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INTRODUCTION

In 1964, John E. Gordon elaborated a strategy for community programs for the diarrheal diseases (1). The first priority was the use of preventive measures, particularly health education of the public. The second priority was the development of the maternal and child health services necessary to promote breast feeding and use of appropriate weaning foods, and to provide instruction to mothers in the hygienic preparation of foods. The third priority was in the medical management of programs, the major factor being the form of rehydration to be administered at home, in out-patient rehydration centers, or in the hospital, depending on the severity of the illness.

These priorities remain sound today. In this report we consider only the two essential direct interventions in management of acute diarrheal diseases, namely, oral rehydration and continued feeding. This is not intended to be a "state of the art review." Rather, our purpose in this discussion is to suggest an appropriate course of action based upon what we now know, even though our present knowledge is incomplete. The contents are a summary of our judgments on these issues; other opinions may be just as valid. We will not deal with issues of community organization or with education strategies, for these areas are currently the special concerns of others and clearly require in-depth research.

Morbidity and mortality due to acute diarrheal diseases have been amply documented in recent years, and the contribution of infantile diarrhea to the development of protein-energy malnutrition is well accepted. One recent and conservative estimate of the global problem is that the more than 500 million episodes of diarrhea that occur yearly in infants and children under 5 years of age in Asia, Africa, and Latin America result directly or indirectly in at least 5 million deaths (2). When one considers in addition that more than one third of pediatric

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beds in developing countries are occupied by patients with diarrhea who may receive expensive antibiotics and intravenous fluids, it is clear that the disease also has enormous immediate economic consequences. It is no wonder that there is a sense of urgency to develop appropriate solutions now.

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ORAL REHYDRATION

Controlled studies in adults and infants (3, 4) have shown the efficacy of oral rehydration techniques in the therapy of mildly to moderately acute diarrheal diseases. Because dehydration is the major cause of the immediate morbidity and mortality of diarrhea (5), the potential health benefits of oral therapy are profound. Early institution of oral rehydration may arrest and reverse progression to severe dehydration, which otherwise usually requires intravenous fluid therapy in a hospital setting. The available evidence leaves no doubt that these benefits justify an intensive program to make oral therapy available now to all high-risk groups (6). It is our opinion, therefore, that introduction of oral therapy is the single most important step in the development of a program to manage diarrheal disease at the community level. It is axiomatic that the water used to prepare oral-therapy solutions should not itself be a risk factor in transmission of enteric pathogens. Local conditions will determine whether available water sources may be used without further attention, or whether it is mandatory to use boiled water.

This decision raises a series of questions: What is the best rehydration formula? How should the formula be packed? Where should oral solutions be prepared? Who should give the treatment? How can use be monitored? The questions touch upon issues of effectiveness, safety, cost, independence or self-reliance, access and acceptability, and in addition bring up a profound practical question of whether the program should be home or health-center based. It should be made clear at the outset, however, that there are no simple best answers to these questions, and that no single implementation method is correct for all countries or all settings. There is a need for more community trials under different sets of circumstances to accumulate the data necessary to guide decision making.

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1. Formula Selection

The World Health Organization has recommended that a single oral-rehydration formula be used to combat acidosis and deficits in water, sodium, and potassium (6). This formula contains 90 meq/L sodium, 20 meq/L potassium, 80 meq/L chloride, 30 meq/L bicarbonate, and 111 mmol/L of glucose. It is an effective and physiologically sound mixture to ensure optimum salt and water absorption for dehydration ranging from imperceptible to severe. To accomplish this, two variables must be considered--the measurement of the salts included, and the measurement of the volume in which these are dissolved.

a. How much sodium?

