These monthly bibliographical listings consist of 8-10 annotated articles and/or other information which our technical editors, Dr. Jon Rohde and Dr. Robert Northrup feel should be circulated to individuals concerned about ORT and related health issues. Editor's comments, where appropriate, are appended in brackets.

Inclusion in a listing does not mean that we endorse or validate the article cited, rather that it is worthy of your attention and further critical appraisal, particularly when it has already been published in a well-known journal. Comments or criticisms are welcome.

Butzner, J. Decker; Butler, Daniel G.; Miniats, O. Paul; et al. IMPACT OF CHRONIC PROTEIN–CALORIE MALNUTRITION ON SMALL INTESTINAL REPAIR AFTER ACUTE VIRAL ENTERITIS: A STUDY IN GNOTOBIOTIC PIGLETS. Pediatric Research, 1985, vol. 19, no. 5, 476-81.

To investigate the relationship between enteric infections and protein-calorie malnutrition, normally nourished gnotobiotic (germ-free) piglets and protein-calorie deprived piglets were both infected with a specific enteric pathogen. Comparative examinations focused on the small intestinal epithelium--its structure, enzyme activity and sodium transport, where both enteritis and chronic malnutrition are known to cause damage. After inoculation with the enteric virus, further reduction in weight gain and an increased mortality were observed only in the malnourished pigs. Sodium transport abnormalities in the controlled pigs recovered after 4 days; their mucosal structure and enzyme activity returned to normal after 4-15 days. In comparison, the malnourished pigs had prolonged structural repair and enzyme abnormalities. Further, their glucose stimulated sodium transport did not recover until 10 days after the infection. In this animal model of a major cause of infantile diarrhea, a reciprocal relationship between enteric infections and malnutrition emerges. Acute viral injury to the small intestinal mucosa delayed epithelial repair in malnourished hosts, and led to further reduction in weight gain.
[This study provides evidence for the long-held belief that delayed repair is responsible for the prolonged course of diarrhea in malnourished children. It also gives experimental basis for the clinical observation that ORT is much more difficult, even often fails, in the malnourished child with dehydrating diarrhea.]


There are 4 basic determinants of the appropriate approach to diagnosis and management of acute infectious diarrhea: the frequency and setting of the illness, the recognizable causes or syndromes, the cost, yield and ease of diagnostic tests, and the treatability of the disease. The frequency rate of acute diarrhea throughout the world is high, from one to more than six episodes per person per year, depending on age, location and living conditions. Recognizable pathogens of diarrheal illnesses range widely from viral, bacterial and parasitic agents, thus preventing the cost-effective use of etiologic studies for diagnosis. Diagnostic tests, such as routine stool cultures are not only expensive, but also often ineffective since widely variant pathogens require specialized identification and detection techniques. Despite variant etiologies, the vast majority of acute diarrheal illnesses are most appropriately treated with glucose-electrolyte oral rehydration solutions. Diagnostic and management approaches to acute diarrhea should be significantly enhanced by an improved understanding of the pathophysiology of secretory and inflammatory diarrheal illnesses. Two diagnostic approaches, the routine addition of campylobacter cultures and the selective use of routine fecal cultures for invasive bacterial pathogens, are suggested to improve the cost-effective management of acute infectious diarrhea in the United States or other developed countries.

[With the cost per positive culture exceeding $900 in many developed country circumstances, it should be obvious that taking routine cultures of diarrhea patients is not appropriate in countries where health budgets are limited, especially when cheap oral therapy and time will cure all but a few. Fecal microscopic examination for leukocytes is cheap, and is 77% accurate (according to Guerrant), in identifying patients with Campylobacter jejuni, Shigella or Salmonella; a practical, cost-effective approach when a microscope is available.]


A collection of 4 symposium papers dealing with growth faltering, viral diarrheas, campylobacter and oral rehydration therapy.
"Growth faltering in young children with diarrhea - is it necessary?”, by Andrew M. Tomkins.

The nutritional effect of diarrhea can be minimized through use of oral rehydration, continued breastfeeding and the administration of solid foods as soon as possible. These two factors, ORT plus increased energy intake, could have a major impact on growth faltering in young children in developing countries.

"Some recent advances in viral diarrhoeas”, by T.H. Flewett.

With all four of the more familiar serotypes of rotavirus having been cultured, prospects for developing a vaccine are good. Some new strains of rotavirus, none yet cultured and more difficult to detect by electron microscopy, may be important epidemiologically, but offer little prospect presently of a vaccine.


The incidence of campylobacter enteritis is higher in developing countries without hygiene facilities; diagnosis depends on special laboratory techniques, and transmission is usually by direct and indirect contact with animals. With frequent exposure in early childhood, campylobacter enteritis is an important cause of infant diarrhea and death, but becomes less important in older persons as immunity builds up.

"New developments in oral rehydration”, by Dilip Mahalanabis.

The present WHO recommended oral rehydration formula provides powerful, effective treatment of dehydration. Two recent studies, however, demonstrated that adding amino acid glycine to ORS and using 50g cooked rice powder in the ORS instead of 20g glucose, reduced diarrhea stool volume by 50% and the duration of diarrhea by 30%.

The replacement of sodium bicarbonate with citrate in ORS formulations lengthens shelf-life, provides just as effective results, and may even reduce stool output.


"The potential effects of rotavirus and cholera immunization (with an improved vaccine) on diarrhoea morbidity and mortality among young children are reviewed using data from field studies and theoretical calculations. In developing countries rotavirus may be responsible for about 6% of all diarrhoea episodes and 20% of all diarrhoea deaths in children under 5 years of age. In industrial countries
these proportions may be higher. Rotavirus immunization may reduce overall diarrhoea morbidity rates by 2-3% and diarrhoea mortality rates by 6-10% among children under 5 years of age in developing countries, depending on vaccine efficacy and programme coverage. The impact of improved cholera vaccines depends on the prominence of cholera as a cause of diarrhoea and this varies greatly from country to country. Taking the extreme example of Bangladesh, where cholera is endemic and may account for about 0.4% of all diarrhoea episodes and 8% of all diarrhoea deaths in children under 5 years of age, cholera immunization might reduce overall diarrhoea morbidity rates by 0.06-0.13% and diarrhoea mortality rates by 1-2% among these children. The similar incidence rates in industrial and developing countries suggest that rotavirus diarrhoea may not be controlled by improvements in water supply, sanitation or hygiene. Control may depend upon the widespread use of an effective vaccine". (p. 569)

[This is the 7th in a series of reviews on potential anti-diarrhoea interventions being published by Bulletin WHO.]


Home solutions of simple salt-crude sugar with and without sodium bicarbonate were tested for efficacy and safety in the treatment of severe diarrhoea. 101 children under 2 with acute diarrhea were studied in a randomized double blind trial. After 4 hours of initial intravenous rehydration, 57 children received the salt-sugar solutions without bicarbonate and 44 children received the salt-sugar-soda solution. The oral solution with simple salt and molasses was successful in 72% of the patients, while 60% of the patients receiving the salt-sugar-soda oral solution were successfully rehydrated. The addition of sodium bicarbonate to crude sodium chloride and molasses did not increase the success rate of oral therapy in maintaining hydration. The salt-sugar-soda solution did prevent acidosis and hypokalemia from occurring, even in treatment failures, while the salt-sugar solution did not. In heavily purging cases of diarrhea such as clinical cholera, oral replacement therapy should include all the four electrolyte components as recommended by WHO (sodium, potassium, chloride and bicarbonate). For less severe diarrhea, however, an oral solution without bicarbonate may be as good as an oral solution with bicarbonate.

[This study demonstrates once again that sugar-salt solution (SSS) is not equal in overall efficacy to the complete WHO formula, although it was almost as effective here in maintaining hydration. Here the SSS was prepared accurately; if errors in mixing occur, usually because of incomplete understanding by mothers, additional
problems can be predicted. We still lack clear data on impact of SSS-based programs which allow a manager to choose between the limitations of a packet-based system (less ready access, cost, medicalization) and those of a SSS-based system (mixing errors, less efficacy in heavily purging patients, perhaps a failure to seek medical help when needed). If bicarbonate is available, this study shows its physiologic worth; its addition might increase the rate of dangerous mixing errors, however. Note that potassium deficiency persisted here despite giving food to the patients; a diet with higher potassium content may help to avoid that.]


Thirteen cases of infantile diarrhea with "severe" malabsorption were randomly treated with parenteral or continuous nasogastric elemental enteral therapy. After 39 days, all patients treated with parenteral therapy failed to improve absorption of Dxylose and were subsequently switched to enteral treatment. Enteral therapy was more effective than parenteral in correcting malabsorption, had fewer complications, and required shorter hospitalization, although both were equal in the treatment of malnutrition.

[These findings relate to the benefits of oral rehydration fluid containing glucose versus intravenous rehydration fluid in the treatment of diarrhea, as well as to the effect of early feeding on recovery by the intestine.]


The efficiency of ORT solutions containing 60 and 90 mmol sodium per liter were compared in the treatment of infants and young children with non-cholera infectious diarrhea. Seventeen well-nourished, moderately dehydrated Turkish infants from 3 to 15 months old were administered the oral solution with 60 mmol sodium per liter (ORS$_{60}$). The clinical response and changes in water and salt homeostasis (judged from serum sodium levels, salt and water retention and renal handling of sodium) were compared to results from a previous, similar study of patients rehydrated with a 90 mmol sodium/liter solution (ORS$_{90}$). Of the ORS$_{60}$ patients treated successfully, sodium and water balance was normalized within 36 hours. Those cases with hypernatremia quickly reached normal serum sodium concentration levels with the ORS$_{60}$. Salt and water retention was satisfactory after ORS$_{60}$, although it was less in comparison to retention achieved with ORS$_{90}$. Changes in sodium and potassium excretion in the urine were not as quickly normalized after ORS$_{60}$. 
The authors, as well as I, point out that the treatment protocol here was rather rigid, to allow for the electrolyte studies described. Although in the 90 mmol solution group three patients did develop hypernatremia, compared to none in the 60 mmol group, we note that infants with hypernatremia have been successfully treated using the WHO 90 mmol oral formula. These results should not encourage anyone to stock two or more oral fluid formulas, but rather to use the WHO 90 mmol formula and stress the liberal, oral administration of water (or formula) after initial rehydration.]


"The village of Ban Pong in northeastern Thailand was studied from January through December 1981 to determine the importance of flies as a source of enteric pathogens. The number of flies (predominantly Musca Domestica) increased in kitchens and animal pens in the hot dry spring, when the incidence of diarrhea was highest in the village. Enterotoxigenic Escherichia coli, Shigella spp., non-01 Vibrio cholerae, and Vibrio fluvalis were isolated from fly pools in yards (69%), animal pens (38%), bathrooms (35%), and kitchens (8%). Enterotoxigenic E. coli was isolated from one fly pool in May and from another in June, when the incidence of such infections was highest in the village. Flies often carry and presumably disseminate enteric pathogens in rural Thailand." (p. 32)

[We need controlled studies of fly control measures to determine if they would bear out the obvious implications of this study.]
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Hernborg, Anders. STEVENS-JOHNSON SYNDROME AFTER MASS PROPHYLAXIS WITH SULFADOXINE FOR CHOLERA IN MOZAMBIQUE. Lancet, 9 Nov. 1985, 1072-73.

Discusses serious, potentially fatal side effects of sulfadoxine administered to 65% of the population in Beira, Mozambique as mass prophylaxis to combat an outbreak of cholera. A single 2g dose was administered to adults (except pregnant women), while reduced dosages were provided for children according to age (except infants). Twenty-two of the 149,000 treated individuals (mean age = 25 years) were hospitalized within 3 weeks of the mass drug administration. Besides fever and skin eruptions, mucocutaneous lesions of the mouth and eyes and urogenital ulcerations were observed, consistent with the diagnosis of Stevens-Johnson syndrome. Three of the 22 patients died.

The fatality rate associated with sulfadoxine in Mozambique is similar to reports among U.S. travelers using weekly "Fansidar" (sulfadoxine plus primethamine) with chloroquine for malaria prophylaxis. Sulfadoxine may be hazardous in some cases and therefore should be cautiously prescribed as prophylaxis against malaria in chloroquine resistant countries, as well as against cholera or meningococcal meningitis.
While antibiotic prophylaxis has been shown to be effective in preventing diarrhea, it may have hazards equal to the disease, as this letter describes, and should not be used casually. RSN

Gryboski, Joyce D.; Hillemeir, A. Craig; Grill, Bruce; et al. BISMUTH SUBSALICYLATE IN THE TREATMENT OF CHRONIC DIARRHEA OF CHILDHOOD. American J. Gastroenterology, 1985, vol. 80, no. 11, 871-76.

Bismuth subsalicylate (Pepto-Bismol) is a non-prescription drug which is commonly used in the United States for the treatment of diarrheal diseases, however there have been few controlled studies to determine its efficacy. This double-blind study was designed to address this issue and to determine a safe and effective dosage for infants and children.

Twenty-nine infants and children aged 2-70 months with chronic diarrhea (duration longer than 6 weeks) were randomly assigned to receive either a bismuth subsalicylate liquid or placebo during a 7 day period. Results indicated that the bismuth subsalicylate group gained significantly more weight and had significantly fewer and firmer stools with less water content than the placebo group. Response to treatment was rated moderate to excellent in 86% of the bismuth subsalicylate-treated group.

Chronic diarrhea is a cause of malnutrition and eventual death in many children in developing countries. This careful study shows the efficacy of bismuth subsalicylate in helping this condition in a developed country study group. What is needed now is a similarly careful, double-blind study showing similar effectiveness in malnourished children with chronic diarrhea in the more contaminated environment of developing countries, and with different local foods.

We should repeat the author's comments that bismuth subsalicylate has not been effective in reducing fluid loss in acute diarrhea in previous studies. Oral rehydration should remain the prime treatment for that condition. RSN


Breath hydrogen tests were used to evaluate lactose absorption and tolerance in 19 North American infants during their convalescence from severe diarrhea. The efficacy of feeding a lactose-containing formula to children with elevated breath H2 levels was studied with regard to effects on growth during this recovery period. Initial results revealed greater intakes and growth rates in the lactose group of infants than in the sucrose group. By the end of the observation period, however, no differences in weight gain were observed.
Results from the study corroborate reports from other studies that breath H₂ concentration after a lactose-containing meal is a poor predictor of tolerance or intolerance. Clinical observations following lactose administration offer more accurate indications of long-term tolerance to a lactose-containing formula.

[This paper suggests again the validity of the old maxim: "Keep your eye on the patient, not the tests." I am also pleased to see that the lactose-fed infants did better; seeming to have more appetite for non-formula parts of their diet. The study is very complex, but seems to corroborate the overall conclusion that clinical tolerance of lactose after diarrhea is often better than the formal lactose tolerance test would suggest. We are not wrong, therefore, to continue to try milk-based formulas in such patients instead of resorting to more expensive "artificial" substitutes. RSN]


"The role of enteropathogenic Escherichia coli (EPEC) was evaluated in a group of children with endemic diarrhea admitted to Dhaka Shishu Hospital in Dhaka, Bangladesh. EPEC was detected in fecal samples of 23% of 104 cases and 8% of 74 concurrent control children. The most commonly isolated EPEC strains were serogroups 020a, 020c:K61; 020a, 020b:K84; 026:K60; and 018a, 018c:K77. Except for 026:K60, these groups had not been reported from Bangladesh. On testing for enterotoxin production, only two strains (serogroups 026:K60, 018a, and 018c:K77) were enterotoxigenic. None was enteroinvasive as tested in the guinea pig conjunctivitis model. Our study supports the concept that EPEC may be an important cause of endemic diarrhea in Bangladesh." (p. 838)

[The higher rate of EPEC in children with diarrhea in this study may be due to a different home environment of the control group children, perhaps less contaminated. It would be interesting to see if age-matched neighbors of the children with diarrhea had a more identical rate of EPEC recovery. These findings, at any rate, do not change the general recommendation to treat routine acute periatric diarrhea with oral rehydration and not with antibiotics. Similarly, good routine medical care for pediatric diarrhea does not require examining the stools of every child with endemic diarrhea bacteriologically, for EPEC or other pathogens. RSN]

Major advances and developments in rotavirus gastroenteritis are reviewed—detection techniques, immunological methods, epidemiology and clinical manifestation, all of which have led to a considerable increase in the knowledge of rotavirus. Although serotyping has revealed 4 basic subgroups of rotavirus, electrophoretic analysis of RNA patterns indicates different strain divisions. Epidemics can usually not be attributed to any single strain of rotavirus since many different strains exist in a given population even during such epidemics, unlike the situation with influenza virus.

In many studies of diarrhea in children in the developing countries, rotavirus is the most frequently defined associated infection of all age groups (up to 46% of cases, depending on the age group). It can cause especially severe diarrhea in the age group of 6 months to 2 years, resulting more often in dehydration and hospital admission. Investigations of rotavirus transmission suggest a wide range of factors including intrafamilial contacts, hospitals, and asymptomatic carriers (rotavirus serological response but no symptoms). The high number of asymptomatic carriers in many studies indicates the variable pathogenicity of the virus in different hosts, and indicates that the mere presence of rotavirus in the stool of a child with diarrhea does not establish clearly that it is responsible for the child's illness.

In temperate climates, rotavirus infections peak during the winter months, however in tropical countries, there seems to be different patterns of seasonal variation. An experimental oral vaccine has been shown to provide protection against rotavirus diarrhea in a small preliminary study, but cross-protection from a vaccine of one sub-group against other subgroups remains a question. Other viruses are associated with diarrhea besides rotavirus, including Norwalk agent, adenovirus, coronavirus, breda-like virus and astrovirus, and deserve further scientific investigation.

[No editorial comment.]


