7 Reduction of morbidity, mortality and i.v. infusions in relation to dehydration.

A curative service such as the ORU will usually not reduce morbidity except for the health education part (e.g. instructing the mother not to stop giving fluid during the next diarrheal incidence). Reduction of mortality and the reduced numbers of i.v. infusions could not be shown since there were no "before" (the ORU implementation) data. Additionally, the approximately 50 % dropout rate (the ones who never returned) impedes any proper statistics. Also the reduction on mortality depends on what was used before the ORU according to the Médecin-Chef, all of the severely and about half of the moderate dehydrated would have received subclavicular vein infusions But that is available at most in only 10 other centers in the whole country' That means elsewhere they receive nothing and die almost certainly, especially the severely dehydrated ones. The fact, however, that 96% responded to oral/nasogastric rehydration under a 1-3 hours observation during their first visit and that all of the returnees reported a cessation of vomiting and a marked improvement of their clinical signs of dehydration, suggests at least that a significant reduction of subclavicular infusions was not harmful, but rather beneficial since their implicit iatrogenic mortality was eliminated. That alone, and the low costs, I would think, gives ample justification for ORU's.

III. MANAGEMENT

Although the ORU is one of the simpliest primary health care service units, its physical set up, training, personnel motivation, integration into other services and the problems of continuing supplies are nevertheless difficult enough and the main reason for the rarity of such obviously very useful units. The following describes the 5 common phases of any new project. planning, preparatory phase, implementation, continuation, evaluation.

1. Planning

1.1. Detailed Knowhow: a checklist of about 45 different items (p.17-19), all of them necessary for a smooth operation, is the first surprise to planners who usually only think of the oralite packs or the raw materials. Our experience was drawn from similar units in 4 other LDC's. The quantity for each of the current items is the next problem, but crucial for the continuation of services (pp. 18): the annual quantity calculation derives from the expected average daily attendance x 250 working days. We planned for 10/day or 2500 children/year, which, in most cases, will be sufficient, provided that not too many children receive a (mostly unnecessary) second dose during their followup visit.

1.2. Availability of all these items is the next step. The infant weighing scale and the ingredients such as glucose, $NaHCO_3$ and KCl are the most important ones. If they are not locally available (as it is often the case) then it might well take 6 months to two years (!) and much paperwork to obtain it from international sources such as UNICEF. In our case, the raw materials were available at a local i.v. infusion bottling plant, which imports the above ingredients in bulk;

1.3. Location: a room of 15 m^2 (e.g. 3m x 5m) is a minimum requirement to handle a maximum of 15 children per day (with exceptional overflows up to 20 children/day), since each child stays only 1-2 hours at the ORU. This room should be closely located to the prescreening room. It should be relatively quiet, clean and with lockable doors.

1.4. Personnel: 1 person can handle at most up to 15 children/day. However, when analyzing the actual nurse - child/mother contact and then comparing it to the average clinic day, the ideal nurse: patient ratio

comes closer to 10 per clinic day, which, in our case, was only 4 hours (from 8-12 a.m.). Follows a detailed timing of activities:

- case-history and examination: 5 min
- weighing : 3 min
- preparation of the standard and quantitation according to the body weight: 5 min
- health education and practical demonstration : 7 min
- handout of bottle and collection of fees: 3 min

Total: 23 minutes

Average working minutes per clinic day: 240 min (4 hours)

$$\text{Nurse-Patient Ratio: } \frac{240 \text{ min}}{23 \text{ min}} = 10$$

Any attendance figure well above or below will mean that the nurse needs extra help or is only employed part-time.

1.5. Financing + disbursement procedures

The extremely low costs of a single ORU makes it often unsuitable for most of the foreign donor institutions: paperwork and expatriate salaries to even write up a proposal would not justify a program of, say $ 300 US. If, as a consequence, the number of units is multiplied, then the capability of one person to set them up physically and train personnel is often exceeded, and things go wrong. Also, since even with the most careful planning, unforeseen extra costs can occur, flexibility in disbursement procedures is important. All this can best be done through private donations, as it was the case in our 2 ORU's in Bamako.

2. Preparatory Phase

2.1. Ordering, purchase and storage of those 45 items as described on p.17-19 requires one parttime person over a 3 week period, a car and a storeroom. Local carpenters who need precise instructions about the design of a table and closet and have to be visited several times, the search for a baby weighing scale, raw materials, nasogastric tubes, mattrasses, boxes, containers etc. are all time consuming. Then, the items all have to be stored somewhere, otherwise they might disappear before the ORU has even started. Containers must be labeled with indelible felt pen: item and amount of handout per standard liter (as well as approximate amount of children who can be supplied with a full container).