With the exception of severe cholera in adults, the WHO-recommended concentration of sodium is suitable for all age groups and for mild to moderate dehydration (up to 10% loss of body weight) due to various etiologic agents (3-5, 7, 8) and for a large proportion of the severe cases as well. The greater the initial deficits and the greater the ongoing losses, the more oral fluid is required. With the exception of rotavirus infection in infants (7), the higher the stool volume in diarrheal disease the higher is its sodium concentration and the greater the magnitude of sodium deficit in the patient. Because sodium losses thus may vary with severity, one might intuitively expect problems in sodium balance to develop when using the high-sodium WHO-formula in mild diarrhea. Indeed criticisms have been raised that the WHO solution may cause iatrogenic electrolyte disturbances in such patients, who should otherwise greatly benefit from oral therapy (9, 10). In fact, this formulation has proven to be successful in clinical trials in both mild and severe diarrheas in which stool sodium content ranges from 25 to 125 meq/L. A second argument for using a formula with sodium content less than 90 meq/L is that it will provide a greater margin of safety should too much salt or too little water be used to make the solution. However, Nalin *et al.* (11) have shown that lowering sodium to 60 meq/L entails a risk of persistent hyponatremia, while the elevations in plasma sodium that occasionally occur with a 90 meq/L solution are rapidly corrected when feeding commences. In our judgment it is better to retain the WHO formula and expend efforts on education in correct preparation and use of oral therapy than to rely on a marginally safer but less-efficient solution for the more severely dehydrated patients, especially those with cholera. Because etiology cannot be determined at the time

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of initiating therapy and we opt for a single-formula program, it is necessary to reduce the risk of elevation of serum sodium, which is the major problem to be considered in hot climates and in febrile, hyperventilating, or malnourished subjects (9). To accomplish this, additional sodium-free water must be provided to the patients. When this is done the WHO-formula may be successfully used without hypernatremia or an upward trend in serum-sodium values, even in infantile rotavirus infection, in which stool sodium averages only 25 meq/L (7, 8). It should be noted that the additional sodium-free water must not be directly added to the formula itself, for this lowers the sugar concentration to levels less effective in enhancing sodium absorption. In a practical sense, sodium-free water may be given to unweaned infants in the form of human milk, which has a sodium content of only 2-3 meq/L or so. Alternating feedings of breast milk and oral-rehydration solution also results in important nutritional benefits such as the maintenance of breast-milk production. These various issues must be considered in making program recommendations for formula selection. We believe that the most feasible program will employ a simplified and direct approach, such as a single-solution formula. The choice of formula will obviously depend on the production, distribution, and monitoring systems adopted and may well differ if the home rather than the health center, is the target for the program.

b. Potassium or no potassium?

The stool potassium in childhood diarrhea tends to be higher than that in the adult disease (9). The cumulative effects of unreplaced potassium losses, especially in children, are known to be detrimental to appetite, behavior, muscle, cardiac, and renal function. Absolute potassium loss as well as internal redistribution occurs during diarrheal diseases, and ideally oral solutions should contain adequate potassium for replacement. The recommended concentration of 20 meq/L in the WHO formula is tolerated by all age groups. In fact, children have been successfully treated using an oral solution containing 35 meq/L of potassium without ill effects (11). In contrast, a potassium concentration of 20 meq/L can lead to persistent hypokalemia. If not given in the oral-therapy solution, potassium should be replaced in the diet. Bananas, citrus fruits, and green coconut water are excellent sources of potassium, and breast milk contains around 13 meq/L.

c. Bicarbonate or no bicarbonate?

Prolonged diarrhea and acidosis are significant problems requiring replacement of base. Bicarbonate in oral

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solutions (25-30 meq/L) prevents or reverses acidosis, with the resultant benefits of improved appetite and cessation of vomiting (5). However, for mild diarrhea, especially of short duration and in the presence of good renal function, bicarbonate is not absolutely necessary (although its inclusion is not harmful). Since early rehydration can reduce nausea and vomiting, maintain appetite, and avoid acidosis, and because addition of a third chemical in a home-prepared formula is likely to magnify the difficulties in making the solution, we do not consider it absolutely necessary to add base *when the emphasis is on early home use of oral therapy*. In other situations, particularly for heavily purging patients, inclusion of bicarbonate is indicated.

d. Glucose or sucrose?