Fecal specimens collected from 331 patients admitted to 2 hospitals in Calcutta from January 1982 through April 1983 were analyzed for etiologic agents. The etiologic spectrum of these cases of acute diarrhea varied among the different age groups. EPEC, rotavirus, shigella and campylobacter jejuni were the prominent etiologic agents found in children under 5; while v. cholerae El Tor, ETEC and v. parahaemolyticus were the main agents afflicting children older than 5. Contrary to results from other studies, ETEC was more frequently encountered among older children and adults, rather than children.
under 5. This study's observations of EPEC, however, as the major etiologic agent of diarrhea in children under 2, especially in infants under 6 months, confirmed results from other studies.

Among infants under 6 months, no etiologic agents could be detected in 56.3-63.6% of the cases. Comprehensive etiologic studies need therefore to include examinations for other more recently described viral agents.

[It should be stressed here again, as in the rotavirus review, that the presence of a "pathogen" in the stool of a child with diarrhea does not ipso facto establish that pathogen as the cause of the child's diarrhea. A number of children in this study, for example, had more than one pathogen recovered, making it impossible to blame either one for sure. Epidemiologic and longitudinal bacteriologic studies, as well as observation of a rise in antibodies, are necessary to prove etiology in many cases. RSN]
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"The Kingdom of Tonga consists of small, widely scattered islands extending over some 300,000 km of the Pacific Ocean about 2,400 km north-east of New Zealand.

"The study population comprised 60,000 of the 100,000 Tongans living on the largest island, Tongatapu. The island and its neighbors are served by one hospital. The Health Service is free to Tongans.

"Tonga suffers a shortage of medical staff and a high morbidity and mortality from paediatric diarrhoeal disease. In February 1980 a programme was started to train the doctors, medical assistants and village administrators in the correct use of 'Orosol', oral rehydration solution. The effect on morbidity, mortality and admission to hospital over the 6 years 1978-1983 was assessed by the two Paediatricians. In the 3 years prior to the introduction of the scheme there were 66 deaths from gastro-enteritis in children under 5 years compared with 3 in the following 3 years. This is statistically significant (P < 0.001). There was no significant change in hospital perinatal statistics.

"After the epidemic of diarrhoea in August 1981, when the instruction in the use of oral rehydration fluid was deputised to non-medical staff, the state of hydration in children admitted to hospital with diarrhoea greatly improved.
"It is recommended that similar programmes allowing for cultural variations be adopted where diarrhoea is a problem. To curtail rising medical costs, deputising the management to patients and their relatives, by the use of audio-visual aids and other staff, can improve compliance and the efficiency of the service we provide."

[This is what all our ORT/case management programs should be aiming for: both better hospital care and better care at home by parents, with a resulting synergistic effect on mortality rates. RSN]

Hoffman, Stephen L.; Moechtar, M. Asril; Simanjuntak, Cyrus H.; et al.
REHYDRATION AND MAINTENANCE THERAPY OF CHOLERA PATIENTS IN JAKARTA: CITRATE-BASED VERSUS BICARBONATE-BASED ORAL REHYDRATION SALT SOLUTION.
J. Infectious Diseases, December 1985, vol. 152, no. 6, 1159-65.

This study was designed to determine whether the more stable citrate based formula of ORS is a suitable replacement or alternative for the standard World Health Organization bicarbonate based ORS. 130 dehydrated cholera patients aged 3 to 82 years were treated with either citrate ORS or bicarbonate ORS in Infectious Diseases Hospital of Jakarta over a period of 6 months. For the more severely dehydrated patients, rehydration was initiated with IV therapy, and then resumed as soon as possible with ORS alone. ORS was thus examined for its efficacy in both rehydration and maintenance, not just maintenance. Following treatment with either citrate ORS or bicarbonate ORS, it was observed that the citrate ORS resulted in less stool output, less vomiting, more rapid clinical recovery and more rapid rise in content of serum CO2. Failure of oral therapy alone requiring use of intravenous fluids occurred in 23% of citrate patients and 35% of bicarbonate patients. Citrate ORS was thus found to be more effective than bicarbonate ORS in rehydration and maintenance therapy.

[This is an excellent, carefully performed study, made more valuable by the author's decision to maximally stress the capabilities of ORT/ORS by using it for rehydration as well as for maintenance of hydration. The authors emphasize, however, that ORS is not a complete substitute for IV therapy. They note that IVs should be used for severely dehydrated patients on admission (10% dehydration - 79% of their patients) and may be required in some patients with lesser dehydration started intially on oral treatment (29% of their patients started on oral fluids needed subsequent IVs). Both intravenous and oral fluids are needed for a diarrhea treatment that is maximally effective and also cheap, but oral fluids can do more than they are given the chance to do in many hospital settings where IV treatment is administered automatically to every diarrhea patient admitted.
The greater effectiveness of citrate over bicarbonate is very interesting from a theoretical point of view. The authors speculate that it may be due to either actual stimulation of active sodium absorption by citrate (a sort of 'super-ORS' effect) or to the lower osmolality of the citrate solution (221 vs. 241 for the bicarb - a 9% difference). From a practical point of view, however, both are quite effective for treatment, and their differences are clinically slight - only detectable in a study like this one, with careful statistical analysis. RSN]

Khin-Maung-U; Myo-Khin; Nyunt-Nyunt-Wai; et al. CLINICAL TRIAL OF BERBERINE IN ACUTE WATERY DIARRHOEA. British Medical J., 7 December 1985, vol. 291, 1601-5.

Berberine is a traditional antibiotic agent extracted from the roots and bark of the berberry bush. It has been used in antidiarrheal medication in Ayurvedic medicine in India and traditional medicine in China, and has recently been shown to inhibit V. cholerae and E. coli toxin in animals. This clinical trial studied the antisecretory effect of berberine in diarrhea in a random double blind placebo controlled trial of berberine, tetracycline, and berberine and tetracycline. 400 adults admitted to the Infectious Diseases Hospital in Burma with acute watery diarrhea participated in the study.

Tetracycline considerably reduced the volume of diarrhea, frequency of diarrhea motions, and the duration of diarrhea in the 185 patients with cholera. The doses of berberine (100 mg 4X daily), however, did not significantly reduce the excretion of vibrios in stools or produce a clinically significant antisecretory effect. Furthermore, berberine seemed to antagonize vibriostatic action of tetracycline when both tetracycline and berberine were administered. Cholera patients given the drugs combined suffered longer duration of diarrhea, purged stools more often, and required larger volumes of IV fluid than those patients given tetracycline alone. Neither tetracycline nor berberine produced better results over the placebo in the 215 patients with non-cholera diarrhea.

[The basic treatment for diarrhea is fluid therapy, to prevent or reverse dehydration. With adequate hydration ensured by continuing fluid therapy, agents which may shorten the duration of disease, or reduce the volume of stool lost, may be helpful. Tetracycline and some other antibiotics have been shown repeatedly to have such an effect in cholera cases (true cholera caused by infection with Vibrio cholerae), by killing the vibrios. This study demonstrates that berberine does not have a clinically useful effect in such cases. RSN]

115 children in 2 drought stricken areas in Ethiopia were assessed for acute malnutrition by 2 age-independent indicators, weight-for-height and mid upper arm circumference (AC). Weight-for-height has been used as an accurate index of acute malnutrition, defined for children as below 80% of the reference median. For children between 1 and 5 years, AC has been used as a simpler and more rapid method for mass screening. In this study, the author found that the customarily used arm circumference indicators—moderate acute malnutrition registered between 12.5 and 13.5 cm with severe acute malnutrition below 12.5 cm—exaggerated the prevalence rates of acute malnutrition. They therefore proposed new AC cut-off points of 11 and 13 cm to reduce false positive rates, and tested them for sensitivity and specificity by comparison with the standard weight-for-height. The new cut-off points maintained a high sensitivity while increasing the specificity of the test.

[Math this article is included both because of its specific content addressing the important influence of malnutrition on diarrhea, and because it is an excellent example of clear-headed field thinking based on the use to which a test will be put, rather than some theoretical point. Here the usual cut-off points were proving of little value in allocating relief assistance, making weight/height surveys necessary. A little further analysis, not difficult to do, allowed redefinition of the points, and a substantial increase in usefulness of the technique in reaching a field decision. This is 'operations research' at its clear-headed best, and it costs practically nothing — just the time for some additional analysis. RSN]


An analysis of enteric pathogens in Southern Indian children with acute diarrhea, revealed cryptosporidium in fecal samples. 682 study children, all under 3 years, were seen for acute diarrhea and had no history of antibiotic or antiparasitic therapy. The control group consisted of 418 children without infectious diseases or gastrointestinal infections. A 3rd Group of acute diarrhea patients had previously received antibiotics.

The frequency of cryptosporidium was found to be slightly higher in the Group 1 children than in the non-diarrhea controls (13% vs. 9%). It was the only "pathogen" found in a few of the children in groups 1 & 2. Cryptosporidium was present in 25% to 34% of the Group III children, suggesting that antibiotics may create a favorable environment within the intestinal lumen for the colonization of this diarrheal pathogen.
Compared to reports from other developed and developing countries, cryptosporidium was found quite frequently in this study from rural southern India. Though cryptosporidium was found slightly more frequently in patients with acute diarrhea than in the controls, it was rarely the only pathogen detected and there were no clearly defined clinical features. In children under 6 months there was actually a higher frequency of cryptosporidium in the control group than in the same age children in the two groups with diarrhea.

[This study documents the presence of cryptosporidium in the stool of children with diarrhea, but does not establish whether it is in fact the cause of diarrhea in those children. Latin American studies, in contrast, show the lack of a carrier state in asymptomatic children, and the importance of this agent in diarrhea there (4-10% of cases). These authors postulate that otherwise symptomless cryptosporidium colonization may aggravate or prolong diarrhea, particularly in children given antibiotics. From a practical perspective, there is no need based on this study to do diagnostic procedures to detect cryptosporidium in routine cases of diarrhea. No antiparasitic drug has yet been accepted widely as best in this infection. Some reports have indicated that ORT works well in these cases, but IVs may be often required. RSU]


In response to the above cited Mathan, et al. paper, this letter notes that other pathogens besides cryptosporidium have been isolated from a high proportion of normal individuals without diarrhea in developing countries. Such high rates of intestinal pathogens and corresponding high amounts of serum antibodies are unusual in industrialized countries. Repeated exposure to pathogens as well as maternally transferred immunity seem to boost the active immune system against symptomatic infections. More thorough studies are needed to determine if pathogens in symptomless carriers are virulent; and if antibodies to the suspected pathogens are produced following acute diarrheal episodes. The pathogenesis of mixed microbial infections needs to be further examined in quantitative studies.


This study was conducted among rural Indian preschool children to determine whether malnutrition influences the prevalence of diarrhea caused by specific pathogens. 721 children under 5 living in 2 villages near Hyderabad were registered in the 1 year study, and classified into different nutritional grades based on weight for age and diarrheal morbidity. Data on diarrheal morbidity were collected twice a week.
Enteropathogens were identified in only 44% of the stool samples obtained, with E. coli being the most common agent isolated. In those cases where no pathogens were detected, the authors speculated that the patients were suffering from diarrhea of non-infective etiology, like malabsorption. [In the Mathan, et al. paper reviewed in this issue, cryptosporidium enteropathogens were present in children at a very early age, however, the pathogens did not seem to predispose children to episodes of acute diarrhea.] Malnutrition was not found to be associated with increased incidence or duration of diarrhea. Diarrhea episodes in children from all nutritional grades occurred about 1.6 times per year (3.1 episodes/child/year in 6-12 month old children). Severe dehydration and higher isolation rates of diarrhea pathogens occurred more often in the most malnourished grade of children, indicating that although pre-existing malnutrition may not affect the incidence of diarrhea, it does influence the severity of the disease.

[This study is consistent with other research showing that the predominant effect of malnutrition is on diarrheal mortality rather than morbidity. Environmental factors rather than malnutrition seem to be the chief determinants of diarrheal morbidity rates i.e., diarrhea incidence. In contrast to Black's Bangladesh results, however, the malnourished cases here did not have more prolonged diarrhea episodes, but rather more severe ones. More prolonged diarrhea can be attributed to delayed repair of the affected cells in a deficient child. More severe diarrhea might be caused by a difference in pathogens (more of the dehydrating type) or by increased infection of intestinal cells by the pathogen. Colonization of the upper intestine is known to be greater in malnourished children, and in this study more of the Grade III malnourished children had enterotoxigenic E. coli. We can draw no final conclusions, however, and should therefore examine these questions more directly.

From an operational point, this study again emphasizes the importance of linking nutrition intervention with diarrheal disease control programs, to reduce the likelihood of death from a subsequent diarrheal episode. RSN]

Michell, A.R. COMPOSITION OF ORAL REHYDRATION SOLUTIONS. Veterinary Record, 16 November 1985, 535.

This letter criticizes the "bewildering variety" of ORS compositions recommended for the treatment of diarrhea. In mixing instructions many manufacturers apparently fail to specify the electrolyte concentrations administered to the animal in mmol/litre. An example of one recipe recalculated from grams per fluid ounce to mmol/litre revealed a 0.75% dextrose and 27 mmol/litre sodium content [not different from some commercially sold solutions for human use]. This is significantly inferior to oral rehydration solutions developed for treatment of human cholera, which contain about 2% glucose and 100 mmol sodium. The author comments that an ORS solution containing only 27% of the amount
necessary for optimum absorption defeats the purpose of rehydration. A 60kg calf with moderate dehydration treated with this low sodium solution would regain only about 50% of its losses even if 100% was absorbed. For severe dehydration the sodium administered through this ORS composition would provide only about half of the extracellular sodium required for replacement.

This veterinarian makes the point about low sodium oral fluids in a cogent fashion - they just won't replace the sodium losses, even if they are totally absorbed! Food given at the same time as oral fluids will potentially provide some of that sodium (if the food contains salt). The bottom line, however, is to avoid fooling yourself that you are accomplishing something if you are giving a solution too low in sodium. RSN]


Zinc is involved in new tissue synthesis and in cell-mediated immunity. Diarrhea has been found to lower serum zinc levels in infants and children. Children with measles seem to be more susceptible to diarrhea (during and after an attack) and have depressed levels of immunity. This study examined the relationship of decreased zinc levels to measles and diarrhea during the acute and recovery phases.

Three groups of children in Bangladesh aged 6 months to 6 years were measured for serum zinc status. The 25 children in Group 1 had post-measles diarrhea, occurring within 2 weeks of measles infection. Group 2 consisted of 17 children with neither diarrhea or measles. Children with additional complications such as meningitis, pneumonia and high fever, high respiratory rate, etc., were excluded. The findings demonstrate that zinc concentrations were significantly lower among the Group 1 children with a history of measles than in the Group 2 children without. Furthermore, the children suffering from post-measles diarrhea did not show significant improvement in zinc levels even 3 weeks after acute diarrhea, and experienced no weight gain. In contrast, the children from Group 2 revealed sharply improved zinc levels during the recovery stage accompanied by weight gain. Zinc levels were related to plasma protein as well as measles, but were not related to age, duration of diarrhea, or shigellosis.

Low serum zinc levels seen in the acute stage of both groups of children and the recovery stage of the post-measles group may be due to poor nutritional intake, dietary restrictions, intestinal malabsorption and increased gastrointestinal losses. An increased demand for zinc by recovering body tissues, however, may be the primary factor.
[This study offers additional tantalizing data regarding the importance of zinc in susceptibility to diarrhea and the pathogenesis of the more severe and prolonged episodes of diarrhea seen after measles.

It compares children with diarrhea regarding their zinc levels and measles history. What we need now is a study of measles cases comparing zinc levels and subsequent incidence and severity of diarrhea. Would cases with lower zinc levels be more susceptible to diarrhea, holding other nutritional and clinical parameters constant? Or would a cohort of measles cases given zinc have a lower incidence of post-measles diarrhea than non-supplemented measles cases?

Further, what is the pathogenesis of the depressed zinc levels? Are they related to clinical severity of measles? To previous sub-clinical zinc deficiency, or other nutritional deficiency? Realizing that diarrhea is more severe and prolonged in children with malnutrition, what is the role of zinc in that relationship? Would prophylactic zinc administration in high-risk children reduce the incidence of severe, life-threatening diarrhea? These questions need answers from some good field research. RSN]
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The failure to recognize all components of malnutrition has led many health workers to pursue inappropriate preventive measures and to prescribe inappropriate dietary regimens during rehabilitation. In order to maximize catch-up growth, this author emphasizes the need for a doubling of the energy intake, and not just the prescription of protein supplements. Examples are reviewed of foods and combinations of foods which are more adequate sources of both protein and energy required to sustain rapid rates of catch-up growth.
The initial phases of treatment for severe malnutrition can be hazardous if a few days are not allowed for some sort of homeostasis to be established. For the first 4-7 days, the priority should be on correcting fluid and electrolyte imbalances; then on treating infections and vitamin deficiencies; then on administering frequent and small amounts of diluted milk with sugar and oil. Desirable rates of catch-up growth may vary, depending on the circumstances of rehabilitation. The disappearance of edema and recovery of a good appetite after these measures signals that the child is ready for the catch-up growth phase, and can consume and use the large intake of energy and protein needed for such growth.

[Diarrhea is commonly accompanied by failure of growth. During the convalescent period this "lost growth" can be recovered in a catch-up phase similar to that described here, placing the same emphasis on energy intake (fats and carbohydrates) as described in this editorial. The message is particularly relevant since malnourished children have more severe diarrhea and thus are more likely to encounter the medical system than well-nourished children with diarrhea. Diarrhea control programs therefore must be prepared for the diarrhea cases requiring nutritional rehabilitation. RSN]


Loperamide was compared with a placebo in the treatment of 112 adults with acute infectious diarrhea. There were no significant differences during the diarrheal episodes in the number of loose stools on the first day of treatment, or in the total number of tablets taken, between the loperamide and placebo groups. Although fewer loose stools were observed in the loperamide initiated patients during the 5 day treatment period, this statistical difference presents little clinical importance. Furthermore, the duration of pathogen excretion was not significantly different between the loperamide or placebo treated patients. The authors conclude that the drug loperamide has little or no clinical effect on the recovery of patients with acute diarrhea. Rather, the diarrheal episodes are usually benign and quickly self-limiting when properly managed by rehydration and dietary restrictions.