Example: Glucose, 24 ml, 65 children. Also, the large amounts of raw materials must be properly labeled, otherwise items like $NaHCO_3$ and KCl might get mixed up! All ingredients must be in fine powder form and therefore ground (e.g. with a household blender). Instruction handouts such as described in the annex pp. 22-23 and part of 24 are underlined with different colors and covered in plastic to be later fixed on the wall above the ORU's table. The standard liter bottle is graduated in 100's ml. This is done with oilpaint, a fine brush and a 100 ml volumetric measure.

All this requires expertise, patience, transportation and time. The lack of it can be one more reason for the rarity of ORU's.

2:2 Renovation of the room: Doorlocks, electric appliances, (fans, sockets, switches), wall paint, general cleanliness and emptying of the room often require 2-3 days and half dozen "jack of all trades" such as painters, electricians, locksmiths, and cleaners.

It is clear that the preparatory phase is not an easy one. Once everything is readily stored, materials get transferred to the ORU and the next phase begins.

3. Implementation and on site training

3.1 Setting up the room, putting instructions (see annex pp. 21) on the wall at both the ORU and in the prescreening room of the pediatric ward, labelling of the closets, shelves etc. takes one day. Already during the physical setup the nurse receives instructions about the mix of the ingredients, the use of all items, stockcontrol and recordkeeping.

3.2 Full operation can begin the next day where the nurse receives detailed on site training. Due to an easy standard operating procedure the nurse is able, after the 3rd rehydrated child, to take case history, do the examination, weighing, preparation of the standard mix, the calculation of the required dose, recordkeeping and collection of bottlefees. Thus, the only remaining major problems are stockcontrol and resupply.

4. Maintenance Phase

4.1 Supervision:

Full-time daily supervision is provided for the first 2 days, then daily visits of

1-2 hours for the remainder of the week, then a visit once a week until supervision is stopped 1 month after the initial training period. Since then the ORU, which is going now for 2 years, is visited by the author every 3 months or so and mainly for moral support. The nurse was of course reasonably well motivated and competent.

4:2. Stockcontrol: With the exception of the bottle fee money none of the items are subject to theft. But, since each of the items has its important function, a vigorous control is indispensable for timely resupply: an initial inventory of all items (see p. 17-19) is made and signed by the ORU nurse, who then is responsible for it. Ingredients are properly labeled and stored in bulk in the cupboard, while the daily containers in the rehydration box are only filled when almost empty: they are labeled, too, indicating the approximate number of rehydration; e.g. a tin of 500 ml volume can store glucose powder for approx. 21 children each needing 24 ml of glucose powder $\cdot \frac{500 \text{ ml}}{24 \text{ ml}} = 20.8$; but the same volume can store KCl for 333 children: $\frac{500 \text{ ml}}{1{,}5 \text{ ml}} = 333{,}33$

Glucose containers should therefore be of approx. a 2-liter volume, sufficient for 84 children. Upon supervision the use of ingredients can be easily checked by comparing it with the daily rehydration (not attendance!) figures, i.e. if a tin of glucose has been used for only half the calculated amount, something is incorrect. A glance at the remaining stock, provided that the initial amount and date is known, will, when compared with the rehydration figures, indicate several months in advance when resupply will be needed.

4:3. The money obtained from the bottle fee can be crosschecked by including daily sums in the daily recording book (see also annex p.25), e.g.:
June 24: 3900 FM.
June 25: 4800 FM and then checked against the daily rehydration figures (Since everyone rehydrated receives a bottle to take home): in our case it would amount to 6 rehydrated children on June 25, because:

$$4800\text{FM} - 3900\text{FM} = \frac{900 \text{ FM}}{150\text{FM(bottle fee)}} = 6$$

Also, since the initial bottle supply is known(50 in our case) the missing bottles x bottle fee amount should always equal the money in the collection

box: in our case on June 25, there should be 30 bottles given out and 20 bottles stored: 4500FM : 150 FM = 30, 50 - 30 = 20.