Glucose is the standard for comparison of the efficacy of sugars or amino acids that enhance transport of sodium and water in the intestine by a facilitated co-transport mechanism. In cases of severe diarrhea, glucose is more effective than sucrose (table sugar) (5) although a recent study has shown no difference in the rate of successful oral rehydration of cholera (that is, no requirement for intravenous fluids) in infants and children with moderate dehydration of 7.5 to 10% fluid deficit (12). In cases of mild to moderate diarrhea, the two sugars are almost equivalent (12, 13), except in the relatively rare situation of acquired sucrase deficiency (12). Since the sucrose must be enzymatically hydrolyzed to its component monosaccharides, of which only the glucose acts to increase sodium absorption, twice as many grams of the disaccharide must be provided to achieve equivalent concentrations of glucose. As long as sucrose is generally available, and glucose is not, it is reasonable to recommend use of sucrose for home-based early rehydration therapy. However, when a prepackaged chemical mix is to be prepared in a centralized facility the use of glucose is preferred. There are several trade-offs to consider. Although glucose is more expensive than sucrose, bulk purchase may lower its cost. In addition, the higher cost of glucose is partially offset by the decreased quantity required compared with sucrose. Table sugar is an important dietary staple and marketplace commodity, and it is subject to fluctuations of both supply and price. Although it does not seem likely that the availability of sucrose would be affected by the amount purchased for use in oral-therapy solutions, even small changes reflected in the price could affect the ability of low-income families to

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purchase sugar for therapeutic use. Therefore such economic considerations should be investigated wherever home-based, market sugar-salt mixes are introduced into the community. In this way, data may be collected relevant to questions of subsidization of home-based oral-therapy costs. Finally, when prepackaged mixes are considered, it should be noted that glucose is more hygroscopic than sucrose so that the former must be packaged in foil, which is more expensive than packing materials suitable for sucrose-based formulae. This economic advantage for sucrose disappears in warm climates and at relative humidity greater than 85%, for under these conditions water absorption by sucrose (as well as glucose) is substantial.

2. Preparation of Ingredients

a. Centralized (local or national) vs. home preparation

The goal of oral therapy is the early and effective treatment of diarrheal disease to prevent dehydration and progression to severe illness. To accomplish this, the technology and the materials must be accessible to households at all times, whatever their location relative to a health center. The family should be trained to recognize the illness, to know when therapy should be initiated, and to decide when additional medical assistance is required. The balance between benefits from unsupervised preparation but early use of oral rehydration and potentially harmful mixture errors and/or incorrect use must be carefully weighed. Several issues should be considered in this assessment.

b. Packaging of pre-mixed ingredients

Centralized national packaging using purified chemicals is recommended to standardize the salt/sugar mix. This is also economical in the bulk purchase of ingredients. With an obligate initial investment in machinery, central national facilities could be mechanized for a large-scale output of packets. As an alternative, local packaging in smaller quantities could be set up in health centers or as cottage industries. Local hand packaging, however, presents a logistical problem for quality control, an essential procedure to minimize the risk of serious error. The extent of that risk is not really known at present and must be determined in the future. As a less-expensive alternative, market salt and sugar can be used to prepare a more simple pre-packaged formula without potassium or bicarbonate. Pre-mixing and packaging undoubtedly add to the cost of preparation of oral-therapy solutions but permit production of a recognizable product, which, if desired, can be promoted as medicine. This may be important

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if use of market sugar and salt will be viewed as food rather than medicine in cultures in which taboos proscribe feeding infants and children ill with acute diarrheal disease. In such a setting it would be useful to stress that the use of the medicine (oral therapy) will permit early reintroduction of food. Understanding local attitudes is obviously critical to correct decision making.

c. Use of measuring spoons

Local preparation of salt/sugar mixes, whether in the health center or in the home, requires correct measurement of the individual ingredients of the formula. For simplicity, volume measures have been selected. Two measuring tools have been suggested or made available: a complete set of spoons for all components of the WHO-approved formula, or a double-ended spoon to measure only sodium and sugar (usually sucrose). The former is adequate for use in centralized local packaging or in the health center, whereas the latter is appropriate for home preparation. It has been suggested that spoons be color coded to the container color for each ingredient to reduce the risk of serious formula error. We believe it is likely that home preparation of oral-therapy fluids, by permitting early treatment, will produce benefits that outweigh the potential risks entailed in using inaccurately prepared fluids. Thus we stress again the need for proper education programs to reduce this risk. Studies are urgently needed to evaluate the magnitude of the risks involved and to monitor safety. A quality control program to ensure proper use of oral therapy is essential, and must be devised.