[for editorial comment, see below.]

219 U.S. students in 7 Latin American countries were treated for acute non-dysenteric travelers' diarrhea with either loperamide hydrochloride or bismuth subsalicylate (Pepto-Bismol). Compared to bismuth subsalicylate, the loperamide therapy was associated with a greater reduction in the number of loose stools during treatment of diarrhea due to ETEC, Shigella sp., other pathogens or no identifiable agent. Shigellosis induced diarrhea did not seem to be prolonged by the loperamide treatment. Loperamide is concluded to be a safe and effective alternative to bismuth subsalicylate for the treatment of non-dysenteric travelers' diarrhea.

[Loperamide is one of the most popular antidiarrheals, and therefore competes with ORS in the budgets of many health ministries as well as on the prescriptions given to many patients treated by private physicians. The Bergstrom et al. study, which showed no useful effect of the drug, was carried out in a developed country with adults whose diarrheal illnesses were mild and brief. The Johnson et al. report studied adults in a developing country with a higher proportion of ETEC and Shigella compared to the Swedish group studied by Bergstrom et al. The fact that loperamide had a clearly demonstrable effect in the first 24 hours compared to bismuth subsalicylate is striking, as bismuth had been shown previously to reduce diarrhea in a similar group by 50%. Equally interesting is that the shigellosis cases were not exacerbated or prolonged by loperamide, as had occurred in an earlier study with diphenoxylate, a related drug. More of the shigellosis patients getting loperamide did receive antibiotics than the bismuth shigellosis patients, however dysentery patients were excluded from the study. This weakens the conclusion that loperamide is safe in shigellosis.

Should loperamide be recommended for pediatric diarrhea? No, is the clear answer. To quote the manufacturer's package insert, "IMODIUM should be used with special caution in young children because of the greater variability of response in this age group. Dehydration, particularly in younger children, may further influence the variability of response to IMODIUM." (Physician's Desk Reference, 39th edition, 1985, p.1033.) At least on the basis of present information, loperamide cannot be recommended for use in young children, the most important age group for ORT efforts. We must look toward super-ORS as the agent with the most promise of safely reducing stool output, frequency, and duration.

Overall we can conclude that loperamide has had mixed results in different groups of adult diarrhea patients, and needs additional controlled research. Pediatric usage is risky and should be avoided; ORT is the treatment of choice for pediatric diarrhea. RSN]

(no abstract; see below for editorial comment.)


(no abstract; see below for editorial comment.)

[Here are two more papers about Cryptosporidium diarrhea. The evidence is increasing as this agent is specifically sought; perhaps it will turn out to be even more important than Giardia as a parasitic cause of diarrhea. Overall, however, parasites remain a minor cause of diarrhea in most parts of the world. RSN]


A new assay for the detection of heat-labile toxin producing Escherichia coli is described. This membrane filter assay isolates bacteria on to a cellulose-acetate membrane filter, which is then incubated overnight on an agar medium containing anti-cholera toxin. The assay compares favorably with results of both ELISA and DNA-DNA hybridization assays. It does not require pooling of bacterial colonies, preparation of culture supernatants, or radiolabelling. Requirements for reagents, media and laboratory facilities were simple. The membrane filter assay could become an important technique for the study of ETEC transmission and epidemiology.

[This technique should make study of the epidemiology of ETEC possible in facilities and with budgets much simpler than now. A useful advance. RSN]
This month's bibliographical listing consists of only 2 annotated articles. Our technical editor, Dr. Robert Northrup, felt that the extremely significant findings by these two studies warranted more detailed review and commentary than usual. Editor's comments are appended in brackets.

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Data on diarrheal morbidity and mortality rates were collected during a period of 20 months among 1467 children in a rural community of Haryana, India. Diarrheal attack rate was 68 episodes/100 children/year, and was not higher in malnourished children. As many as 23 diarrhea related deaths were recorded during a total of 1663 diarrhea episodes. ORS was used in 34.4% of the diarrheal attacks, while sugar-salt solution was used in 4.3%.

Although the incidences of diarrhea were similar in different nutrition groups, higher mortality was associated with severe malnutrition. 66.7% of the malnourished died from diarrhea during the first year of life, compared to a 35.1% diarrhea mortality rate among the normal children.
Mortality was higher in protracted diarrhea than when diarrheal duration was less than 2 weeks. Only 35% of the diarrhea-related deaths occurred in less than 7 days after the onset of diarrhea; diarrhea had persisted for 2 to 8 weeks prior to death in 39%, and for over 3 months in 13%. Half of the deaths were in grade II or III malnourished children.

Six of the deaths were admitted to hospitals; 2 of these died later at home after receiving IV fluids, being discharged with no ORT instruction, and having recurrent dehydration leading to death the next day at home. Poor nutritional status and delayed recovery from acute diarrhea, as well as non-use of ORT, were the important factors associated with diarrhea mortality in this rural community.

[These data emphasize the central importance of good nutritional management of diarrhea cases, especially the malnourished. Nine of the 22 who died had been treated by private practicing physicians. This reemphasizes the importance of including this group in training programs, as well as Ministry of Health physicians. RSN]


Initial Egyptian efforts to promote ORT nationally relied on a prepackaged Oralyte approach, which was unsuccessful for the following reasons:

- poor ORT knowledge among doctors and paramedical staff;
- no ORT knowledge among the population;
- low utilization of health services, particularly for diarrhea;
- inadequate ORS supply; and
- poor access to ORS (it was a prescription-only item, available only from pharmacies and medical units).

In an effort to examine alternative approaches, a six-month intervention program and study (the "Strengthening Rural Health Delivery" Project) was launched in 1980 in 28 villages, with a total population of 190,000 and an under-five population of 29,000. The study population was divided into 6 groups, as follows:

1. Control group 1 - no interventions.
2. Control group 2 - Oralyte was made available to all health facilities; doctors were made aware of ORT and instructed in appropriate referral, but no special training was given.
3. Group 3 - Oralyte was distributed to homes and mothers trained in its use.
4. Group 4 - Oralyte was provided to commercial establishments to sell at a nominal price and mothers were informed of its availability and cost.

5. Group 5 - Mothers were instructed in the preparation and use of sugar-salt solutions and encouraged to give potassium-rich foods.

6. Group 6 - Prepackaged sucrose and salt was distributed to homes and mothers trained in its use.

The results showed significant differences among the groups in the percentage of children presenting to a health facility with dehydration. The percentage was lowest in groups 6 (2%), 3 (11%), and 5 (11%), and highest for groups 2 and 4 (21% and 23% respectively), suggesting that home-based therapy was effective in preventing dehydration.

The major part of the results presented focused on the mortality impact of ORT provided through various channels and compared ORS and sugar-salt solutions. There was a marked decrease in child (1 month - 5 years) mortality during the study period compared with the period May 1976 - October 1979, in all three of the home-based ORT groups (groups 3, 5 and 6); these groups also had significantly lower diarrhea-specific mortality rates than groups 1, 2 and 4. A review of the fatal cases revealed that 90% received either no ORT or insufficient amounts.

An economic analysis of the alternative interventions suggested that rehydration with sugar-salt solution by mothers backed by ORS administered by health providers, is a cheaper, yet just as effective, means of preventing diarrhea mortality than the use of ORS packets alone.

The authors concluded that solutions prepared with ordinary household salt and sugar, together with a food source of potassium, may act as an alternative to, or temporary replacement of, the more costly and less readily-available ORS packets. The authors did not advocate the substitution of ORS by these home solutions, but rather their complementary use. Maternal involvement, retraining of health staff, methodical and regular supervision, and good logistics were emphasized as key factors in the success of the project (i.e., mortality reduction). It is notable that this success was achieved by a project which depended entirely on local infrastructure, with the help of a single expert advisor.

[It is unfortunate that some of the results from this study were presented rather too sketchily to permit their full interpretation. However, the study provides a number of useful messages—on the efficacy of sugar-salt solutions, the relationship between accessibility and use of ORT, and the importance of education and training with a focus on mothers.

We were pleased to see this study since there are not many studies which examine the impact of the use of sugar-salt solutions on diarrhea mortality. Importantly, this study reveals that the early treatment of diarrhea with a sugar-salt solution, prepared by mothers, can be an effective intervention for the prevention of dehydration and reduction of diarrhea mortality.

-3-
Recent data from several countries have highlighted errors in the preparation of sugar-salt solutions, resulting in alarmingly high sodium concentrations in the administered fluids. These findings have prompted a rethinking of the use of sugar-salt solutions. The sugar-salt solutions in this study (Groups 5 and 6), were designed to yield solutions with sodium concentrations less than the 90 mmol/liter of the WHO formula (i.e., 40-60 mmol/liter) to minimize the effect of mixing errors. Although the sodium concentrations in the home-prepared sugar-salt solutions were not measured, the low prevalence of convulsions in referred patients suggests that mothers were not mixing solutions with overly high sodium.\[1\] This suggests that one way around the problem of mixing errors is to lower the suggested sodium concentrations in home-based solutions to a level which provides a safe margin of error while still maintaining the effectiveness of the solution. WHO has in fact recently recommended that sugar-salt solutions be prepared to give sodium concentrations in the range of 30-80 mmol/liter.

Another alternative, investigated in this study, is to provide homes with prepackaged sugar and salt, thus reducing the number of errors which can occur in mixing. The study found that the cost per death averted with this option was slightly higher than with home distribution of ORS packets, thus offering no advantage. More work is needed to examine the safety and effectiveness of these and other ORT alternatives in a variety of geographical and cultural settings.

This study also gives food for thought on the issue of ORT availability and use. It is well documented that ORS, if properly used, is very effective in reducing diarrhea mortality. The fact that the diarrhea mortality reduction in the home-distributed ORS group (and, in fact the other home-based ORT groups) was greater than for the groups in which ORS was not so close to hand, suggests that ORS was not as frequently used to treat diarrhea when mothers had to travel to get it. The message here is that for ORT programs to be maximally effective, they must improve accessibility, with inclusion of a home-based component.

Finally, this study highlights the importance of adequate training, not only on when to use ORT, but also how (i.e., how to prepare it and how much to give). The authors rightly point to mothers as being the key to successful ORT programs. A mass media approach to ORT promotion and education has been used successfully in a number of ORT programs and is gaining in popularity. The project reported here successfully used direct one-to-one instruction of mothers to promote ORT messages, reminding us that face-to-face contact can be a very effective communication strategy. RSN & DB]

\[1\] The presence or absence of edema is not a useful indicator of the presence or absence of hypernatremia, contrary to a statement made by the authors.
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**COMMENTARY:** A comment from one of our readers concerning the Kielmann, et al. article reviewed in the last July issue (Vol. 1, No. 5, CONTROL OF DEATHS FROM DIARRHEAL DISEASE IN RURAL COMMUNITIES, Tropical Medical Parasitology, 1985, Vol. 36, 191-98), indicated that Kielmann's determination to find equivalency between packets vs. salt/sugar neglected to emphasize the overall impact of ORS. The number of deaths averted in the salt/sugar cell, combined with the number of cases rehydrated with the WHO formula in clinics, reveals a "magnificent", 50% overall reduction in mortality due to the administration of some form of ORS. (EJJ)

Berezin, Stuart. **PROLONGED MILD DIARRHEA CAUSED BY CAMPYLOBACTER.** New York State J. Medicine, January 1986, 29.

In contrast to other reported campylobacter infections which are usually self-limited and resolved in less than 2 weeks, this report describes the case of an 11 month girl with persistent mild diarrhea caused by Campylobacter jejuni that lasted for 3 months. The most common symptoms associated with Campylobacter include fever, diarrhea,
bloody stools, abdominal pain and vomiting. The symptoms of this patient, however, were compatible with chronic, non-specific diarrhea of infancy. The client had 2-6 loose non-bloody stools per day; no abdominal pain, and normal weight gain. Although a high fat diet was initiated (an appropriate measure to combat chronic non-specific diarrhea), treatment was switched to erythromycin after stool cultures revealed Campylobacter pathogens. During the 7 day treatment with erythromycin, the diarrhea stopped and never recurred for the next year. Campylobacter thus may cause chronic diarrhea in infants. In such cases, stool cultures are useful for determining appropriate treatment after customary management is unsuccessful.

[In the usual acute case of diarrhea, cultures continue to be unnecessary, indeed wasteful, and should be reserved for cases with dysentery or more prolonged disease, such as this one. RSN]


(no abstract; see below for editorial comment.)

[This article is one of many in the literature on diarrhea coming from developed countries. Persistent diarrhea (duration more than 14 days) associated with malabsorption of common nutrients is a larger concern of pediatricians in developed countries than in developing countries, where such cases are proportionately rare among the flood of acute, usually self-limited diarrheas. The article describes the complex adjusting of nutrient intake required to get these intestines to function more normally. Such nutrient tinkering is expensive, the diets being beyond the reach of all but the wealthiest families in developing countries. ORT is not the answer to these chronic diarrheas, either. More research will be necessary to define appropriate technologies to deal with these problems in developing countries. RSN]


This letter reemphasizes the effectiveness of orally administered glucose electrolyte solution for rehydration as well as maintenance; many Western institutions unfortunately rehydrate dehydrated children almost exclusively with intravenous fluids and persist in "resting the bowel", despite evidence that recovery is hastened by oral hydration and prompt resumption of feeding. The referred paper (see summary below; Tamar et al., ORT OF INFANTS IN A LARGE URBAN U.S. MEDICAL CENTER, J. Pediatrics, July 1985, 14-19), presents evidence that should help convince U.S. pediatricians to use oral fluid therapy more extensively. Mention is made of the new reformulated Pedialyte that contains 2.5% dextrose, 45 mEq/L sodium, 20 mEq/L potassium, 35 mEq/L chloride, and 30 mEq/L citrate.*
*The most recent formulation of Pedialyte by Ross Laboratories in Columbus, Ohio (as of August 1986), contains 45 mEq/L sodium, 20 mEq/L potassium, 35 mEq/L chloride, 30 mEq/L citrate, and 25 gm/L dextrose. Pedialyte is distributed mostly to pharmacies in the U.S.


100 well-nourished infants with dehydration and acidosis caused by acute gastroenteritis were randomly assigned to receive either standard intravenous therapy or oral rehydration. The randomized study was carried out at the Jackson Memorial Hospital in Miami, Florida, from 1981 to 1983. Two ORS solutions were administered consecutively, first solution A, with a higher sodium level (75 mEq/L), higher chloride (75 mEq/L) and lower glucose (2 mg/dl) than the B solution. Solution A was followed six hours later by solution B, containing 50 mEq/L sodium, 30 mEq/L potassium, 50 mEq/L chloride, 30 mEq/L bicarbonate and 3mg/dl glucose. In all but 3 cases (6%), oral rehydration was comparable to the IV therapy with regard to clinical improvement, but superior in terms of faster correction of acidosis and sustained rise in serum potassium concentrations.

Potassium was given from the beginning of oral rehydration at a higher concentration than recommended by WHO, yet no hyperkalemia occurred. Authors conclude that oral rehydration therapy is safe, less expensive for patients and more convenient.


(no abstract; see below for editorial comment.)

[Dr. Pizarro stresses two critical elements in this review of oral fluid (ORS) treatment of diarrhea and dehydration in neonates: (1) the importance of including free water along with ORS (either from the beginning of treatment, or starting after initial rehydration); and (2) the importance of careful monitoring of the volumes of fluid being given, being consumed, and coming out as diarrhea and urine, as well as monitoring of the clinical state of the patient. Using this approach, Pizarro has had great success in treating both hyponatremic and hypernatremic cases of diarrhea with ORS in tiny infants, with very low rates of complications. He cites reports including infants of 2 days of age, of only 1050 grams (2/5 of normal birthweight), with blood sodium concentrations as low as 93 mmol/L and as high as 181 mmol/L, and with severe acidosis. Many of the reports he cites show rates of complications (e.g. convulsions) lower in ORS treated cases than in IV treated cases. RSN]
Most urban hospitals in China, especially teaching hospitals, routinely use IV fluids to treat diarrhea. Barefoot doctors, however, have been using a simple sugar and salt oral rehydration solution for more than 20 years. Surveys in 5 rural counties in China also revealed that 34% of mothers said they use ORS. Apparently widespread use of oral rehydration in rural areas was promoted as far back as the late 1950's, directly with the rural services rather than through teaching hospitals. Previous health surveys in China have revealed high morbidity, but low mortality from diarrheal diseases. Acceptance of oral rehydration seems facilitated by beliefs in traditional Chinese medicine which often include carbohydrates. Rice water and porridge are also widely used to treat diarrhea, therefore a cultural base for new efforts to introduce improved cereal-based ORT solutions exists. Field studies are needed to extend home use of traditional solutions made from rice, carrots, and other carbohydrate and amino acid sources. The major problem to be immediately dealt with is imprecise measurement of ingredients for the oral solution.

[There is currently debate in ORT circles as to whether diarrhea control programs should start within the health system, training doctors and setting up hospital-based ORT units first, or should concentrate on the community and consumer, with training for village health workers and public education programs (especially mass media) for mothers. China's experience suggests that the outreach emphasis can be successful in increasing utilization without much change in the treatment methods used by physicians. Where limited resources demand a choice between the two approaches, the Chinese approach provides an example from a society where health professionals have not had total control over health services policy. The problem of inaccurate mixing reported here is widespread, and is a major concern of WHO at present. RSN]


Growth monitoring should be adopted as an integral component of primary health care, since (according to Morely, UNICEF State of the World's Children, 1984, Oxford, Oxford University Press, 1983) it can provide early detection of malnutrition, advise on the timing of supplementary feeding, indicate children at high risk of malnutrition, improve health education and mother's participation, and provide epidemiological studies on undernutrition. Warnings from various reports on the Integrated Child Development Services (ICDS) scheme in India, cited in this editorial, have been directed against improper use of growth charts by health workers. The weighing-scales themselves are not always accurate, since they are often not standardized, and there is also a high percentage of errors on the part of health workers in charting weights - up to 80%. Mother's participation in weighing their children is low, since they have failed to relate weight to their children's health. Health workers have also been found to not appreciate the importance of weighing. An
alternate 2-pronged strategy to growth monitoring is suggested which includes initial screening by mid-arm circumference measurement and then referral to clinics for weighing.