4:4. Resupply: If ingredients are locally available, leadtime (period between ordering and receiving) will vary between 1 day (without bureaucracy, if money is available and distances are not too great) and 6 months and more, e.g. through the Ministry of Health or if obtained from sources abroad. But,since most ORU's annual recurrent costs will, under above conditions and exclusive of i.v. infusions, salaries and utilities,not exceed 14000 FCFA($50 US) bureaucracy is often a greater hurdle than money Glucose is generally the hardest item to come by, but can, in most cases, be replaced by sugar. KCl is not absolutely essential except for the severe cases. Prepacked (oralite) mixtures are preferable, provided that they are not older than 2-3 years. Separate ingredients have a much longer shelflife and were 1/4th of the price in our case. Resupply of bottles must be ensured by a high enough fee to be collected during the first visit and returned on followup (of the child and the bottle): the fee has to cover the price of a new or used and properly rinsed bottle on the market plus transportation. It should also be a round figure in order to minimize small change. In our case the bottle fee was 150 FM or 75 FCFA ($ 0.27) whereas resupply costs (including the important stoppers) were 110 FM, thus leaving 40 FM ($ 0.07 US) for taxi money. Since the initial stock consists of 50 bottles, sufficient money will be generated to cover bottles and transport. This is all under the assumption, of course, that the bottle fee money is not used for other purposes. As long as most LDC's still have a free services policy and salaries are low, the physical storage of money in a public hospital remains a critical problem area with all its consequences for the continuity of the ORU.

4:5 Personnel motivation and continuity. It is often assumed that ORU personnel would be more attracted by a method which is by far simpler and less dangerous than the I.V., in our case subclavicular, infusion. And yet the medical personnel's acceptance of OR as a scientific substitute for infusions has to overcome major obstacles: the OR "looks" less scientific, less of a medical act than an infusion, where needles, syringes etc. are involved. Second, the nurses "specialized" in subclavicular infusions often receive cash money; by contrast, in the ORU there is nothing to earn. Some of the doctors simply refuse on the ground that such a cheap medicine, which costs

less than a box of matches, simply cannot be good. High personnel turnover is always a problem in LDC's. It is therefore crucial for the continuity of an ORU to train more than one nurse and even doctors, especially in a hospital setting, where there is personnel rotation such as nightduties, holidays, etc.

4:6. Integration of the ORU into the hospital routine. There has to be a two way flow system between the prescreening point (usually the doctors or nurses room) where dehydrated cases are identified, and the ORU, where they are treated. Personnel at the prescreening point therefore has to be trained in symptoms and signs of dehydration, and the ORU nurse must report back to the doctor whenever a child seems to get worse or constant vomiting suggests another method such as the nasogastric or i.v. infusion. The ideal is that everybody in the pediatric ward receives basic OR training. Only then the problem of replacing ORU personnel whether during the night, on holidays or sickleave, can be guaranteed.

4:7. Summary of the management timeframe:

1. Planning: 3 weeks, 1 person
2. Preparatory phase. 3 weeks, 1-2 persons
3. Implementation: 1 day, 2-3 persons
   On site training: 1 full day, 1 person
   1 week. 1 hour/day, 1 person
4. Supervision: 1 month: 1/2 hour/week, 1 person
   Maintenance: Continuous, as long as ORU functions

Thus any ORU can be fully established in 3 months, provided there are no major bureaucratic, financial and personnel obstacles.

IV. COST ANALYSIS

Although line item budgets vary and are country and unit specific, they are less so than generally anticipated. They are also the most crucial factor in the planning, implementation and evaluation cycle, since they require detailed and correct knowhow in all phases. The aim in the least developed countries (LDC's) should always be to establish at least the (minimum) level, i.e. the absolute necessary items and knowhow, to guarantee (maximum) efficacy. Ideally, checklists should be as comprehensive as possible, inclusive of all essential items under all possible variations and with the actual price tag for the smallest possible element. This is what we call line item budgeting per functional unit.

Below prices are expressed in $ U.S., at the $ 1 US/560 FM/280 FCFA conversion rate in May 1981. They reflect actual expenditures at the ORU in Bamako.

1. Capital Investment: For a unit which can rehydrate up to 20 children per clinic day with one hour of average duration of stay;

1.1. Renovation of a 20 m^2 room: painting, doorlocks, electric appliances such as new sockets, neon lighttubes, repair of fan, etc.: $110.