d. Selection of container

The final electrolyte concentration of the oral solution is dependent not only on the quantity of salts it contains, but also upon the volume of water in which they are dissolved. Therefore a standard container must be available wherever the oral solution is prepared--hospital, health center, or home. Suitable containers may already be available but even in hospitals and health centers this is by no means a certainty. A number of suggestions have been made for provision of a vessel for home use: (1) graduated plastic bottles could be given (or sold) to health facilities or communities; (2) salts could be packaged in plastic bags that will contain the desired volume when filled; (3) or some locally available standard measure such as a beverage bottle (beer, rum, soft drink, etc.) or a drinking glass could be used as the volume measure. Naturally the quantity of salts must be adjusted to the volume to be prepared. For the health clinic, it might

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be appropriate to prepare 5 or more liters at a time, whereas for home-use packets, spoons and containers suitable for 200 to 500 ml might be preferred. Solutions should not be permitted to stand long enough for bacteria to multiply to potentially dangerous levels, and therefore no more fluids should be prepared at any one time than the amount to be used in an 8-hour period.

3. Distribution of Oral Rehydration Solutions

a. Distribution of pre-mixed packets

Packet preparation and distribution could be accomplished by either the government or private agencies. Government action, presumably through the Ministry of Health, could potentially keep costs below those of commercial companies. However, the efficiency of the government health system varies from country to country. The pharmaceutical industry must continuously demonstrate the ability to produce, package, distribute, and sell drugs in order to survive. While this expertise could be useful in promoting oral therapy it is not certain that this industry will consider it to be in its own best interest to produce and market oral-therapy packets at the lowest possible cost. The pricing structure is critically important because the diarrheal diseases most severely effect those with least access to medical care and the least ability to pay for it. The availability and distribution of pre-mixed salt/sugar packets require consideration. Should the packets be used in the center only or should they be distributed for use in the home? While the goal of widespread and early use of therapy dictates the latter approach, it must be decided how much of a supply is to be made available for each episode of illness. A more ideal solution would be to keep packets in the home in readiness for use as soon as the diarrhea begins, but this would undoubtedly increase utilization beyond physiological need and thus increase costs. Such economic pressures preclude unlimited distribution of oral-therapy packets and make mandatory an educational campaign that stresses proper guidelines for initiation of oral therapy, instruction in preparation and use, and recognition of severe disease that requires medical attention. Unfortunately, even in countries wholly committed to delivery of oral therapy through government health centers, only a fraction of the population may have easy access to them (10). In such situations, village or household distribution carried out by community health workers may be necessary, but this requires good community organization and a determined distribution scheme. Some health ministries may already be experiencing difficulties

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in supplying medicine to health centers both continuously and adequately and there is no reason to believe that these difficulties will be reduced for oral-therapy packets. Where geography and distance or breakdown and distrust of the official health-care system prevail, commercial distribution may improve the situation. Promotion of home preparation of oral-therapy fluids, even with prepared sugar/salt packets, implies the necessity of a suitable education and surveillance system at the same time. This permits monitoring of efficacy and safety of oral therapy, as practiced in the health center or in the home.

b. Home preparation of rehydration solutions

The double-ended spoon for salt and sugar facilitates preparation of a defined oral-rehydration solution in the home, when needed and without a visit to a distribution center. It is an inexpensive tool that can be cheaply mass-produced. However, the spoon does not measure bicarbonate or potassium chloride, it can be easily misplaced or broken, and it is designed for a standard volume although a suitable container may not be available. It must be used correctly in the home (heaping or level spoonful, however calibrated), the correct ingredients in the appropriate end, and the right number of spoonfuls per container. The most important attributes of home preparation are the potential for early use (and therefore effect) and the involvement of the mother in the process of delivery of health care that is critical to development of self-reliance. Home preparation does not necessarily require a spoon. With training, adequate solutions can be made using a fistful of sugar and a pinch of salt. While the risks of inaccurate measurements by this method are understandably increased, it has the advantage of literally putting therapy in the hands of the people. It is important to consider at the outset that home preparation of oral-therapy mixes will increase the potential hazards of both overconcentration and underconcentration of sodium, because of potential errors in both the quantity of salt used and the volume of water in which it is dissolved. The former problem can be minimized by providing families with prepackaged salts (which contain base and potassium). The latter error remains regardless of how the salts are provided: it can be dealt with only by provision of a standard container or by use of a suitable local measure available to all. While the double-ended spoon does not solve the home-measurement problem (and there is a clear risk that somebody will mistakenly use the larger sugar measure for salt instead), gross errors may be detected