The author urges careful examination of this approach to growth monitoring, while at the same time noting the importance of field workers, their selection, training, and supervision, to the success of any system.


These letters were written in response to an editorial "GROWTH MONITORING: INTERMEDIATE TECHNOLOGY OR EXPENSIVE LUXURY?", which appeared in Lancet, 14 December 1985, 1337-38 (see below for summary).

Dixon, R.A.: Addresses the need raised in the December 14 editorial for cheap, light and accurate weighing devices and describes a $10 TALC device weighing less than 2 kg. Also suggests that the arm circumference measurement technique needs to be compared with the TALC device to determine its accuracy as a screening technique for malnutrition.

Morley, David: On the basis of his experience, Morley notes the problems of health workers from developing countries in interpreting graphic information. The introduction of growth charts, therefore, requires careful education by educationalists (rather than by doctors) in order to ensure accurate, meaningful interpretation.

Shears, Paul: Suggests that there is evidence that the other 3 components of COBI (oral rehydration, breastfeeding, immunization) may also be having limited impact, similar to the dubious impact of growth charts on alleviating malnutrition. Questions the "package approach" of various primary health care interventions, and suggests a more selective target-oriented approach to primary health care improvements.

Lennox, Christopher E.: Stresses the importance of accurate statistical recording required for accurate assessment of improvements in child health. Serious errors in statistical reporting from child health clinics can result in misleading malnutrition rates.


This article summarizes current views on the use of drugs to treat acute diarrhea and dysentery in infants and small children. The three important forms of diarrhea discussed are acute watery diarrhea (stools are soft or liquid, but are not bloody), dysentery (stools contain blood and mucus), and persistent diarrhea (diarrhea that begins acutely, but lasts more than 21 days). The most serious complications of acute diarrhea are dehydration and tissue catabolism (which contributes to malnutrition, especially when food is withheld).
At least 90% of all episodes of watery diarrhea presenting at health facilities can be managed by oral rehydration therapy alone, while an even higher proportion of cases occurring at home can successfully be treated this way. Only patients with serious dehydration (less than 1%), as in cholera, require initial intravenous rehydration. Dietary intake, including breast milk, should continue in all cases. Antibiotics are primarily effective in cholera and dysentery, and antiparasitic agents are used for *G. lamblia* and *E. hystolitica*. Among the many other treatments intended to diminish stool volume and shorten illness, none has been found safe enough nor sufficiently effective to be used routinely with infants and young children. The most effective and safest "antidiarrheal" drug may be an improved ORS solution containing glycine and glucose, for example. These have been shown to promote reabsorption of secreted intestinal fluids, thus causing a reduction in stool volume and duration of diarrhea of as much as 50% over standard ORS solution. Similar results have been found in using cooked rice powder as an ingredient of ORS. Other solutions, cereal based or containing maltodextrins rather than glucose, are being investigated.

No antibiotic or chemotherapeutic agent has proven value for the routine treatment of acute diarrhoea, and their use is potentially dangerous. The practice of treating episodes of diarrhea with multiple adjunct agents and antibiotics, sometimes as combination drugs, is to be deplored. "...antimotility and antisecretory agents, exogenous aciduric flora and adsorbents have no practical value and increase both the cost of treatment and the risk of adverse reactions. Oral rehydration therapy is the only proven cost-effective method of treating diarrhea, and the economic savings from treating the disease in this way can be considerable."
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El-Mougi, Mahmoud; El-Akkad, Nayerra; El-Hadi Eman, Mohamed; et al. EVALUATION OF A PROGRAMME OF TEACHING MOTHERS THE MANAGEMENT OF ACUTE DIARRHOEA. J. Tropical Pediatrics, February 1986, vol. 32, 24-25.

The Diarrhoeal Disease Research and Rehydration Center (DDRRC) at Bab El-Sharrey University Hospital in Egypt conducted a study to assess the effectiveness of teaching mothers to change their knowledge and attitudes concerning the treatment of diarrheal dehydration. 1000 mothers were trained how to diagnose dehydration, how to mix and administer ORS correctly, and what to feed their children during diarrhea. During the 1-2 hour training sessions, each group of 10 mothers was taught correct procedures for preparing ORS by a physician, and suitable feeding practices during diarrhea by a nurse (e.g., feeding mashed potatoes and starch gruel in addition to breastfeeding). After each step for preparing ORS had been demonstrated and then performed by the mothers, the physicians repeated the steps with deliberate mistakes (e.g. using only half the amount of water). The mothers were encouraged to point out the errors and then asked to prepare the ORS once again, correctly. Throughout this process, praise by the physician for correct preparation reinforced the mother’s motivation and interest.
3-7 months later, 100 randomly chosen mothers who had participated in the training sessions were visited at home and questioned about their use, preparation, etc. of ORS. 100 close neighbors identified by the mothers were also interviewed to determine their knowledge of ORS. Results of the questionnaires were compared with a control group of 100 mothers from other villages. 98% of the trained mothers and 41% of the close neighbors used ORS for diarrhea. 87% of the trained mothers and 20% of the neighbors knew how to mix the solution correctly, compared to only 3% among the controls. The 13 trained mothers who failed to mix correct ORS made mistakes concerning the size of the cup, and consequently prepared solutions with a high sodium concentration. Special 200 ml plastic cups (produced by the National Diarrhoeal Disease Control Project) were subsequently distributed to alleviate this risk.

With proper instruction and correct teaching methods, mothers will retain instructions concerning the proper management of diarrhea. By commencing treatment of diarrheal dehydration in the home, the mother thus appropriately becomes the central figure in the management of dehydration.

[Editorial Comment: This is an exciting report which shows the kind of results education can provide when some attention and imagination are applied, and mothers are further motivated by receiving a certificate. The excellent results show how well this aggressive, interactive approach works.

The BRAC experience in Bangladesh obtained similar levels of capability by the mothers, but much lower use rates. Is that because television messages in Egypt constantly reinforced the interpersonal messages given in the clinic? The investigators did not control for ownership of TV sets in their analysis. Controlling for TV exposure would have helped strengthen the authors' conclusions that the neighbors learned the methods from the study subjects and not from TV.

The report shows that a very intensive approach (1-2 hours, with teaching by doctors and nurses) works. Would it have worked equally well if health educators or even aides had done the teaching? Will distribution of a special 200 ml plastic cup reduce the error rate? Would a group not given certificates perform equally well? These are just a few of the possible questions aimed at techniques of teaching which are critical for effective use of ORT by mothers. Why is it, then, that we have endless studies on slight variations in sodium concentration or carbohydrate type in the oral fluid, but hardly any like this one on techniques in teaching? RSN]


Sixty-five infants from Finland, most over the age of 1 year (mean 14.7 months), with up to 15% diarrheal dehydration caused mainly by rotavirus (71%), were treated for 6-10 hours with ORT followed immediately by reintroduction of full feedings appropriate for age. Thirty-eight of the infants received cow's
milk and milk products in addition to ordinary mixed diets (e.g. broth, soup, mashed vegetables, potato, meats, banana, etc.). The diets of the remaining 27 infants contained no milk.

In both groups 600-1100 calories were consumed in the first 18 hours. Clinical and laboratory evaluations of infants on milk-free diets compared to infants on milk-containing diets revealed no statistically significant difference with regard to duration of diarrhea (1.3 days vs. 1.2 days), length of hospitalization (mean = 3 days), weight gain, or acid base and serum electrolyte balances, both during and after the diarrheal episodes. With respect to the potential danger of developing allergy due to increased exposure to antigens through a damaged intestinal epithelium, there was no increase in prevalence of atopic eczema, total IgE serum levels, milk specific IgE antibody, or serum IgG and IgA antibodies to lactoglobulin and casein in the milk-fed group as opposed to the group not receiving milk. There was slightly more vomiting noted in the milk diet group with 9 of the 38 milk-fed children experiencing more than 2 episodes of vomiting, compared to 3 of 27 children in the no-milk group.

[Editorial Comment: The debilitating malnutrition-diarrhea cycle found in children throughout developing countries emphasizes the need for appropriate feeding regimens during and after diarrheal episodes. Full feedings are beneficial because they not only enhance the absorption of fluids in the presence of macromolecules from digested foods, but also maintain and correct nutritional status. The benefits of this approach even in well-nourished children have been reported by these authors, who have noted that diarrhea is shorter in children handled with rapid feeding than in those where feeding was gradually resumed.

Critics have argued particularly about milk. The wisdom of including milk in refeeding has been of particular concern for two reasons. First is the possibility of malabsorption of lactose leading to osmotic diarrhea as a complication of the original infectious diarrhea. Second is the possibility of increased risk of developing allergy to milk proteins during a period of increased permeability of the epithelium, which in turn would lead to increased diarrheal episodes later. Adverse effects of milk feeding in diarrhea, however, have not been apparent in most clinical reports, and this study similarly shows no apparent danger from including milk.

In short, the old adage about "resting the gut" during and after diarrhea has increasingly been demonstrated to be unfounded. This report further documents that. RSN]
The oral solution administered was a modified WHO formula containing 60 mEq/L sodium, as well as potassium, chloride, citrate, and both glucose and fructose. Of the 15 patients treated with ORT, 13 were successfully rehydrated as outpatients. The other 2 required hospitalization and parenteral therapy as a result of persistent vomiting. Both were subsequently found to also have urinary tract infections. One patient in the ORT group did receive initial intravenous treatment to restore his fluid volume, after which he was treated orally. All 14 patients treated intravenously were successfully rehydrated, 7 as outpatients in the holding room and 7 as inpatients.

The ORT outpatients spent a mean of 10.7 hours in the holding room, while the intravenously rehydrated inpatients were hospitalized for a mean of 103.2 hours. The cost for treating outpatients with ORT ($272.78) was significantly less than the cost for treating inpatients with intravenous therapy ($2,299.50). Thus, oral rehydration was found to be safe and cost-effective for treating dehydrated children in an outpatient setting in the U.S. The use of a holding room also demonstrated cost savings even when IVs were used, and prevented unnecessary hospitalization.

The companion editorial* supports the conclusion that the oral approach is equivalent medically in most patients, and is substantially cheaper as well. It also avoids hospitalization with its psychological disturbances and disruption of family routines. *(Fulginiti, Vincent A. EFFICACY AND COST CONTAINMENT: INSEPARABLE FACTORS IN DIAGNOSTIC AND THERAPEUTIC DECISIONS. American J. Diseases in Childhood, March 1986, vol. 140, 199-200.)

[Editorial Comment: This report is like the old "good news...bad news" situation. The good news is that the efficacy of ORT is at last being recognized by major academic pediatric departments in the United States, and they are beginning to support its use even for patients who can pay hospital costs! The bad news is that the investigators withheld food and milk from the patients, automatically assigned patients with greater than 10% dehydration to initial intravenous treatment even if they could drink, and never even measured the duration of diarrhea, stool volume, or any other indicator that might have shown that the ORT treated patients did better than the IV treated patients.

A recent report from Finland mentioned that patients given ORT were easier to feed early in their care; a larger proportion of IV treated patients rejected food, i.e., their mothers had a hard time getting them to eat. They therefore lost weight during their hospitalization.

Since ORT is not just fluid treatment, but in fact fluids and food, along with referral from home to medical care when necessary, cases treated in that fashion compared to those treated with the standard IV approach described by these authors would probably show not only a difference in the cost of treatment, but also much better results in terms of decreased morbidity for the child.
If the mothers are taught about ORT they might avoid dehydration occurring in a future episode of diarrhea as well. Food plus oral fluids might cut down on the 8-12 hours that the authors held the patients in the emergency holding room. We need studies of that sort in the U.S. as well.

Also, the lessons from the developing world with regard to initial treatment of dehydrated patients could well be applied in the U.S. Many patients with greater than 100 ml/kg weight loss are well able to drink, and can be rehydrated orally. Careful observation can assure their safety, particularly when IVs are readily available, while the use of the oral route will avoid the dangers of overhydration. Other benefits of the oral approach include treating hypernatremia and hyponatremia as reported by Pizzaro and others. In contrast to the authors' statement, the routine approach in well-run diarrhea treatment units in developing countries is not to rehydrate the child with greater than 10% dehydration exclusively with IVs, but rather to begin immediately with oral fluids in all children who can drink. IVs are reserved for those whose progress is unsatisfactory, or who cannot drink.

Further studies such as this one, in groups of more than 24 patients, and in academic centers in the U.S. and Europe, can lead to wholehearted adoption of ORT in the centers which train so many young physicians from developing countries and influence their thinking and treatment techniques. RSN


Diarrhea continued to be the leading cause of childhood deaths in a southern Indian rural community, despite the establishment in 1977 of a comprehensive community-based health program. In 1983, a KAP survey of mothers indicated that 87% did not know what caused diarrhea, 48% did not understand dehydration, and 43% administered less fluids during diarrhea. Subsequent efforts by community health volunteers to educate parents about the causes of diarrhea, proper prevention and management in the home and the use of simple home-made ORS for treatment were evaluated in this study.

210 mothers were interviewed of which 90 had had children with diarrhea during the preceding 6 months, of these 62% had begun treatment at home with ORS. 75% were able to prepare the ORS correctly, however, few knew how much ORS should be administered and only 9% knew that ORS worked by replacing salt and water losses. Attitudes about feeding during diarrhea had changed: 91% said it was not harmful to continue breastfeeding, and 90% would offer food. Traditional attitudes and practices concerning the management of diarrhea did change in this community, even though traditional reasoning about the causes of diarrhea and dehydration were not so easily affected. The reported number of diarrheal cases and diarrheal deaths have declined since the inception of the community health volunteer campaign to educate mothers about ORT.
[Editorial Comment: It would be wonderful to conclude from this report that a CHV-run mother education program had indeed cut diarrhea deaths in half. Unfortunately, a number of deficiencies in the study methods make it unconvincing to draw this conclusion from the data presented.

First, the proportion of 5-year-olds with diarrhea during the past six months was only 90 of 210 interviewed, a remarkably low figure in most poor, rural populations of this sort. Also, we note that the number of cases of diarrhea has fallen dramatically. Why has the incidence fallen, since we know that ORT generally is not considered to be a preventive measure for diarrhea?

The answer is perhaps in community development in the RUHSA project, perhaps better availability of water or sanitation, perhaps a higher incidence of breastfeeding. Whatever the cause, the case fatality rate from diarrhea actually rose slightly (from 4.5% in 1982, 3.3% in 1983, to 5.19% in 1984). Neither the reporting mechanism for deaths nor the method of defining diarrhea deaths or cases is described in the paper, so the quality of even this data is not known.

In short, while the result is positive, it is hard to accept that it is due solely to the rise in ORT usage and other desirable behavioral changes seen in the survey. The survey's methods are inconclusive, having used 6 months as the recall period. Can anyone remember accurately what they did for an episode of diarrhea six months ago? The recommended recall period for this kind of study is 2 weeks only.

One may also note that only 8% of the respondents had changed from a traditional belief and behavior pattern to a more scientific one as a result of the program (although some unnamed proportion had previously acquired scientific understanding). It is unlikely that this small change alone would have been able to bring about the fall in mortality or morbidity observed. RSN]

ORAL REHYDRATION THERAPY FOR TREATMENT OF DIARRHOEA IN THE HOME.
WHO/CDD/SER/86.9, 13pp.

This article reviews three approaches to early home management of diarrhea. The choice of approach is influenced by cultural attitudes and practices concerning diarrhea and by socioeconomic status. The effectiveness and safety of Oral Rehydration Salts (ORS) solution has been well established for treatment of dehydration resulting from diarrhea, however, ORS is not necessary for early home therapy in most cases. Also, since ORS is available only to one-third of people living in the developing world, mothers are being educated to give fluids that are either normally available in the home or that can be prepared with ingredients usually found in the home. These are: Sugar Salt Solution (SSS); Food-based solutions; Commercial beverages and other fluids. Each is discussed in light of its effectiveness for early treatment of diarrhea, availability of ingredients, success of efforts to teach and promote its use, and needs for future research.

To provide adequate oral rehydration therapy, however, regardless of the approach to home solutions, all children should have access to ORS in the case of dehydration. The goal is to use home solutions and ORS in sequence and not as mutually exclusive alternatives.
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(no abstract; see below for editorial comment.)

[Editorial Comment: Although this study lacks much in objectivity (the means by which the control group was selected is not described, and no studies for enterotoxigenic E. coli were done), the rotavirus rates found are interesting: 20.7% in 450 acute diarrhea cases (35% in the age group 0-12 months) and 3.2% in controls without diarrhea. 15.4% of the rotavirus negative cases were positive for Salmonella or Shigella - but then, 14% of the rotavirus positive cases were also positive for Salmonella or Shigella. What caused the diarrhea?

Another interesting item is that the rotavirus rates are constant with the seasons, despite seasonal variation in the number of cases. This is not the case in other countries, where rotavirus rates peak during certain seasons. RSN]
Incorrect treatment of hypernatremic dehydration such as too rapid rehydration, or the use of rehydration solutions that are too hypotonic, may lead to convulsions and sometimes permanent brain damage. Past studies claim that oral rehydration instead of intravenous therapy might reduce the risk of convulsions. This study examined the efficacy of an oral solution for the management of hypernatremic dehydration caused by gastroenteritis.