1:2 Furniture $485

- 1 closet w.4 shelves
- 15 m^2 of squatting area: mats, mattresses and sturdy plastic cover
- 2 chairs
- 1 table w. drawer
- 1 bedcot w. mattress and plastic sheet
- 1 hook for infusion bottle or a dripscand

1:3 Equipment $ 200

- 1 rehydration box (wooden or cardboard) containing :
  - . 2 plastic syringes at 3 ml (or 5 ml), 0,5 ml graduated
  - . 1 measure spoon (or volume) for 24 ml or a 5 ml teaspoon
  - . 1 one-liter bottle, 100 ml graduated
  - . 1 funnel
  - . 4 containers w. tight lid for ingredients, labeled (pp.12-13)
  - . 1 collection box for money deriving from bottle deposits

- 20 plastic cups
- 20 teaspoons
- 50 one-liter bottles w. stopper
- 1 ruler
(- 1 water filter: Berkefield type: not absolutely necessary)
- 1 baby weighing scale : UNICEF No. 0145500
- 3 plastic buckets
- 1 waste basket
- 2 bottle cleaning brushes
- 5 nasogastric tubes, polyethylene, for infants
- 2 syringes at 50 ml, polyethylene, for nasogastric infusion
- cleaning material: cloth, broom, brush
- plastic sealed instructions fixed on the wall

Total capital investment: approx. $800 US, half of it going to items such as a closet, waterfilter (not absolutely necessary), bedcot, and infant weighing scale.

2. Annual Recurrent Costs

Low cost of the OR is the principal reason for its use in LDC's. In fact, our recurrent cost comparison between single oral (or nasogastric) and intravenous (i.v.) rehydration is 10 FCFA or $0.035 US versus 2000 FCFA or $ 7.15 US, exclusive of personnel salaries. That is a ratio of 1:200!

2:1 Rehydration Ingredients (whenever the oralite packs are not available) for 1000 rehydrated children at an average body weight of 6 kg: all are in powdered form and were, in our case, locally available.

- 20 kg glucose:	$ 21.40
- 3.5 kg salt :	5.00
- 2.5 kg $NaHCO_3$:	2.25
- 1.5 kg KaCl :	1.34
Total	29.99, say $ 30 US or $ 0.030 US per child.

If UNICEF oralite packs were used in Mali, the price would be approximately $ 0.12 US or four times more than the ingredients in separate packings.

2:2 Technical Material for 50 i.v. rehydrated children, based on the assumption (and confirmed by our survey), of a 5% need for i.v. infusions amongst 1000 children who present with signs of dehydration: Total approx.: $ 360 US or $ 7.15 per child:

- 50 bottles at 500 ml Ringer lactate w. giving sets
- 50 sterile syringes and needles
- 5 rolls of zinc oxyde adhesive tape
- 30 disposable scalpvein needles

This estimate is, of course, an area of great variation, mainly depending upon the degree of physicians preference for i.v. infusions, but also upon the unit price of Ringer lactate bottles (or its equivalents). Also, in most LDC's, these costs will be carried by the

2:3 Stationery and recording/reporting materials: $ 2 US

- 1 daily recording book
- 100 daily tally sheets
- 24 monthly report sheets
- 4 ballpoints pens
- scrap paper

2:4 Cleaning Materials $ 12 US

- 5 soap bars
- 3 floorcloths
- 3 packs of soap powder

2:5 Other important recurrent costs: (which require usually no additional resources):

- personnel salary: 1 full-time employed lower grade nurse: $ 750 US for an average of 15 children/day
- utilities: water, electricity, depreciation of furniture and equipment: cost varies

All equipment, furniture, technical materials were, in our case, locally available. If some of it have to be imported, then at least 50% additional costs are required for those items.

Also, the quite considerable costs of foreign technical assistance for planning, implementation and evaluation and its logistic costs (transportation costs notably) are not accounted for, since this was done under the author's present work assignment and with his own financing. Obviously, for national purposes these line item budgets will have to be included.

V. ACKNOWLEDGEMENT

Since this manual is mainly based upon field experience, personal contacts and evaluations of ORU's over a period of 10 years in Zaïre, Yemen Arab Republic, Afghanistan, Chad and the Sahel Region, many people and organizations have advertedly and inadvertedly contributed to this work.

My special thanks go to the Sahel Development Planning Regional Office/USAID, Bamako, to the Prof. Dr. Balla Coulibaly, the medécin-Chef of the Pediatric ward I at the National Hospital Gabriel Touré in Bamako, Mali, the two nurses working at the ORU, to Dr. Uwe Brinkmann, the German Epidemiologist in Bamako as well as to my late wife who assisted in the setup of the Bamako unit. Finally, I wish to thank the Club du Sahel Secretariat for preparing this manual for publication.