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if everyone is taught to taste the solution before using it. Inevitably, however, some individuals who taste the solution will find it too salty or not salty enough, and improvise their own mix. This can be combatted only by education and surveillance. If home-prepared and -administered therapy is chosen as the basis of the program, whether using a double-ended spoon or a fistful and pinch approach with a simple sugar/salt mix, an effective surveillance/education program could be employed to develop a two-tiered therapy system. In this scheme failure to respond to early home therapy would be the signal to bring the child to medical attention where the more complex WHO oral solution could be employed. There is, in fact, much to recommend such a village triage system.

4. Economic Considerations

Undoubtedly, home preparation of mixes with market ingredients is the least costly approach. However, there are some hidden costs to consider when comparing home-based plans with more expensive, centralized programs. Teaching the home preparation and use of formula requires an effective education effort, and, as for other programs, ensuring that it works requires surveillance and re-education. There may be market fluctuations in the price of sugar and salt at the local bazaar.

When considering pre-mixed packets, it must be recalled that effective early oral therapy can decrease the use of expensive non-specific remedies, as well as antimicrobials and intravenous solutions, and thus offset costs of effective training of professionals, paraprofessionals, and parents. The likelihood of waste entailed in the use of packets may be partially offset by the expense of replacement of spoons or containers distributed to the household in a community distribution scheme.

No matter which plan is adopted, the cost will inevitably depend on government policy concerning subsidization of packets, ingredients, distribution and implementation, and/or control over commercial and market pricing. An overriding consideration is the effectiveness of the program. How can the greatest number of patients be reached as early as possible, and with appropriate safety in administration of the treatment?

5. Cost-effectiveness of Different Oral Therapy Programs

Several different issues have been discussed in the above sections. Table 1 reviews the options available and suggests situations in which different choices might be appropriate.

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TABLE 1

Plan	Advantages	Disadvantages	Situation
Pre-packaged WHO formula.	Effective even for severe cholera. Standardized. Highly visible and identifiable. Effective for cholera and mild diarrhea.	More expensive. Ingredients may not be locally available. Can lead to hypernatremia if incorrectly used.	Effective for a health system reaching the bulk of the population.
Pre-packaged WHO formula with sucrose.	May cost less. Sucrose may be more readily available.	Less effective for severe diarrhea. May increase vomiting. Ineffective if sucrase deficiency develops.	Effective for a health system reaching the bulk of the population.
Local Mixing using WHO formula (spoon set).	No dependence on central facilities. No packaging costs.	Increased risk of error. Storage of ingredients may be a problem.	Effective for a system of urban and rural clinics with outreach to patients.

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Home Mixing using salt/sugar formula (double spoon).	Reduced costs. Direct participation of community and family. No dependence on health system. Permits early institution of treatment at home.	Not as effective as WHO formula. Requires individual instruction of users. Requires a proper sized container in the home.	Effective where majority has no access to a centralized health service but where there is strong community involvement in health.
Local Mixing using salt/sugar (no spoons).	Requires no packets, spoons or devices. Minimum investment. Encourages self-reliance.	Measurement of ingredients is more variable. Efficacy of solution cannot be assumed. Requires instruction, standardization and frequent follow-up.	Effective where provision of measuring spoons is not practical.
Any distribution scheme using formula with lower sodium content (e.g., 60 meq/L).	Decreased risk of hypernatremia.	Risk of hyponatremia. Less effective in severe diarrhea caused by *V. cholerae* or *E. coli*.	Effective where supervision and surveillance is impossible.

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We consider the lower-sodium formula to be less desirable, particularly where cholera is prevalent. It may nevertheless be reasonable to propose a lower-sodium solution for home preparation if a second level of help is available at the health center for severe cases and for those who fail to respond well to home treatment. Educational efforts are necessary to teach the family when to refer such severe illnesses and treatment failures to the local health center. With the use of a triage system we believe it is feasible to introduce two different formulas into the community: a simple lower sodium formula for home preparation and use and the more complex WHO solution for supervised use in the health center.