18 well-nourished infants aged under 6 months with hypernatremic dehydration were treated for the first 24 hours with 120 ml/kg of an oral glucose electrolyte solution. The solution contained less sodium (60 mmol/L) and half the potassium recommended in the WHO solution (which has induced hypernatremia in past instances). The oral rehydration solution safely rehydrated all 18 children without inducing convulsions. Results of decreasing natremia were comparable to the fall in natremia among 26 similar infants who were treated in a previous study with intravenous fluids. Seizures were avoided during treatment as a result of the slow decrease in plasma sodium. The slow, constant administration of ORS is concluded to be an effective alternative to intravenous therapy.

[Editorial Comment: The authors note that their modification of the standard WHO solution allows them to avoid periods of giving pure water. They feel this is safer as it avoids the chance for steep falls in serum sodium levels which might occur during such periods, and lead to convulsions.

One drawback in their approach is their very slow rate of fluid administration - only 12% of the child's body weight during the first 24 hours, in a group of patients of which about half were over 10% dehydrated. This would be inadequate treatment if the child had heavy stool fluid losses during that period. A better approach would be to link volume administered with both initial percentage dehydration and continuing fluid losses measured over the initial 24 hours.

Also, they treated children with clinical signs of shock or a low level of bicarbonate exclusively with IVs. Given the likelihood that many of those children could drink, oral treatment should have been started at the same time. A number of reports conclude that it is the oral route of administration which prevents convulsions, perhaps by allowing the ingested fluid to be "buffered" by serum in the gastro-hepatic circulation rather than going directly from vein to heart to brain. If so, the investigators should use oral replacement in the children in shock and acidosis as well, perhaps exclusively. This deserves further study. RSN]

(no abstract; see below for editorial comment.)

[Editorial Comment: We include this rather brief review in our listing because it points out several facts and perspectives which will be important in the future. Madeley comments that rotavirus appears likely to show the antigenic "shift and drift" phenomenon seen with influenza viruses. This will make it more difficult to produce a vaccine that will provide immunity against next year's rotavirus strain, even if it does protect against this year's. A difference between the flu virus and rotavirus is that with rotavirus, not only is there antigenic shift, but multiple strains circulate in the community simultaneously. With flu, only a single strain causes the majority of infections. This adds yet another level of complexity to the challenge of vaccine antigenic design.

Diagnosis of rotavirus infections in developing countries is feasible without too much technological complexity by using the enzyme immunoassay and latex agglutination techniques. The problem is that if antigenic shift occurs, then the reagents for these tests will no longer be as likely to detect the presence of the new (and antigenically different) strain in the stool. The alternative is polyacrylamide gel electrophoresis, a much more complex and difficult technique.

The last striking bit of information from this article was Madeley's comments on adenoviruses. They are emerging as the biggest rival to the rotaviruses: 6-8% of routine stools have them in one study, 13.5% in another. These are being picked up by electron microscopy, which makes widespread testing more difficult. What role do these agents play in diarrheal diseases? RSN]

Stoll, Barbara J.; Svennerholm, Ann-Marie; Gotheors, Leif; et al. LOCAL AND SYSTEMIC ANTIBODY RESPONSES TO NATURALLY ACQUIRED ENTEROTOXIGENIC ESCHERICHIA COLI DIARRHEA IN AN ENDEMIC AREA. J. Infectious Diseases, March 1986, vol. 153, no. 3, 527-34.

Fifteen adult patients with naturally acquired enteropathogenic Escherichia coli (ETEC) were tested in Bangladesh to determine if local and systemic antibodies to ETEC were produced. Either oral or intravenous rehydration therapy was administered, but no antibiotics were used. ELISA technique was used to examine serum, saliva, breastmilk and intestinal fluid. A majority of the patients had more than a doubling in local antibody levels in the intestine. Secretions examined from breastmilk and saliva also contained local antibodies, however, the usefulness of these secretions for measuring local intestinal antibodies remains unclear.
This study demonstrates that natural ETEC disease stimulates an increased production of immune responses in the intestine as well as in breastmilk, saliva and serum. Serum antibodies stimulated by natural infections may provide protection for only a short period of time. However, the intestine's immune response seems to be strengthened by exposure to ETEC. Future vaccine development should focus on indentifying protective antigens and stimulating local intestinal antibodies to these antigens.

[Editorial Comment: Two-thirds of lactating mothers showed a rise in breastmilk antibodies to ETEC after LT disease. This process is a major component of the protection which is provided by breastfeeding to the newborn, to which is added a decrease in exposure to pathogens since breastmilk is lower in bacteria than milk which sits around in bottles.

The authors comment, however, that although serum antibodies were stimulated, they are unlikely to play a major role in protection because of the need for rather high titers which then diffuse into the intestine. Probably more important is the priming effect of an infection on the ability of the intestine to produce local antibodies quickly after contact with an invading organism.

The poor general response to parenteral immunization in cholera may relate to the fact that parenteral immunization does not stimulate intestinal lymph nodes as effectively as an intestinal infection, the fact that the rapid multiplication of bacteria in the intestine (in contrast to the much slower course of replication in systemic viral infections) may not give even a primed intestine time to respond, and the fact that serum antibody levels do not stay high enough after parenteral immunization to protect for long.

The dynamics of fairly rapid falloff in intestinal antibody titers, the necessarily slow process of lymph cell response to an intestinal infection, and the rapid reproduction of intestinal pathogens to pathologic levels may prevent the development of an oral (or parenteral) vaccine which will protect effectively for more than a few months against an intestinal bacterial infection. RSN]

DEVELOPMENT OF VACCINES AGAINST SHIGELLOSIS. WHO/CDD/IMV/86.1, 12 pp. (Summary of a meeting held at the National Institute of Cholera and Enteric Diseases, Calcutta, India, on 19-22 May 1986.)

This report summarizes present efforts to develop vaccines for shigellosis and recommends priority research topics. The development of vaccines for the prevention of shigellosis is important because measures currently in use to control the infection, for case management and the control of epidemics, are of limited efficacy. For example, strains of Shigella may be resistant to most available antibiotics, and treatment is expensive since new and costly
antibiotics may be necessary. Even appropriate antibiotics in severe cases may not produce rapid clinical improvement or prevent death. Oral rehydration therapy is also of limited use, since dehydration is not necessarily an important feature of dysentery. The measures, besides vaccines, that are of significant value in preventing shigellosis are improved personal hygiene and sanitation, which interrupts transmission of the pathogen, and the provision of adequate water for household use. It is also probable that the incidence or severity of illness can be diminished by non-specific interventions such as measles immunization, measures to improve nutrition, and possibly vitamin A supplementation. It is hoped that the recommendations contained in this report will stimulate further research which will ultimately lead to the development of efficacious anti-shigellosis vaccines.
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This article summarizes the Egypt National Control of Diarrheal Diseases Program efforts through community education to develop an effective alternative to commercial ORT and establish a treatment regimen that was readily implementable throughout rural Egypt. The primary responsibility for this program was focused on the rural mothers and secondary responsibility on the itinerant nurses within the network of health care facilities.

Six villages were chosen as study cells. In some villages packets were supplied through home distribution or were available at shops and pharmacies. In one village mothers were taught to prepare rehydration fluid from home supplies of sugar and salt. Health education was provided once every four to six weeks to all mothers with children of preschool age by a health facility nurse through home visiting, and the village men were exposed to health education by sanitarians at Friday prayer meetings. Health messages stressed the importance of diarrhea as a dangerous disease, recognition of diarrhea, early management of the disease at home, dietary advice during and following the diarrheal episode, and recognition of danger signs requiring immediate referral to a health facility.
The main conclusions drawn from the results of the program include the following: 1) Mothers are willing and able to recognize diarrheal disease and to be responsible for its early management; 2) Repetitive and patient training is necessary to enable mothers to take responsibility for early home management; 3) All facets of the program must be worked out in detail before program implementation; and 4) Activities should be monitored and corrected continuously throughout the life of the program.

[Editorial Comment: This article is a follow-up to a preliminary study reviewed in TLJ Vol. 1, No. 5, July 1985 (Keilmann, A.A.; Mobarak, A.B.; Hammamy, M.T.; et al. CONTROL OF DEATHS FROM DIARRHEAL DISEASES IN RURAL COMMUNITIES I. DESIGN OF AN INTERVENTION STUDY AND EFFECTS ON CHILD MORTALITY. Tropical Medical Parasitology, 1985, vol. 36, 191-98). EJJ]


The terminal illness of most starved children and adults is diarrhea or a respiratory infection. Diarrhea in starvation is generally attributed to bacterial overgrowth and mucosal infection, however, physiological and biochemical evidence now suggest that malnutrition of the intestinal epithelium is the major factor. The intestine’s ability to absorb nutrients provided by refeeding is crippled when the epithelium is starved of energy for effectively controlling absorption. Consequently, within the first few days of oral refeeding, diarrhea will usually worsen and may lead to death.

The different therapeutic implications make it necessary to distinguish between infective diarrhea and starvation diarrhoea in severely malnourished children. Antibiotics are detrimental in starvation diarrhoea because they prevent effective bacterial fermentation and thus production of substrates for mucosal growth and repair and efficient sodium absorption in the large intestine.

5-7 days should be allowed for refeeding, enabling the starved intestinal epithelium to return to more normal functioning. The refeeding diet should be higher in polysaccharides and dietary fibre, including glutamine along with smaller amounts of glucose and fatty acids (milk fats), than are usually administered to severely malnourished children. If the malnourished intestinal mucosa is not resuscitated before refeeding, further diarrhoea caused by osmotic food loads will ensue and may lead to death.
[Editorial Comment: This exciting review draws attention to the colon as an important location for nutrient absorption as well as the small intestine. It emphasizes that the first step in repairing the nutrition of the starving child is to repair the nutrition and function of the intestinal mucosa with specific nutritional therapy and that intestinal repair needs a different diet than child nutritional repair. These points are likely to be important in the management of chronic diarrhea as well. Further research is needed to develop practical clinical methods for appropriate application to diarrheal disease. RSN]


According to UNICEF the benefits of new health care technologies (Gobi-FFF) can be made rapidly available to all through social mobilization (SM). SM is a scaled-up version of community participation, emphasizing the involvement of organizations at the national level as well as individuals and families, with greater emphasis on the planning and use of communications. As currently found in national EPI campaigns, SM efforts should be carefully planned, based in particular on a detailed analysis of potential participating organizations. A social mobilization campaign should begin with efforts to induce political support, particularly among national decision makers. Induction of community interest and participation is then brought about through communication approaches.

As seen in the well-publicized national campaigns in Columbia and Turkey, such SM can bring about a new focus and interest by policy makers in health. This encourages sharing and reallocation of resources among sectors and resource-poor communities, new levels of community participation, and revitalization of health workers.

While campaigns have been criticized for not contributing to the permanent development of the health infrastructure, SM, if done appropriately with adequate planning at the start, can succeed in preserving the sectoral alliances, the interest of policy makers, and resource allocations. Social mobilization can use the new implementation skills, the community involvement, and the new roles of churches and schools in health to bring about permanent improvement in the health infrastructure.

EPI is a particularly appropriate vehicle to introduce these social changes, for a variety of reasons, but any health intervention around which a community could be mobilized (ORT, water and sanitation, growth monitoring) could serve.
UNICEF advocates EPI acceleration as a "leading edge" for the acceleration of the PHC development, and as an appropriate isolated activity in very poor countries with little prospect of significant health infrastructure development. Program activities will be sustained where community empowerment, a demand for health services, and political will are sufficient.

[Editorial Comment: These ideas are very attractive and stimulating and it remains to be seen if good planning for the components of social mobilization described here - preservation of alliances, continued interest by policy makers, and continued resource reallocation - can actually make those things persist over a number of years, thereby producing a long-term improvement in the health infrastructure. Another question for diarrhea control efforts is whether such a short-term push, such as a campaign, will work when what is needed are permanent changes in behavior (e.g. using ORT). We know that an aggressive communications campaign can produce rapid changes in ORT knowledge and use. But experience in the Gambia has shown us that such use falls off rapidly when the funding and the promotion cease. Can social mobilization in UNICEF's model change that sequence? Continued social mobilization for two to three more years in the countries where the program is already in place will answer that question. RSN]


The popularity of common "cola" drinks for the treatment of diarrheal dehydration is inappropriate. The sodium, potassium and osmolality content of soft drinks are not in accordance with the WHO recommended composition of ORS. As the following Table indicates, the sodium and potassium contents are usually very low and the osmolality high. Popular soft drinks are thus not suitable for use as oral rehydration solutions.

<table>
<thead>
<tr>
<th>Soft Drinks</th>
<th>Sodium (mEq/l)</th>
<th>Potassium (mEq/l)</th>
<th>Osmolality (mosm/kg H2O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonated &quot;cola&quot; type</td>
<td>4.0 to 6.1</td>
<td>0.0 to 0.3</td>
<td>445 to 678</td>
</tr>
<tr>
<td>Carbonated, others</td>
<td>7.0 to 9.9</td>
<td>0.1 to 0.2</td>
<td>428 to 790</td>
</tr>
<tr>
<td>Noncarbonated, fruit</td>
<td>4.6 to 5.1</td>
<td>1.3 to 1.9</td>
<td>448 to 480</td>
</tr>
<tr>
<td>flavored</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHO solution</td>
<td>90</td>
<td>20</td>
<td>333</td>
</tr>
</tbody>
</table>

(p. 61)
[Editorial Comment: This article is one example of a more general fact: that a country's popular or commonly used drinks frequently are not good substitutes for ORS. The most likely danger is high sugar content such as seen here in the osmolality figures. The resulting high osmolality can lead to an osmotic type diarrhea on top of the original infectious one. Health workers should look carefully at which drinks are commonly used, and examine their composition, rather than just casually recommending any "home available solution" for diarrhea treatment when ORS is not available.

Drinks such as these are useful only in the very first stages of a diarrheal episode, when no clinically evident dehydration has occurred, in short, before the child needs a replacement fluid. At such times children are not particularly thirsty, and would commonly reject ORS anyway. Given frequently (30-50 cc every 30 min.) and in small quantities at that stage, such sweet drinks will do no harm in mild cases of diarrhea. RSN]


Intractable diarrhea of infancy is a disorder characterized by diarrhea that lasts for more than 2 weeks during the first 3-6 months of life and is associated with negative stool cultures, progressive weight loss and malabsorption. The difficulties in treating intractable diarrhea are due not only to the severity of the malabsorption, but also to an inadequate understanding of the diarrhea's pathophysiology. The authors assessed the value of the small bowel biopsy in predicting the clinical cause of intractable diarrhea of infancy by examining the small bowel biopsy specimens of 19 infants with intractable diarrhea, and then rating each specimen with a score in terms of the severity of the disorder. Biopsy scores were compared with the duration of nutrition support needed to treat each patient and subsequently revealed no correlation between the severity of the small bowel mucosal injury on biopsy and the clinical case of the patient. Thus, no prognosis or specific therapy for intractable diarrhea in infants can be derived from small bowel biopsies.

In the individual case, the role of the biopsy seems limited to the diagnosis or exclusion of specific diseases. Tests for mucosal function, which may include biopsy tests as well as simpler tests of mucosal function (d-xylene, breath hydrogen, stool pH), are more reliable for determining appropriate treatment and management of non-specific diseases.
[Editorial Comment: The fact that negative stool cultures occur in areas where infectious diarrheas are infrequent (certainly not the case in developing countries) indicates that intractable diarrhea of infancy is not the same as "persistent diarrhea" - which follows an initial infectious episode, seems to occur more frequently in malnourished children, and leads to greater malnutrition. It is now becoming apparent that many of the children who die from diarrhea in developing countries are in fact dying from persistent diarrhea, not from acute watery diarrhea. As noted in the PRITECH Task Force recommendations, better understanding of persistent diarrhea should be a priority for research, both epidemiological and clinical, in the next few years. The high-tech approach described here obviously is not feasible for routine management of persistent diarrhea, but may be useful in research. Of utmost importance are studies on the nutritional management of persistent diarrhea. RSN]


74 children (under 12) with cholera and 34 infants (under 2 years) with infantile diarrhea, and either severe or moderate dehydration, participated in this study. The severely dehydrated patients were initially rehydrated with IVs and then maintained with either ORS-citrate or ORS-bicarbonate. The success rates, stool output, ORS intake, gain in body weight, correction of acidosis, and maintenance of electrolyte balance 24 hours after initial therapy, were compared to assess the effectiveness of treatment with either ORS-bicarbonate or ORS-citrate.

The ORS-citrate successfully rehydrated 92% of the children with cholera and 100% of the infants with infantile diarrhea. This compared to the ORS-bicarbonate success rate of 86% for the children with cholera and 94% for the infants. Heavily purging cholera patients were more likely to be "clinical failures", that is, to become increasingly dehydrated with either solution. The results thus indicate that the more stable ORS-citrate can safely and effectively replace ORS-bicarbonate for rehydration in cases of cholera and infantile diarrhea.

[Editorial Comment: The author measured stool output but did not give this data. He did observe a trend toward lower stool outputs in the citrate group, however, which was not statistically significant. This is consistent with an earlier report from Jakarta that ORS-citrate led to lower stool outputs in older cholera patients compared to ORS-bicarbonate.
It looks as if citrate does have a slight absorption-enhancing effect which is probably always present, but is only statistically demonstrable in cholera patients who have higher stool rates. It was surprising to see that the initial rehydration given to severely dehydrated patients was 100 ml/kg of normal saline in the first 4 hours. The speed and quantity (10% of body weight) are appropriate, but why a solution with no bicarbonate or potassium? RSN]


150 infants aged under six months were hospitalized with acute gastroenteritis and treated with rice water (RW), rice-based electrolyte solution (RES), and the glucose electrolyte solution (GES) recommended by the World Health Organization. 67% were under 3 months of age; 74% were receiving bottle feeds. Dehydration was moderate or severe in 64% to 72% of patients. Only 8% had positive stool cultures. Stool volumes were measured only as large, moderate, and small, along with measurement of stool frequency. Children were continued on their usual feeds, with either RW or RES used to dilute milk.