VII. ANNEX (Technical Manual)

1. OBJECTIVE OF THE ORU AND ADMISSION CRITERIA

OBJECTIVE

- Reduction of mortality in the severe stages of dehydration, when health-education of proper fluidintake alone would be too late or too risky to rely upon.
- Controlled supervision of adequate intake of rehydration fluid.

Rehydration at a BHC is a curative service reserved for the advanced cases of dehydration. The mild cases of gastroenteritis/dehydration should receive health education on fluid-electrolyte intake and a close followup, but not a routine handout of oral rehydration fluid.

ADMISSION CRITERIA

a . Without signs of dehydration: less than 5% of body weight loss or 50 ml/kg of body weight fluid loss.

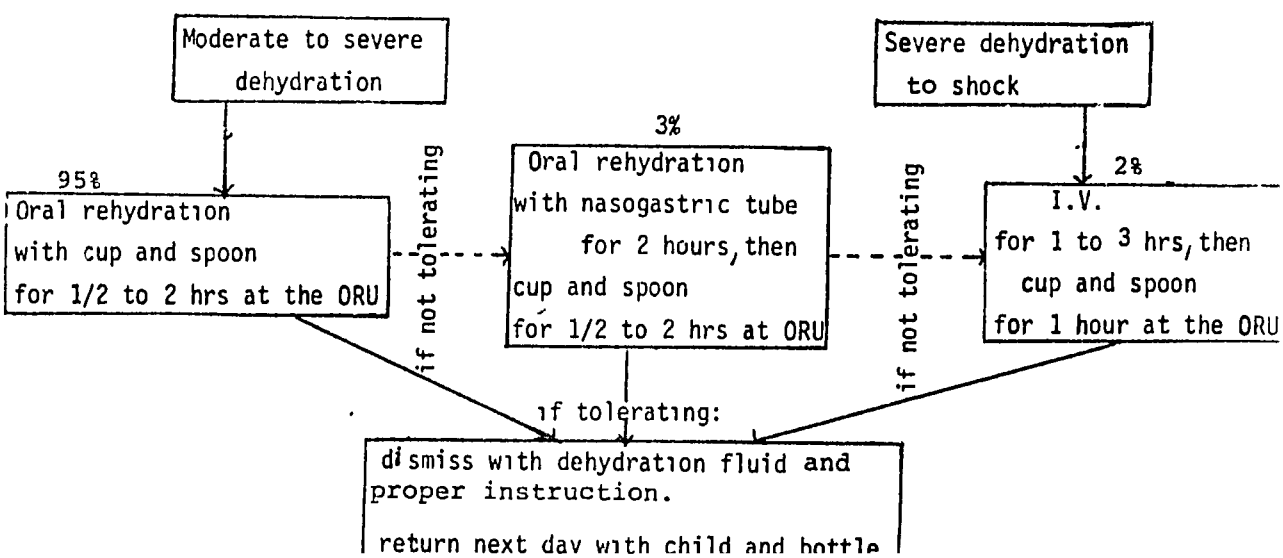
These children are not referred to the ORU; they are:

a) given health education on fluid intake ("don't stop fluid intake"): fluid with some salt contentswhich is available at home: ricewater, soups, breastfeeding, tea, and if possible:

b) advised to return the next day for re-examination.

They constitute 95 to 99.9% of all complaints of common diarrheas, depending on the nutritional status and (incorrect) bottlefeeding prevalence: only 0.1% to about 5% of these have to be referred to the rehydration unit.