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CONTINUED FEEDING

Diarrheal disease has an important adverse effect on nutritional status through direct and indirect influences on nutrient intake, absorption, or utilization (14-16). To minimize this effect it is important to continue feeding during and after diarrheal illness (5, 17). Several significant problems must be faced in recommending early reinstitution of feeding in these patients, particularly because medical folklore has prescribed "resting the bowel" during episodes of enteritis. Major efforts are required to change practices long held to be proper by the community.

1. Anorexia, Nausea, Vomiting, Abdominal Cramps

A common accompaniment of all acute infection is anorexia, although neither the reason nor the mechanism is clear. However, the clinical significance of infection-anorexia in the development of protein-energy malnutrition in populations with marginal nutritional status has been documented (15, 16). Indeed, the combined effects of negative metabolic balances, anorexia, and culturally determined withdrawal of food during acute illness can be nutritionally disastrous. A number of factors other than anorexia make feeding difficult in acute infection. These include lethargy, nausea and vomiting, and abdominal cramps which are due in large part to dehydration, electrolyte imbalance, and acidosis. When these problems are corrected the patient is awake, alert, and better able to take nourishment by mouth (5). The use of oral-rehydration solutions in acute diarrheal disease will correct dehydration, electrolyte imbalance, and acidosis and thus make it clinically feasible to introduce foods early in the course of the illness.

2. Milk Tolerance in Diarrheal Disease

In young children receiving milk an additional problem presents itself, namely the frequent and significant decrease in intestinal lactase activity during acute gastroenteritis that interferes with lactose metabolism and absorption (18). In turn, lactose malabsorption itself

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may produce symptomatic fermentative diarrhea. As a consequence, both lay and medical custom have restricted milk intake during diarrhea, as well as eliminating other foods. Is this wise or justified?

While the prevalence of lactose malabsorption in children in many parts of the developing world is exceedingly high, lactose malabsorption does not necessarily result in milk intolerance (18). The abnormality is particularly prevalent during acute gastroenteritis and in protein-energy malnutrition. This is grafted upon a background of increasing prevalence of lactase deficiency during early childhood in most orientals and blacks as the result of a genetically determined trait. The production of symptoms due to lactase deficiency, however, is dependent upon the dose of lactose, how rapidly it is ingested, and the vehicle employed (18). Symptoms can be titrated according to the dose of sugar ingested. In many instances a dose of lactose given as an aqueous solution may produce symptoms, whereas an equivalent amount given as milk will not. This is presumably because the delay in gastric emptying due to milk ingestion is sufficient to permit residual mucosal lactase to fully hydrolyze lactose presented to the small bowel at a slower rate. The symptoms in a lactose-deficient subject are also minimized when lactose is ingested as part of a test meal. It is clear that milk intolerance in a person with lactose malabsorption is a quantitative and not qualitative phenomenon. Therefore milk can be included in diets designed to rehabilitate malnourished children, whether or not lactose malabsorption is demonstrated by a tolerance test, so long as the amount given is titrated clinically.

The same is true for milk feeding during and after acute diarrhea, accepting the caveat that the milk must be titrated. Cautious introduction of foods, including milk, is appropriate as soon as dehydration and acidosis are corrected and nausea and vomiting subside. The latter goals are readily achieved within 6-8 hours, and feeding can be started just as soon as the child will accept food, even if the efficiency of absorption of nutrients is less than normal (19). Feeding will increase net absorption during the acute episode and thus minimize cumulative negative metabolic balances and weight loss. Even in the presence of lactose-induced diarrhea there may be little or no alteration in nitrogen balance during early refeeding, or only a transient effect. Catch-up growth can then proceed more expeditiously during the convalescent period since the host is already in better nutritional status. Such positive gains from early refeeding have been demonstrated in the field in the Philippines (20).

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The qualifications applied above to feeding of lactose-containing foods such as cow milk do not seem to apply to human milk. Torun *et al.* (18) state unequivocally that breast feeding "*should not be discontinued*" during infectious diarrhea because there is "no evidence of milk intolerance in breast-fed infants." This may be because acquired lactase deficiency does not commonly begin in the first year or two of life.