Results showed RW and RES superior to GES in reducing the frequency and volume of stool output and in producing weight gain, as well as in reducing blood urea nitrogen and creatinine. Serum potassium was lower in the RW group than in the RES group.


The author disagrees with the conclusions of Mehta and Subramanian (see above) that rice water is better than the standard WHO solution in the treatment of acute diarrhea in infants under 6 months. Rice water must be distinguished from rice-powder ORS, however, Mehta and Subramanian do not adequately specify the composition of their rice water. Neither do they adequately describe input and output volumes: ORS was given on demand "depending on the condition of the patient"; frequency of stools measured is an inadequate indicator of output. The study days are numbered confusingly, and the weight gain measurements are not carefully evaluated.

Other problems with this non-randomized trial are noted. Generally, the study was not adequately standardized or balanced to support the claim that rice water is superior to the WHO solution for rehydration.
[Editorial Comment: Some additional problems are worth mentioning. With 67% of the patients aged under 3 months, amylase levels, needed to digest starch, are likely to be low. Stool reducing substances or pH were not measured. Also, there is no indication of the amounts of lactose-containing milk administered. WHO principles specify giving breast milk (low in sodium) or free water to babies taking GES. The authors instead gave diluted milk for the RES group and perhaps the GES group also, although that is not stated specifically. This extra osmolar load may have increased the stool output in those groups -- but milk plus RW and milk plus RES intakes are not described, nor is any data presented indicating any similarity among the three groups according to age of child and pre-diarrhea diet.

Several factors were affected by giving a solution with no electrolytes. Perhaps the diarrhea lasted for too short a period in these cases to show a difference in sodium content between the RW and other groups, but the potassium level did end up being lower in the RW group.

In short, while the authors' observations are interesting, and while RW may be a good solution to use, the methods the authors used are not adequate to allow us to accept their conclusions. More carefully controlled studies aimed at the specific concerns mentioned are needed. It is hard to imagine that a non-electrolyte containing solution like RW can be safe for a child with anything but the mildest of fluid and sodium losses. As a first step by mothers at home, rice water is fine, for prevention of dehydration. However, as a rehydration solution, RW alone cannot replace sodium and potassium losses, and can only lead to complications. RSN]
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This 20-month study investigated the frequency, etiology, seasonality and potential sources of infectious diarrheal diseases in a peri-urban slum community with approximately 15,000 residents. Twenty-three random households with children under the age of 2 were selected for monitoring. The attack rate of diarrhea ranged from 0.2 to 4.8 episodes per person per year with 78% of those episodes occurring in children under six; 60% occurred in children under three. Enterotoxigenic E. coli was the most frequent etiologic agent isolated in children under six years, followed by Giardia lamblia and Shigella. Older children and adults more frequently carried G. lamblia, followed by Shigella and Entamoeba histolytica. ETEC pathogens were isolated in nearby stream water used for cleaning purposes, and household flies.
[Editorial Comment: Attack rates in children under 18 months were 3+ episodes per year, a high rate. Striking findings are the high frequency of Giardia recovery, and presence of ETEC in flies from households with ETEC diarrhea cases. It is possible that flies are more important than currently perceived in the spread of this disease. RSN]


Fourteen malnourished Turkish infants 3-15 months old, with acute infectious diarrhea, were successfully treated with a rehydration solution containing 60 mmol sodium/liter. Clinical responses and changes in water and salt homeostasis were studied for 36 hours during the oral rehydration therapy. Lower urine volume and urine sodium excretion were found in the malnourished infants compared to similarly treated well-nourished patients of the same age. The results indicated that the malnourished infants retained more fluid and sodium than normally nourished children. This retention problem could lead to circulatory failures during ORT. ORT is concluded to be safe and efficient in the treatment of malnourished infants with acute diarrhea, but it requires careful monitoring of the volume of fluid that is administered.

[Editorial Comment: The authors have documented a frequent pattern in malnourished children where low serum albumin makes it difficult to retain administered fluid in the blood vessels. Fluid instead escapes into the extra-vascular spaces of the body, and thus is not available to the kidneys for excretion. This gives the appearance of renal malfunction, while the kidneys in fact are not damaged.

The critical point should be that in such patients, more fluid may be required than usual to attain adequate blood flow. One must be watchful, however, for the complications of fluid outside the vascular system, especially pulmonary and peripheral edema. Malnourished children thus require a tricky balancing act for fluid administration. RSN]


Serum, saliva and breastmilk samples were examined to determine whether intestinal immune responses following oral vaccination or disease are reflected by rises in antibody titers in more readily accessible extraintestinal body fluids. Specimens were collected in 4 different trials from Bangladesh volunteers orally immunized with a new cholera
vaccine candidate, or from patients with clinical cholera or enterotoxigenic E. coli. Results showed less frequent IgA antibody responses in saliva (44%) and breast milk (25%) than in intestinal fluids (76%) after oral vaccine administration. After clinical disease, responses were both more frequent and more similar among the three types of secretions (78%-100%). Varying correlations between saliva, breast milk and intestinal antibody responses were noted.

[Editorial Comment: The critical points to draw from this work seem to be the following:

1. Antibodies do appear in breast milk after infections and also after oral immunization, although infrequently. This is doubtless related to the importance of breast feeding for preventing diarrhea in countries where diarrhea is prevalent. Intestinal antibodies responded well to both stimuli, which is important since intestinal immunity is probably more important than serum immunity in many diarrheas.

2. None of the extra intestinal fluids directly reflects the intestinal immune response after either oral immunization or clinical disease, but serum antibody measurements remain reasonably accurate and useful even after immunization, and saliva and breast milk are useful after clinical infection. Choosing the test to use to measure antibody response is very important, since different antibody types (IgA vs. IgG) are more active in particular antibody tests (antitoxin vs. vibriocidal antibody, for example). RSN]


The sodium, potassium and chloride content of stool samples was examined from 107 children aged 1-32 months suffering from acute diarrhea. Oral rehydration was administered for the first 24 hours and then feeding was gradually reintroduced. No drugs were given. An average of 4 fecal samples were collected over a period of 2-4 days for each child. Regardless of etiology, duration, severity, food administered or oral fluid given, the electrolyte concentration of the stool samples did not vary significantly from the following values: 42 ± 20 mmol/l sodium, 51 ± 24 mmol/l potassium, 24 ± 11 mmol/l chloride.

[Editorial Comment: These studies, done with patients in France, differ from others which show a gradual reduction of Na concentration in cholera patients over their course of recovery. The high potassium seen here reflects the importance of replacing it with food (e.g. citrus fruits), or potassium containing ORS. Sugar-salt solution has no potassium. Stool sodium is higher in cholera, and in more
heavily purging cases than in these non-cholera diarrheas. The threat is double in cholera: higher fluid loss and higher sodium loss.

These data point to the recommendation to provide additional "free water" (plain water, or breast milk, which is low in sodium) when treating ordinary diarrhea cases with ORS equivalent to the WHO formula (90 mmol sodium per liter). RSN]


Childhood malnutrition is a major health problem in the Western province of the Solomon Islands. Growth slows after 6 months and by the age of 2, over half the children are malnourished and will end up stunted. A community nutritional survey of anthropometric indicators and food intake was conducted in 1983-1984 to help determine etiology of this malnutrition.

The anthropometric survey recorded weight for height and height for age for 477 children under 5. Weight gain slowed between 6 and 17 months. The highest rates of malnutrition were noted in the children aged 12-23 months. Heights and weights in the second part of this survey indicated that 88% of the children under 1 were normal, but during the 2nd year of growth, 51% of the children became stunted, wasted, or both.

A concurrent dietary survey conducted among 79 children aged 6 months to 5 years indicated that the diets of both weaning children and children older than 11 months consisted primarily of sweet potatoes. The energy and protein content of these diets was insufficient particularly in the child's second year when 77% of the 31 children received less than the recommended intake. It is concluded that the principal diet, sweet potatoes, is low in energy and protein concentration and also is not given frequently enough (only 2-3 times daily).

[Editoral Comment: The aggregate growth curve for the group was flat between 9 and 18 months, the peak period for diarrhea. The authors stress that the coincidence between beginning to use weaning foods and the onset of growth failure means that the cause of growth faltering is nutritional. Yet they cite the high frequency of diarrhea in the population, and the fact that food intake is cut back when the child is sick. A further interpretation would stress the importance of diarrhea, resulting in part from contamination of weaning foods by bacteria, as the cause of poor appetite, and that food withholding by the mothers is the response. Nutritional studies such as these could be improved by paying more attention to diarrhea as an influence that is manageable through increased feeding during and after diarrhea. RSN]

Child feeding practices were studied in relation to the mothers traditional attitudes, to determine the impact of sex bias on the incidence of Protein Calorie Malnutrition (PCM) among female children. Results of the survey indicated that a greater number of female children are deprived of non-vegetarian foods by mothers with traditional attitudes. Seventy-one percent of the female children in traditional families were fed vegetarian meals compared to only 39% males. In those families where the mother had "modern" attitudes, 41% of the female children and 33% of the male children were fed vegetarian foods; 59% of the female and 67% of the males were fed non-vegetarian food. The incidence of PCM was almost the same among both male (22.9%) and female (22.5%) children of mothers with modern attitudes. PCM was highest among female children (44%) compared to male children (26%) of mothers with traditional attitudes. The degree of severity of PCM was higher among female children in general than in male children. This study clearly indicates that often the more traditional attitudes a mother has, the greater the chances for malnutrition among her female children.

[Editorial Comment: This Indian study reiterates that more awareness may be needed of the quite different treatment which mothers give to female children versus male children in many societies. This difference applies to treatment for illness, e.g. whether a child is taken for medical treatment, as well as feeding practices. RSN]


(no abstract; see below for editorial comment.)

[Editorial Comment: The Turkish example cited here used trained midwives to train community women, who then became a source of information on diarrhea management for other women through a strong female social network in the villages. By empowering women and their network in this way, Wagner says, they may be encouraged to take more active responsibility for various health problems. This could be seen in a more active approach to caring for the child with diarrhea, rather than waiting for the episode to end. More sustained and effective results could follow from using such an approach, which focuses beyond the current "social marketing" tactics. RSN]
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Approximately 5% of the population in Western Rwanda were stricken with drug resistant Shigella dysenteriae 1 during an epidemic which migrated through Central Africa. Without effective chemotherapy the natural duration of the illness was about one week, and the age and sex of the patients did not significantly influence the duration of the illness. Among adult hospitalized patients, females were predominant; they are more susceptible to serious illness because of prior exhaustion since they perform the bulk of heavy work in Rwandan society. 8% of the women in this study were pregnant. During the week of hospitalization, a
high amount of abortions and severe perinatal complications were observed, indicating that epidemic dysentery is a potential risk for pregnancy.

The children hospitalized were mostly male, which may reflect different attitudes by Rwandans towards male and female children. Dehydration and fever were effective screening indicators for the more severely afflicted patients at risk of fatality. Prevention through sanitation, personal hygiene and health education is the only way to decrease the risk of infection among poorer populations.

[Editorial Comment: This report points out some interesting aspects of dysentery. First, 55% of the hospitalized patients were dehydrated and needed fluid therapy, and 19% had vomiting. The different pathologic mechanisms of dysentery (invasion of the gut epithelium), its predominant symptoms (bloody stools), course (frequently becomes persistent), and management (use of antibiotics recommended), distinguish it from acute watery diarrhea, which has no or little invasion, in which the primary symptom is dehydration with no bloody stools, which is usually self-limiting, and for which antibiotics are not needed. This study emphasizes, however, that dehydration is important in both syndromes. Indeed, it is probable that dehydration was an important contributor to the overall serious clinical picture which led to the hospitalization of some patients and not others.

Second, dehydration with fever was significantly associated with a fatal outcome. This means that diarrhea control messages must emphasize the importance of looking for blood and mucus in the stool, and seeking medical attention quickly if fever or dehydration follow. The large number of fatalities (6% of cases) reflects the importance of dealing effectively with this disease in diarrhea control programs.

ORT alone is not sufficient to control dysentery. Since the goal is to reduce mortality from diarrhea, programs must stress to mothers and health workers that dysentery is different from "ordinary" diarrhea, and therefore requires a different response. Packages and home fluids are not enough. Like the child with pneumonia, these patients need medical attention and drugs. RSN]


170 children at the Cayetano Heredia Hospital in Lima, Peru were enrolled in this double-blind placebo-controlled study to determine the efficacy of early treatment with erythromycin on the duration of diarrhea associated with
Campylobacter jejuni. Earlier studies have shown erythromycin shortens the duration of bacterial shedding, but does not reduce the duration of the diarrhea. The authors attribute this lack of clinical effect to delays in starting therapy, usually 4 or more days after the onset of diarrheal symptoms and failure to control for the type of clinical syndrome being studied. In contrast, this study initiated treatment immediately and enrolled only patients with acute dysentery. 30 patients with Campylobacter jejuni were divided into placebo and erythromycin groups. After 5 days of treatment, 50% of the placebo patients and 93% of the erythromycin group had normal stools. Fecal excretion continued significantly longer in the placebo group. These results indicate that early administration of erythromycin significantly reduced the duration of diarrhea and fecal excretion in infants and children (aged 3-60 months) with acute dysentery associated with Campylobacter jejuni.

[Editorial Comment: The recent recognition that Campylobacter is an important cause of dysentery raises a new dilemma: what antibiotic to use for dysentery cases? This study shows that erythromycin is effective not only in shortening the duration of bacterial infection (the duration of stools positive for Campylobacter), but also in reducing the duration of diarrhea caused by this infection. Erythromycin, however, is not effective for Shigella dysentery - cotrimoxazole is the drug of choice for that type of bacteria, while Campylobacter is uniformly resistant to cotrimoxazole. Twenty-six per cent of the acute dysentery cases in this study were caused by Shigella, 17% by Campylobacter. How should one handle an acute dysentery case, particularly where laboratory facilities for culture are not available?

The authors draw attention to age as an important factor related to the bacterial cause. In their study, all of the Campylobacter infections occurred in children less than 1 year of age; other studies have shown the percentage of dysentery cases which were caused by Campylobacter in this age group to be from 24% to as high as 93% of cases.

With Campylobacter thus the cause of a significant proportion of the dysenteries in this age group, the authors suggest starting both erythromycin and cotrimoxazole for dysentery in children under 1. For children over 1, start cotrimoxazole only, and add erythromycin after 2 days if the child has not improved (ideally prescription should be based on culture and antibiotic sensitivity studies when available). While further study is certainly indicated, especially to determine the epidemiological causes of dysentery in this age group in other places, this seems to be a reasonable working recommendation for the present. RSN]
A previous study of rural Bangladesh children discharged from hospital after treatment for diarrhea had found a higher rate of mortality than that in a control group of non-diarrhea children; malnourished children were particularly at risk of death after discharge.

The authors of this study visited 74 urban children, aged 2-5 years, at home, to determine mortality 4 months after discharge from ICDDR,B where they had been treated for diarrhea. 43% of the children had been severely malnourished and 28% moderately malnourished at the time of their presentation to ICDDR,B. During the followup period only 2 deaths (3%) had occurred, none in the severely malnourished group. When asked whether their children were malnourished, parents were significantly less likely than health workers (p=0.02) to recognize malnutrition in the children.

The authors conclude that there are substantial rural-urban differences in the survival of children after treatment for diarrhea. Parental underrecognition of malnutrition may impede the nutritional rehabilitation that is necessary to avert much of the morbidity and mortality that ensues after an episode of diarrhea. Greater access to medical care for problems that do occur may be the reason for the lower mortality seen in the urban children here as compared to the rural children in the previous study. Other explanations are also discussed.

[Editorial Comment: It is important to emphasize the impact of diarrhea on nutrition, and thereby on morbidity and mortality. Many studies have documented the higher rate of mortality in malnourished children, and the previous study in rural children referred to by these authors suggested that diarrhea accentuated that tendency.

This study, while small (only 74 children, compared to 551 in the previous study) and short (4 months compared to 1 year), seems to show that diarrhea and even malnutrition need not lead more frequently to death. Various conditions of rural life, among them poor access to medical services and parental underrecognition of health matters, may be responsible for the higher mortality seen in rural post-diarrhea children in Bangladesh.

The lack of recognition of malnutrition in their children by parents documented here points out two areas of concern which should be of top importance to every health facility treating diarrhea patients: 1) the need to determine the nutritional status of every child coming for diarrhea; and 2) the need for effective communication with the parents about nutrition, including the nutritional status of the child, the nutritional impact of diarrhea, and the special feeding steps to take to avoid that impact. All
too often hospitals and clinics confine the use of scales and growth cards to the well-baby clinic. Those that do weigh children with diarrhea often use the resulting weight only as a means to calculate fluid requirements, and fail to use it, properly plotted on a growth chart, as a means for impressing on the parents the importance of feeding during and especially after diarrhea.

Because of the close relationship of poor nutritional status with more severe diarrhea, hospitalized diarrhea cases are particularly likely to be malnourished. Severe diarrhea cases need special attention to nutrition, both during the hospital stay, and also through followup participation in a continuing growth monitoring program.

Every hospital treating diarrhea needs to have a system of interviews of parents at the time of discharge to ensure that they have learned what they need to know: how to feed the child after the diarrhea episode, what signs to look for to know when to seek medical care, and how to treat a future episode of diarrhea. This study emphasizes additional points that should also be included: the nutritional status of the child, and what that means. The educational treatment of diarrhea cases needs as much attention as the fluid treatment. [RSN]


Chronic Diarrhea is one of the more frustrating illnesses to treat, since a specific cause and explanation is hard to discern. In this case presentation, an otherwise healthy 50 year old woman experienced 9 months of acute diarrheal episodes with and without vomiting, usually followed by lower abdomen cramps. The initial symptoms of acute infectious enteritis occurred 24 hours after the patient ingested fresh raw oysters during a visit to Mexico. A heavy growth of Campylobacter jejuni was found in the patient's stool culture; no parasites were found; abdominal examination showed no abnormalities; all other physical findings were normal. Erythromycin was prescribed (500 mg 4X a day) for 10 days, which effectively cleared up the diarrheal episodes. No symptoms recurred.