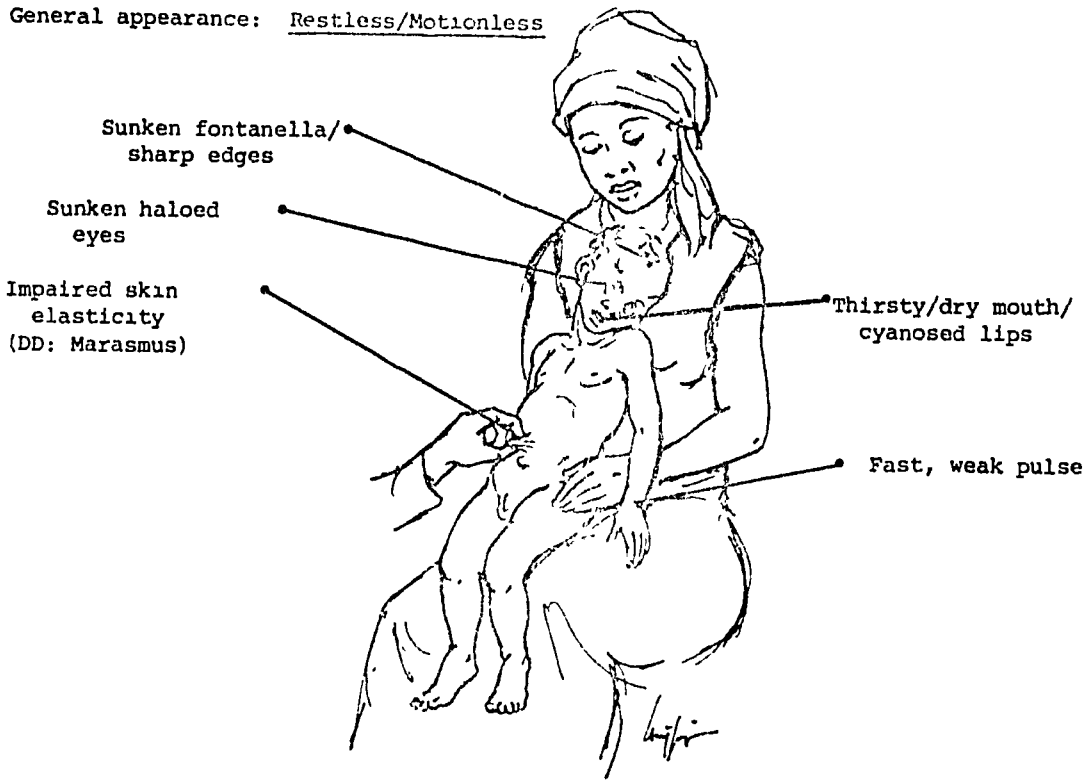
b . With signs of dehydration. between 7 and 12% of body weight loss or 70-120 ml/kg body weight fluid loss.



Next day: examine, give health education on proper fluid intake; if still dehydrated: repeat procedure (approx. 5% of all returnees)

2. SIGNS OF MODERATE /SEVERE DEHYDRATION

General appearance: Restless/Motionless

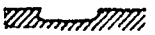


and a history of: diarrhea (more than 6 times per day) and/or vomiting (after every fluid intake, but not posseting). However, never rely on history alone, always examine for signs of dehydration. The stages of moderate, severe and shocklike dehydration are not clearcut but fluctuating in their signs. Shock is diagnosed when there is no peripheral pulse felt: then I.V.

rehydration should be started immediately (often difficult due to collapsed veins, as a last resort try the femoral vein but <u>not the subclavicular</u> one due to the danger of air emboly and pneumothorax) DD: impared skin elasticity in marasmus.

<u>The anterior fontanella</u>:

Normal: slightly below skullbone level

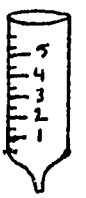
Sunken:  (sharp) edges: DEHYDRATION

Bulging: above bone level: MENINGITIS (sometimes also in rickets)

Caution: If meningitis is combined with dehydration (inability to suck, vomiting): then fontanella can look almost normal.

3. <u>PREPARATION OF THE ORAL REHYDRATION FLUID</u>

Item	Weight	Volume
NaCl (cooking salt)	3.5g	3 ml
$NaHCO_3$ (sodium bicarbonate)	2.5g	3 ml
KCl (potassium chloride)	1.5g	1.5 ml
<u>Glucose</u> or sugar	20 or 40 g	24 or 48 ml
add <u>water</u>	1 kg	1 liter



5 teaspoonful or 10 teaspoonful (8 sugar cubes)

1 liter of water

Note:
Add flavour if available (syrup, oranges), but not necessary; <u>Caution</u>: acid flavour destroys $NaHCO_3$.

Prepare daily fresh rehydration fluid, discard leftover at the end of clinic day.