Cessation of breast feeding during acute diarrhea may lead to premature weaning with undesirable long range consequences. For this reason alone continued breast feeding should be encouraged. Because the sodium content of breast milk is so low (2-3 meq/L), it may be employed as a source of free water to mitigate against the possibility of hypernatremia resulting from use of the WHO rehydration formula. The breast-fed infant can be offered *ad lib.* oral therapy solution and human milk alternately and accomplish both goals of rehydration (including correction of electrolyte and acid-base disturbances) and refeeding.

3. Foods Other Than Milk

Feedings should not necessarily be limited to milk. Other elements of the diet, including fruits, vegetables, and sources of protein may be offered early in frequent small feedings, particularly in those patients in whom severe dehydration has been prevented or corrected. Although anorexia may be present the child will usually take some nourishment and should be encouraged to do so.

4. Indirect Potentially Deleterious Effects of Fasting

"Resting the bowel" rapidly leads to a diminished capacity to absorb glucose, salt, water, and amino acids in normal volunteers and may be accompanied by decreased disaccharidase activity as well (21). This is not prevented by intravenous feeding: nutrients must reach the gut to maintain absorptive function (21). In the host with diarrheal disease any impairment in absorption can lead to prolongation of diarrhea and increased malabsorption and so contribute to the progression of malnutrition.

The other side of this issue is that feeding may exert a positive effect on gut function in addition to supplying nutrients. For example, it has been shown that feeding adult volunteers can induce intestinal digestive enzymes in the normal host, albeit in a relatively substrate specific and dose-responsive fashion (22). If this is true during diarrheal disease, then continued feeding would not only provide required nutrients but also condition the gut to more effectively absorb and use these nutrients. Although this is theoretical at the present time there is an important potential positive feedback loop here that should not be ignored.

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RECOMMENDATIONS

1. Analysis of evidence presently available suggests that community management of the diarrheal diseases should include introduction of oral-rehydration solutions and early feeding of patients.

2. The WHO-recommended formula, which includes 90 meq/L of sodium and lll mmol/L of glucose along with potassium and bicarbonate, is the most desirable choice at the present time. Alternative solutions, for example, employing sucrose in place of glucose, with a lowered content of sodium, or without potassium or bicarbonate, may be indicated in certain situations after considering both benefits and risks. Remaining uncertainties concerning formula and distribution must be answered by continuing research efforts in the field.

3. Based on still inadequately validated current concepts, continued breast feeding of the unweaned child and early refeeding of the weanling are desirable. Feeding can begin as soon as the child will accept food, often within a few hours of initiating rehydration treatment. It may be necessary to limit the quantity of milk being offered to avoid milk intolerance, but it seems likely that the vast majority of patients will exhibit no symptoms and will benefit nutritionally. This requires documentation by future studies.

4. A key part of the program involves development of a community system for surveillance and education on a continuing basis. This will require an investment in infrastructure, but enables the ultimate extension of the program to include other components of health care such as education on weaning foods, population control, and environmental sanitation, as well as on immunization and prenatal care. Each of these has a direct effect on the incidence and severity of diarrheal disease and an indirect effect through improvement in nutritional status.

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RESEARCH NEEDS

1. Studies in the field to evaluate the impact, risks, and costs of effectively bringing oral therapy in its various forms into general use. A specific data form could be developed to compare the results obtained with patients from different environments and geographic locales.
2. Evaluation of educational techniques available for introduction of oral therapy. How does one most effectively train field workers to train mothers? How can mothers be effectively trained to prepare a safe, accurate oral solution or to go to a distribution center for prepared mix? What factors influence the use of oral solution by mothers in the home, when they seek outside medical help, and the decision on when to begin to feed the child after onset of acute illness?
3. Development of a simple quality control surveillance system.
4. Studies of community organization and the role of community health workers to influence a continuing program of oral rehydration.
5. Definition of guidelines for unsupervised initiation of therapy in the home and triage of severe cases and treatment failures.
6. Quantitative guidelines for refeeding, including caloric goals and timetables for weight restoration.
7. Guidelines for unsupervised continued breast feeding and minimizing the risk of milk intolerance in the home setting.

Surveillance and evaluation of all aspects of the program, including the incidence and nature of therapeutic failures, are essential for future revision of the program and improvement of the health of the people it serves.

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