Campylobacter jejuni is recognized as a common human pathogen capable of causing acute enteritis and also mimicking many other disorders manifested as chronic diarrhea. Erythromycin is the preferable drug for treatment of established infections. Tetracycline, the aminoglycosides, clindamycin, and chloramphorical may be effective as well. Antimicrobial agents are not recommended, however, for prevention of travelers diarrhea.

[Editorial Comment: This case report is included as a reminder that Campylobacter can cause a range of symptoms, and, as mentioned earlier, may be associated with chronic diarrhea. This woman did not have dysentery. [RSN]
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This article reviews five recent evaluations of community-based ORT programs: the Egyptian Strengthening Rural Health Delivery (SRHD) Project; the Indonesian National ORT Program; the Honduran PROCOMSI Project; the Gambian Mass Media and Health Practices (MMHP) Project; and the Bangladesh Rural Advancement Committee (BRAC) Program. Most evaluations emphasize the "impact" indicator, mortality, and also the cost-effectiveness of an ORT program. However, they should not ignore the more intermediate "process" indicators: availability of ingredients, perceptions about diarrhea and its treatment, knowledge of ORT, safety of the fluids prepared, and use of oral rehydration solutions, both home-made and from packets.
This report advises that the evaluation of community-based ORT programs should be concerned with standardizing and measuring the process indicators so that implementation may be made more effective. If the program has been implemented effectively, as determined by the above mentioned process indicators, an impact on mortality should result. Suggestions for standardizing the measurement of process indicators are presented along with actual questions and reporting procedures that can be used to more accurately determine effective use.

[See Below for Editorial Comment.]


A survey instrument and interview procedures were developed in Geneva and tested in a rural area of an Asian country where extensive ORT education of families had been taking place. The survey and interviews identified children under 5 with diarrhea on the day of or on the day before the interview and determined effective use of ORT by that child's caregiver.

The modified survey instrument used in the trial includes the following indicators:

- characteristics of the diarrhea;
- details of the caregiver's clinical assessment of the child;
- what the caregiver had given the child in response to the diarrhea (breastfeeding, type and amount of fluids, type and amount of food);
- demonstration by the caregiver of preparing ORS from a packet (1 liter packets), sugar-salt solution, and other home fluid preparations;
- demonstration by the caregiver of the containers used for giving fluids and the approximate amounts of fluid given.

The rural field test found 630 children under 5 in 843 houses in 13 villages. 57 of the children had diarrhea the day of or the day before the interview. The length of the interviews was usually 11 to 25 minutes; 5 - 7 interviews could be done in a day. Respondents maintained interest until the end of the interview because of their active involvement in the demonstrations, which were at the end of the interview.

Problems encountered with the new technique included several factors such as: difficulty in assessing quantities of breast milk consumed; children giving themselves water; lack of information because of multiple caregivers; difficulties in assessing frequency and volume of stool; differences between what is offered to the child
and what the child actually takes in; and concerns about the accuracy of clinical assessment of the child by the caregiver or an interviewer with little training.

Results showed 100% of mothers continuing to breastfeed during the diarrhea, and 66% of those giving additional fluids as well. However 58% of the children drank less fluids than before the diarrhea. 32% of mothers had given no food in 24 hours, but some of these may have been breastfeeding exclusively. 37% of children over 13 months received no food or less food (inadequate food) during the diarrhea. 42% of all children were receiving medications; of these 40% had bloody stools, and 15% had been sick for more than 14 days. The caregivers did observe changes in the children: 67% of the children were described as weak. The interviewers did not assess the children themselves. Only 5% of caregivers had given ORT, none had used sugar-salt-solution, 3% had used a home fluid of rice paste with a pinch of tamaric and salt.

The author concluded that the survey instrument was feasible to use and provided useful information.

[Editorial Comment: Program managers and consultants are increasingly aware that the process of changing caregivers' responses to diarrhea is extremely complex and difficult; hence the increased attention to improving the methods used to monitor and evaluate program efforts. These two articles concentrate on evaluating that aspect of programs. Chowdhury stresses the importance of going beyond measurement of ORS or ORT use alone to the measurement of effective use. Wornham's report indicates that WHO-CDD has taken definitive steps toward developing a practical approach to doing this in the field. Clearly there is an important difference between giving 2 teaspoons of ORS twice a day to the child who has diarrhea, and giving a glassful for each stool. Measurement of effective use attempts to make that distinction; merely asking "Did your child have diarrhea in the past 2 weeks?" "Did you give Oralit?" "yes, or no" would have recorded the same answer for both of those responses - yes. Since giving 2 teaspoons twice a day would be the same as giving nothing, the more detailed approach is needed to determine whether mothers are changing their behavior in an effective way.

Chowdhury's article stresses use of fluids. Continuation of feeding, however, is probably as important as fluid administration, not only for its effect on reducing the nutritional deficit caused by diarrhea, but more acutely for its enhancement of absorption of fluids by providing carbohydrate and other substrates, and for its help in bringing about more rapid recovery of the intestinal epithelium. The new WHO effective use survey emphasizes feeding as well.

To get accurate answers, finding children having diarrhea within 24 hours of the interview is necessary. The trial survey shows that that is practical.
The mother's recognition of when her child is getting dehydrated or sicker, and bringing him or her for medical assessment and treatment, is called self-referral. Ensuring that this takes place is critical to a program's having an impact on mortality, in order to get antibiotics, intravenous treatment, or other more demanding interventions to those sicker children who would die without them. The field trial of the new form shows that mothers generally are sensitive to the changed behavior of their children, and some observed other more specific signs of dehydration (sunken fontanelle, dry mouth). But the instrument does not deal with the mother's understanding of what these signs mean, her response to them, nor her use of medical facilities. The modified form in the report does not include specific questions about use of medication, although the interviewers did ask about that area of activity.

Much more work needs to be done in testing alternative approaches to the assessment of effective use, not just use, to know whether program efforts are doing any good. Thus country programs can be in touch with WHO-CDD (or with PRITECH) to get the latest measurement techniques for effective use prior to designing field survey instruments for evaluation of their programs. This is an excellent first step. RSN]
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Editorial. CHRONIC DIARRHOEA IN CHILDREN - A NUTRITIONAL DISEASE. Lancet, 17 January 1987, 143-44.

Chronic or intractable diarrhea of infancy occurs within the first three months of life in the absence of bacterial pathogens, and persists for over two weeks with more than three stools per day. It has a variety of causes, all difficult to manage, and causes considerable mortality primarily due to growth failure and malnutrition. Mucosal damage is present in most cases, often accompanied by crypt cell proliferation with abnormal secretion and villous cell atrophy. Resulting malabsorption of fats, proteins, and carbohydrates contributes to bacterial overgrowth, osmotic diarrhea, malnutrition, and slow healing of mucosal injury. This leads to further mucosal damage, and so on, in a vicious spiral.

Adequate nutrition is essential for recovery. Recent controlled studies have shown that intravenous total parenteral nutrition is more expensive, slower, less
effective, and causes many more problems (infection, catheter slippage, thrombosis) than feeding through the gut. Food in the intestine feeds the mucosal cells, enhances cellular proliferation for healing and induces enzymes, while resting the gut results in atrophy.

No single diet is effective in all cases. Even diets of pure food elements (e.g. amino acids) may be poorly absorbed. Human milk may be effective in difficult cases.

[Editorial Comment: The presence of this editorial in Lancet emphasizes the importance of chronic diarrhea in our efforts to control mortality and morbidity from diarrhea. Many chronic diarrhea cases, for example "persistent diarrhea", may begin with a typical acute episode, then persist in the form described. In chronic diarrhea the nutritional impact is the central problem and food is the answer--given orally, not intravenously. As the author puts it, "Use the bowel, this is both the natural and the best way to treat diarrhea." This is true, for both acute watery diarrhea and chronic diarrhea. RSN]

Stanton, Bonita F.; Rowland, Michael G.M.; Clements, John D. ORAL REHYDRATION SOLUTION -- TOO LITTLE OR TOO MUCH? Lancet, 3 January 1987, 33-34.

Recommendations for the use of ORS in the home are inconsistent. Mothers have been encouraged in some instances to administer ORS immediately after the first watery stool; in other cases they are advised to continue normal feeding and give plenty of fluids during mild diarrhea, and reserve ORS for the more serious diarrheal episodes. The result of these inconsistent guidelines may be an inadequate use of ORS. The authors reviewed six clinic-based studies of children with mild to severe diarrhea and five studies of the use of ORS in the home to determine the adequacy of ORT per episode of diarrhea. The ORS consumed in four of the clinic-based studies was inadequate for initial rehydration and subsequent maintenance treatment.

In the home-based studies, often only one liter of ORS was given prospectively to parents. The amount actually consumed was 310 ml (median). In both cases this is too little to be useful if the child was more than mildly dehydrated.

The authors suggest that ORS not be recommended to mothers to treat every case of diarrhea in the home, but that it be reserved for more severe cases with potentially life-threatening dehydration. This rationale is two-fold: first, to avoid a situation in which mothers treat dangerous dehydration inadequately, and second, to reduce the cost to government.

[Editorial Comment: The authors highlight issues in their article which occur in many of the national diarrhea programs: What should be the recommendations for home
treatment? How many packets should be given to mothers to treat one episode of diarrhea? They point out that current use is often inadequate for successful rehydration. Finally, the provision of adequate supplies of ORS to every household for every episode of diarrhea would be very expensive and logistically difficult.

WHO policies have evolved to address these considerations, recommending increased home available fluids and continued feeding for diarrhea management at the home. The mother should also be taught to recognize the signs of dehydration and subsequently seek medical attention where ORS would be administered. Medical support will be necessary for most mothers to effectively handle a child with severe dehydration—without a more medical understanding, it is hard for mothers to believe that such a child should be given so much fluid. Community education efforts should thus stress: 1) increased use of home available fluids; 2) continued feeding; and 3) appropriate, timely referral to the medical unit. Those countries urging home use of ORS packets should carefully monitor the volumes used, and determine whether mothers are getting medical help for the more severely dehydrated children.


During a one year study, the authors investigated the etiology and epidemiology of acute gastroenteritis in 416 children admitted to hospital or treated as outpatients in Sweden. The clinical features of gastroenteritis caused by rotavirus, enteric adenovirus, and bacteria, were shown to exhibit certain patterns that can be useful in accurate diagnoses.

One-hundred sixty-eight cases of rotavirus diarrhea were compared with 32 cases of enteric adenovirus, 42 bacterial, 16 mixed, and 135 non-specific infections. The clinical features of rotaviral infections presented a consistent pattern: sudden onset of vomiting, frequent fevers and dehydration, and diarrhea lasting 5.9 days. In the cases of enteric adenoviruses, diarrhea lasted much longer, 10.8 days. The bacterial infections were characterized by abdominal pain, bloody stools and prolonged diarrhea lasting 14.1 days. Mixed infections were not more severe than the rotaviral diarrhea, although they caused diarrhea that lasted longer (eight days). The 135 non-specific cases of diarrhea most resembled the clinical features of the bacterial infections.

[Editorial Comment: This study illustrates some important points relative to clinical assessment and management. Fever, as shown, often accompanied diarrhea associated with viruses in the stool, as well as the much smaller number of
"bacterial diarrhea." Thus, the current recommendation to not use antibiotics in the usual case of acute watery diarrhea can be well understood—antibiotics are not effective in treating viral infections.

Second, the authors took 4-5 days to get the patients back to full feeding. This slow resumption, in contrast to current general recommendations to return to full feeding within 1-2 days in most cases, may be partly responsible for the long duration of diarrhea in their cases. Furthermore, these cases were treated at a medical unit and thus represent only a portion of all the diarrhea cases occurring in the community, many of which do not attract medical attention.

Third, the authors did not use a separate case management protocol for cases with blood in the stool. WHO currently recommends antibiotic treatment for all patients with blood in the stool, because of the high proportion of such cases caused by shigella. Other bacterial diarrheas (e.g., E. coli) are generally much briefer in duration and do not need antibiotics. Because of this important difference, it is necessary for studies such as this to separate shigella from other bacterial causes, rather than grouping them together.

Fourth, acute and convalescent serum samples were examined for specific antibody response to the illness in only 50 percent of patients. The fact that three control children without diarrhea had a positive serum antibody response to rotavirus confirms the cited results of other European studies which show a high carrier rate of rotaviruses. This further illustrates how inaccurate it is to state that a particular agent has "caused" diarrhea when there is no supporting evidence of a rise in serum antibodies during convalescence. Investigators planning similar etiologic studies, or clinicians trying to ascribe clinical patterns to certain etiologic agents, should keep this clearly in mind.

Finally, despite statistical differences, rotaviral infections do not present distinct clinical characteristics that distinguish them from adenoviral or ETEC infections. Based on symptoms alone, it is difficult to make accurate clinical diagnoses. Blood in the stool of an acute case may be the only accurate clinical sign for distinguishing etiology and suggesting special clinical management. All other cases of acute watery diarrhea without blood can be handled well with fluid replacement and continued feeding alone. [RSN]

Pizarro, Daniel; Catillo, Bernardita; Posada, Gloria; et al. EFICACY COMPARISON OF ORAL REHYDRATION SOLUTIONS CONTAINING EITHER 90 OR 75 MILLIMOLEs OF SODIUM PER LITER. Pediatrics, February 1987, vol. 79, no. 2, 190-95.

Two oral rehydration solutions were compared for their efficacy in rehydrating and maintaining 62 infants aged 2 to 35 months with mild to severe dehydration (mean 5.11
percent initial dehydration). One group of patients received the WHO recommended ORS, containing 90 mmol/l of sodium and 110 mmol/l of glucose. The second group received Pedialyte RS (Abbott Laboratories, Ltd., North Chicago) which contained less sodium (75 mmol/l) and more glucose (139 mmol/l). The oral rehydration solutions were administered alone during an initial 6-10 hour rehydration period (longer if necessary), until the patients were successfully rehydrated. During the subsequent maintenance period, the volume of fluids administered equaled that of stools excreted. Breast milk or full-strength formula, other food for older children, and plenty of water were concurrently administered.

The two solutions behaved identically, with similar numbers of dehydration failures and other complications. Eight patients treated with the WHO solution and four infants from the Pedialyte group developed mild, asymptomatic hypernatremia (serum Na >150 mmol/l), while four patients treated with WHO formula and six with Pedialyte had mild asymptomatic hyponatremia (serum Na <130 mmol Na/l). Three infants from each group had to be treated with IV fluids because of high stool outputs or other reasons.

Clinical observations and laboratory results, including normalization of serum electrolyte values, and sodium and potassium concentrations in stool and urine, were similar in both groups. Pedialyte RS was thus found to be a safe oral rehydration solution.

[Editorial Comment: There is no magic about the 90 mmol/l of sodium used in the WHO recommended formula for ORS. It represents a compromise between an appropriate concentration for rehydration, and a concentration ideal for maintenance during continuing diarrhea. Dr. Pizarro and his colleagues demonstrate that a slightly lower concentration also works, both for initial rehydration and for maintenance. During maintenance, they put patients on full-strength milk formula or breastfeeding (with other food in older children) and freely administered water. The early feeding doubtless improves the absorption of fluid and shortens the diarrhea, as well as improving nutrition.

What is magic is the importance of having a single solution to prevent confusion in national diarrhea programs. When national communication efforts in countries with more than one solution type or packet size must attempt in their messages to instruct mothers (or physicians) about which packet or solution to use, the result may be discouraged use altogether, or even wrong or dangerous use. Therefore, it is strongly recommended that multiple ORS formulas be avoided if possible. The needed variation in concentration of electrolytes between rehydration and maintenance can be handled perfectly well by giving water to drink and immediate feeding, especially breastfeeding as Dr. Pizarro's study demonstrates. Both steps lower the concentration of sodium in the total fluid intake, and allow the preservation of a single solution approach. RSN]

[Editorial Comment: This 1983 study showed that citrate ORS was clinically as effective as bicarbonate ORS. Citrate has been accepted as the standard base in WHO’s recommended ORS formula, because of its better shelf-life.

The study here was done with effervescent tablets of citrate and other salts, each to be dissolved in 120 ml water. The formulation also contained vanilla flavor. All but two of 50 adults and children graded the taste as neutral (40%) or good (56%). Unfortunately, the bicarbonate ORS was not taste-tested for comparison.

While tablets of this sort could be misused by someone unable to read or understand the instructions, and flavoring in ORS might conceivably lead to over consumption, the increased convenience and good taste of this formulation urge broader testing in the community to determine if problems occur, and if the changed characteristics lead to better sales and broader use. RSN]
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The author resists the condemnation of carbonated beverages such as cola drinks by Weisman (reported in our December 1986 TLU). He notes that they have been used for years by pediatricians "without any side effects," are widely available, provide calories, and can be diluted to reduce osmolality. They are also cheaper than current commercially available oral rehydration solutions in the U.S.

[Editorial Comment: Yes, well nourished children with mild diarrhea and no clinical evidence of dehydration can tolerate these solutions and others like highly sugared tea or apple juice. Because they have little intestinal pathology, they can handle these hyperosmolar solutions, and their kidneys can adjust to the nearly total lack of electrolytes in them.

But such drinks are completely inappropriate for dehydration. It was precisely such hyperosmolar solutions which caused trouble in the 1950's in the U.S. with
hyponatremia. I also suspect that the impression that these drinks are safe may be more from a lack of objective data. How many mothers persist in using such fluids for children with more severe or persistent diarrhea? How many of the cases of hyponatremic diarrhea which are seen at U.S. hospitals have been "treated" with these hyperosmotic fluids? It would be preferable to recommend water along with some source of starch (rice gruel, toast, other cereal products) than to recommend these drinks.