Use volumetric measures only:

- a 5 ml graduated syringe for NaCl, $NaHCO_3$ and KCl
- a volumetric measure of 24 ml or teaspoons of 5 ml capacity for glucose or sugar (8 sugar cubes)
- a standard 1 liter bottle or a graduated measuring cylinder

4. QUANTITATIVE SCHEDULE

Moderate/severe dehydration:

ORAL/CUP AND SPOON: **20 ml/kg body weight within first hour**

(sometimes within 1/2 hour but not less)

then:

120 ml/kg body weight within 6 hours

(taken home in a bottle, tell the mother "feed the child with it until the sun goes down")

then continue with any fluid available:

breastfeeding, ricewater, soup, tea,

even bottle-feeding.

Always return the next day.

If cup and spoon-feeding not tolerated (continuous vomiting for 20 minutes:

NASOGASTRIC TUBE: Same regimen as above for the first 1/2 to 1 hour:

20 ml/kg/hour

Maximally 3 ml per minute with a syringe attached to the nasogastric tube, then try cup and spoon method:

20 ml/kg/hour; if tolerated:

dismiss with 120 ml/kg/6 hours,

same as above.

Severe/shocklike dehydration:

Except in the true clinical shock (pulseless, unconscious), always start with cup and spoon, then with tubefeeding;
Only in shock or if still vomiting with nasogastric feeding:
INTRAVEINOUS (i.v.)/INTRAPERITONEAL (i.p.) only if i.v. admin. can't be done.
Ringer's lactate or Halfstrength Darrows solution for children
Fullstrength Darrows solution for adults

Children:	30 ml (up to 50 ml/kg bodyweight within 1 hour, then 10 to 15 ml/kg " " next hour (usually 15 drops per minute) all in all: 100 ml/kg " for 6 hours

Adults :	1 liter within first 15 minutes, then 10 to 15 ml/kg per hour all in all: 160 ml/kg bodyweight for 6 hours

If improvements after 2 hours, try oral fluid, if tolerating, dismiss as instructed above.

5. POSSIBLE COMPLICATIONS

Overhydration - hypernatremia - cardiac failure:
especially with i.v., i.p., infusions, sometimes also with oral fluid in very young infants. Caution: pneumonia with signs of dehydration and marasm. Check for moist rales and any signs of beginning cardiac failure, reduce fluid intake to half of the dosages given above. Always check (next day) for signs of overhydration: oedemas (esp. feet or eyelids) pulse, breathing, moist lung rales.

6. INDICATIONS FOR ANTIBIOTIC TREATMENT

Dehydration combined with infection: otitis media, meningitis, etc.,where fever is always present: give disease specific antibiotics.
"Invasive Diarrhea" Shigellosis, cholera: give tetracyclines

THESE ARE THE ONLY CASES WHICH REQUIRE ANTIBIOTICS IN ADDITION TO REHYDRATION.

7. RECORDING SYSTEM

A. Daily tallysheet (selfmade), from there transfer daily into:
B. Daily recording book, transfer monthly into:
C. Monthly reports, keep always a copy at the ORU

Example

A.

Date	1st	Follow up	
		Routine	Repeat
3.5.	~~IIII~~ III	IIII	I

B.

Date	1st	Follow up		Total	Remaining Money
		Routine	Repeat		
3.5.	8	4	1	13	1450 FM

C.

Month	1st	Follow up		Total	Remaining Money
		Routine	Repeat		
January	172	135	10	317	3150 FM

VIII. SOME USEFUL REFERENCES

1. A Manual for the Treatment of Acute Diarrhea,
WHO/CDD/SER/80.2 (1980)

2. Bibliography of Acute Diarrheal Diseases
WHO/CDD/BIN/82.2 (1980)

Contact Address: Program Manager
Diarrhoeal Diseases Control Programme
World Health Organization
1211 Geneva 27
Switzerland (English Version)

and;

Monsieur Le Directeur
Du Programme De Lutte Contre Les
Maladies Diarrheiques
Organisation Mondiale de la Sante
1211 Geneve 27 Suisse (French Version)

3. Oral Therapy in Children with Cholera: A Comparison of Sucrose and Glucose Electrolyte Solutions
Sack, D.A. et alii, P. Ped. 96:20-23, 1980

4. Oral Fluid Therapy in Diarrhea and Dehydration: Current Concepts and Practical Considerations
Parker, R.L., Johns Hopkins University, 1980

5. Oral Rehydration Therapy: An Annotated Bibliography
PAHO/CDC, 1980

Contact Address Reference 5:

Pan American Health Organization
Pan American Sanitary Bureau
Regional Office of World Health Organization
525, Twenty-Third Street
Washington, D.C. 20037 U.S.A.