The point about price is sad but true in the U.S. Why is it that mothers in many developing countries can buy a packet of ORS for a few cents (cost of manufacturing and materials is no more than U.S. $0.10 per liter packet in Europe), but in the U.S. no ORS packets are being commercially distributed, only the pre-mixed solutions?

Sarker, S.A.; Wahed, M.A.; Rahaman, M.M.; et al. PERSISTENT PROTEIN LOSING ENTEROPATHY IN POST MEASLES DIARRHEA. Archives Disease in Childhood, 1986, vol. 61, 739-43.

This study sought to quantitatively assess the duration and amount of protein lost during post-measles diarrhea (i.e., diarrhea cases with a history of measles in the two weeks preceding admission). Children aged 6 months to 6 years presenting with less than 5 days of diarrhea, were selected for the study at the ICDDR,B. The first group of 19 children had had measles 2 weeks prior to the diarrheal episode. The second group (15 children) had no history of measles during the preceding 6 months. All children were rehydrated and maintained with WHO recommended ORS and given early feeding with rice and chicken curry.

Alpha-1 antitrypsin was used as an endogenous marker to determine fecal clearance of protein. Data collected indicated that protein-losing enteropathy occurred during diarrhea with or without measles, but in cases with post-measles diarrhea, it was more severe and prolonged. It was more severe in children with post-measles shigellosis and diarrhea caused by ETEC than in cases associated with rotavirus. The higher clearance of alpha-1 antitrypsin in post-measles diarrhea may be attributed to direct action of measles virus on the intestinal mucosa. Persistent protein losing enteropathy may be an important factor in the development of malnutrition after post-measles diarrhea.

1 Feachem and Koblinsky, in their article, "Interventions for the Control of Diarrhoeal Diseases among Young Children: Measles Immunization" [Bulletin of WHO, 61(4): 641-652 (1983)], distinguish between two types of measles-associated diarrhea: with-measles diarrhea (diarrhea starting between one week pre-rash-onset and four weeks post-rash-onset), and post-measles diarrhea (diarrhea starting 4-26 weeks post-rash-onset). The measles-associated diarrhea discussed in the Sarker, et. al. article is characterized by Sarker, et. al. as "post-measles," but would fit in the "with-measles" category of Feachem and Koblinsky.
These results emphasize the importance of measles as a precipitating factor leading to diarrhea and malnutrition. The data suggest either that measles has directly affected the intestinal epithelium producing protein-losing lesions in addition to those produced by the acute cause of the diarrhea (Shigella, ETEC, or rotavirus) or that previous measles infection has caused the impact of the subsequent infection to be greater. It may be postulated that the mechanism for this enhancement of pathologic effect is lowered immune resistance, a phenomenon well documented after measles infection.

The study documents important protein loss during ETEC and rotavirus diarrhea, as well as during shigellosis -- as much as 135, 60, and 160 ml of serum respectively on the first day. Even that is probably an underestimation due to the breakdown of some alpha-1 antitrypsin in the gut. The Shigella post-measles cases had also a decrease in their serum albumin levels. This suggests again the importance of adequate early feeding during and after diarrhea, particularly dysentery, and particularly post-measles diarrhea of any sort. RSN]
even in most research labs, the ELISA and DNA probing techniques offer promise as new research approaches, if not as routine lab tests.

The authors do not mention why children under one year were not included. Such children might have had higher incidence of Campylobacter diarrhea.

To be included in the study, all children had to have stool positive for occult blood. It is of interest, then, that visible blood was seen by the nurse in only 124 of the 200 children's stools, and by the family in only 85 children. Greater than ten white blood cells (WBC) per high power field were seen in microscopic stool exams in only 63 of the 200 children. In this last, most selective group, 79 percent had Shigella, compared to 60 percent and 62 percent Shigella in children with blood seen by the nurse or reported by the family respectively. Texts often mention stool microscopic exams for WBC as an important diagnostic tool in cases of dysentery. These results indicate that such an exam can give a slight improvement in the accuracy of clinical diagnosis of Shigella infection without culture. Practically, however, the data suggest that the extra work may not be worth the effort. The appropriate clinical response would be to treat for Shigella those children with visible blood or blood reported by the family.

The data also shows that a history of mucous in the stool without blood is not very helpful to the clinician. A test for occult blood, a quick and easy procedure, was associated with a Shigella isolation rate of 44 percent.

Bhatnagar, Shakuntala; Dossajh, Urmil. DIARRHOEAL DISEASE MORBIDITY IN CHILDREN BELOW FIVE YEARS IN URBAN SLUMS OF DELHI. Indian Journal of Medical Research, July 1986, vol. 84, 53-58.

The incidence of diarrhea among children 0-5 years old during the previous two weeks was assessed by a household cluster survey in four slum areas of Delhi, India in May-June 1984. The practices of mothers in treating diarrhea were also investigated.

Of 3,645 children, 26.4 percent had had diarrhea in the previous two weeks, giving a mean annual incidence of 7.9 episodes per child with average duration of 3.9 days per episode. Incidence ranged from 4.1 to 11.9 in the four areas.

Peak incidence by age was 7-12 months (13.6 episodes/child/year), followed by the 1-2 years age group (11.3 episodes/child/year). In the poorest slum, the rates were 18.6 and 15.1 for these two age groups respectively.

A mean of 24.2 percent of families sought no medical help (max. 40.4 percent), 54.5 percent were treated by private practitioners, 21 percent in hospitals, and only 0.3 percent used home remedies. Only 20.2 percent of mothers knew about ORT.
[Editorial Comment: Given the seasonality of diarrhea, the two-week incidence taken in the "high diarrhea season" cannot be directly extrapolated into annual incidences without first making seasonal adjustments (see WHO/CDD/SER/84.6). However, the data reported in this study do highlight the fact that diarrhea is a common event and may occur more than once per month in some age groups during the peak diarrhea period each year. Just how much can we expect a mother to do if her child has diarrhea every three weeks? In such circumstances, diarrhea is almost as "normal" or customary a condition of the child as not having diarrhea.

The data also point out the importance of reaching the private practitioner with instruction in diarrhea case management including ORT, especially in such urban settings. Programs which aim training and education only at government health workers will miss many patients in these Delhi slums. RSN]
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The effects of socio-economic conditions on diarrheal morbidity were the focus of a study conducted in Santiago, Chile, between 1 August 1982 and 31 January 1983. The subjects of the study were two kindergarten classes, one (Group I, n=112) in a wealthy neighborhood, the other (Group II, n=90) in an area of extreme poverty.

Parents were asked daily when they brought their child to school if the child exhibited symptoms of acute diarrhea, defined as the passing of at least one liquid stool in 24 hours. Parents were called or visited during weekends and holidays and when the child stayed home from school. Stool
samples were taken at the first sign of an episode, and investigators noted the episode's clinical characteristics, duration, and treatment. Each child's growth was also monitored monthly.

Results of the study indicate that socio-economic factors have an effect on the incidence rate and duration of diarrhea episodes. On average, Group I children had half the number of diarrhea episodes as Group II (20 vs. 38), and 75% of the episodes in Group I lasted 1-2 days, as compared to 34.2% in Group II. The mean monthly number of episodes per 100 children was 3 in Group I and 7 in Group II. Whereas the percentage of those excreting bacteria was similar for the two groups, the percentage of those passing parasites was much higher in Group II.

Physically, children in Group I weighed more and were taller than Group II children. Children in Group I who stayed well during the study were generally heavier and taller than those Group I children who had diarrhea; this finding was not observed among Group II children.

[Editorial Comment: This report provides confirmation of the frequently observed finding that wealthier children are healthier and bigger than poor ones.

Perhaps more importantly, however, it provides an illustration of the difficulties of doing meaningful research on diarrhea epidemiology.

The authors, presumably for convenience, used study groups selected by virtue of their attending two kindergartens. One wonders if those children attending even the poorer kindergarten were not better off than similar children from their neighborhoods who were not able to attend kindergarten. Also, the ages of the children (mean ages of 46 and 52 months for the two groups) were well past the peak period of diarrhea incidence (6-24 months). The small size of the groups and the low incidence of diarrhea make it impossible to conclude much from their lack of any severe cases needing hospitalization, particularly since both groups were generally well-nourished (there is a nationwide government-sponsored food supplementation program for poor children in Chile). The researchers wanted to investigate possible differences in etiology, as well as seek healthy carriers. Unfortunately, they were unable to perform tests for enterotoxigenic E. coli, and examined only children with diarrhea for rotavirus. Their decision to treat children found during the initial baseline exam to have pathogens in the stool even though they were not sick, may have seriously influenced the further results of the study. Given what we already know, these gaps in their methodology make their study unable to advance our knowledge significantly.

Other things they were able to observe under these circumstances are of interest. The wealthier mothers tended to feed their children better during diarrhea--only 12.5% of them severely restricted feeding compared to 65.2% in the other group. Also, the carrier rates for Giardia in both groups were high--27% and 55% for the rich and poor groups, respectively.
The lesson is that worthwhile projects in diarrhea epidemiology demand big efforts—study groups truly representative of the community and of the highest risk age groups rather than convenience samples, adequate sample size based on preliminary calculations of expected findings, difficult lab studies, and complex analyses. The benefits from less rigorous investigations may not be worth their cost. RSN]


An ophthalmologist examined the eyes of children 0-5 years in a national household survey. Weight, height, and arm circumference measurements allowed nutritional assessment as well. Receipt of a vitamin A capsule during the previous six months from the national vitamin A distribution program was also assessed.

The prevalence of binocular blindness was 6.4 per 10,000 children, 75% of it due to malnutrition. The prevalence of severe visual impairment, including monocular and binocular and marked corneal scarring, was 26.8 per 10,000. Night blindness was seen in 3.6% overall, ranging from 0.5% at one year of age to 6.7% at five years, with a higher prevalence among males. Drying of the conjunctiva (xerosis) was seen in 1.9%, and Bitot's spots in 0.9%. Active corneal lesions and corneal scars from vitamin A deficiency were seen in 10.2 and 25.2 per 10,000, respectively.

Aside from age and sex, premature cessation of breastfeeding, diarrhea, and measles were the most important indicators of risk of eye damage. More than half of the children with active or old corneal lesions had a history of diarrhea within four weeks before the reported onset, and all the children with the most severe lesion, keratomalacia, had recently had diarrhea. Children with any type of xerophthalmia were more emaciated and stunted than non-xerophthalmic children. Forty-five percent of the children had been given vitamin A capsules (VAC) during the past six months. Night blindness rates ranged from 4.3% in areas with under 25% coverage of VAC to 2.7% in areas with over 75% coverage, and active corneal lesions were three times less common in children given the capsules.

[Editorial Comment: These results are important to persons concerned with diarrhea because of the close link between diarrhea and nutritional blindness in countries such as Bangladesh, where vitamin A deficiency is prevalent. In such circumstances, special regular attention to looking at eyes and asking about symptoms of night blindness should be part of the management of every case of diarrhea seen by a health worker, and part of the ORT messages taught to mothers. Measles immunization, too, is a powerful tool for preventing both diarrhea and nutritional blindness. We all await further data as to whether administration of VAC will reduce overall mortality and diarrhea rates. RSN]
Jinadu, M.K.; Ojofeitimi, E.O.; Osifor, E.O. FEEDING PATTERNS OF CHILDREN WITH PROTEIN-ENERGY MALNUTRITION IN NIGERIA. Tropical Doctor, April 1986, 82-85.

The main objective of this study was to investigate the socio-cultural factors behind the development of protein-energy malnutrition (PEM) in Nigeria. One hundred fifteen children suffering from PEM were seen at the pediatric outpatient clinic of Ile Ife University Teaching Hospital in Nigeria between December 1978 and May 1979. A questionnaire was designed to determine the personal characteristics of the children and their parents, and to determine their feeding practices: breastfeeding, artificial milk, supplementary and weaning foods, food preferences, and taboos.

The interviews showed that almost all the mothers breastfed their children for at least five months: one-third had stopped by 12 months, and about two-thirds of the mothers stopped by 17 months. Feeding other foods began very early, however, first with artificial milk for a few months prior to six months of age, then "corn pap," a thin gruel, in 91% by six months. Solid starchy foods, such as "yam" and "hard-pap" were not started until after 12 months in 84% of children. No meat or fish were given by 80% of the mothers, because it was felt that these foods would cause worms, abdominal pain, and loss of weight. Two-thirds of the mothers would not feed their children cow's milk, groundnut, or cowpeas, because they felt these foods would cause diarrhea. The major causes of PEM in this study were, thus, attributed to the cessation of breastfeeding, inadequate feeding of artificial milk, and inappropriate beliefs about weaning foods.

[Editorial Comment: The authors note that modernization has led to a reduction in duration of breastfeeding, which used to be continued past the second year in this area of the world. The corn pap which supplements the breast is low in caloric density--only 70 grams of carbohydrate (280 calories) per liter, in contrast with milk, which has more than 600. Add the cultural taboos regarding needed foods like fish, eggs, and meat, and you get acute malnutrition.

The article does not comment on diarrhea as a precipitating factor, but we can expect, based on data from elsewhere, that the early supplementation of breastfeeding (well before six months) leads to more diarrhea because of contamination in the supplemental foods, poor hygiene of feeding bottles, etc. Breastfeeding must be exclusive to maximally prevent diarrhea; this is possible during the first 3-5 months of life; after that, supplemental foods are required to maintain steady growth. In the presence of inadequate caloric intake, such diarrhea will have a greater negative nutritional impact. RSN]

This study attempted to discern the effects of adding glycine to an oral rehydration solution containing 60 mmol/L sodium and glucose in varying concentrations. Two glycine supplemented ORS (one containing 80 mmol/L glucose and 60 glycine, the other containing 110 glucose and 110 glycine) were compared with a standard ORS containing 144 mmol/L glucose alone in the treatment of diarrheal dehydration in children. The patients treated with the 110 glycine ORS had poor weight gain and increased stool and urine volume after rehydration. The 60 glycine ORS had comparable effects on stool and urine volumes as the standard 144 glucose ORS. On the basis of these results, it may be concluded that no improvement can be expected from the addition of glycine to a 60 mmol/L sodium ORS. Indeed, an excess of glycine in relation to sodium in an oral rehydration solution may lead to osmotic diarrhea, osmotic diuresis, and poor net rehydration.

[Editorial Comment: Calcutta studies showing higher effectiveness of a glycine supplemented ORS (WHO formula) prompted the authors to try a similar approach in Finland. Glycine, an amino acid, is absorbed by the same kind of sodium-linked mechanism as glucose, but a different one. Using both mechanisms at once might allow more salt and accompanying fluid to be absorbed, reducing stool volume and hastening rehydration. The failure of the approach may largely be related to the low sodium in the ORS formula used in their studies: only 60 mmol/L compared to 90 mmol/L in the WHO formula. Since the sodium absorption is what carries the water in, you need to have a good supply around to make the mechanism work. But the hypertonicity of the ORS containing 110 mmol of both glucose and glycine per liter may also have attracted fluid into the intestine and produced the greater stool volumes seen in that group. Those patients also had higher urine volumes, possibly because some of the glycine absorbed was not metabolized and was excreted in the urine, carrying water along with it (osmotic diuresis). The glycine-glucose solution with the same total molarity as their glucose-ORS (80 glucose + 60 glycine, compared to 144 glucose) showed no advantages over the straight glucose solution. The authors discuss the possibility that the greater proportion of rotavirus in their study group (around 60%) may have caused their poor results. This implies that if they had had patients with secretory diarrhea (e.g., cholera), their solutions would have done as well as Patra's in India. Perhaps, but I doubt it, for the reasons noted above. For rehydration to occur, an adequate amount of sodium is required. Maintenance can be done with 60 mmol/L sodium, but rehydration appears to need more.
More fundamentally, these studies, and those in a number of other countries, suggest to me that glycine is not as promising a substitute or supplement as is starch from cereals. Unlike starch, glycine adds to the osmotic load, and may lead to a further shift in the balance toward osmotic diarrhea. Add to that the possibility raised here of osmotic diuresis from non-metabolized glycine, and my attention in the future is going to be on the cereal-based solutions. RSN]
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Two hundred fifty pre-school children from a rural village in Ghana were examined in this follow-up study to determine the age-specific incidence rate of diarrhea and the effect of nutritional status on the incidence of diarrhea. A preliminary census was undertaken before active surveillance of the children began in August 1982. According to median WHO reference standards, the children’s mean weight-for-age ranged from 81-97%, while the mean height-for-age ranged from 91-101.4%. Approximately 60% of the children were classified as normal (according to Waterlow, 1973), 27% thin, 9% stunted, 3% wasted, and 0.9% both stunted and wasted.
Mothers were asked to assemble at a central location weekly for an interview; the assessment of diarrhea incidence was based on information gathered at that time. The mean number of annual contacts was 24.4 of the desired 52. Children with no recorded episodes of diarrhea attended the sessions a mean of 21.5 times over the year, while those with 6-14 episodes attended a mean of 33 times. As recorded by this method, the mean incidence of diarrhea was 1.9 episodes per child per year with the highest incidence rate found in children between 7-12 months old. It seems that food contamination is the main cause of diarrhea in this age group, since solid weaning foods are normally introduced to babies in Ghana after the age of four months. Children who were less than 80% of the standard weight-for-age at the start of the study had significantly more diarrheal episodes recorded. The mean recorded incidence of diarrhea per year increased as both height-for-age and weight-for-height decreased. The authors thus concluded from their data that malnourished children have more cases of diarrhea.

[Editorial Comment: This paper illustrates sadly the pitfalls and difficulties of research in diarrhea epidemiology. The data shows that mothers will not consistently attend a weekly examination session: 13.6% of the group came less than 10 times during the year. The authors do not state that they asked only about diarrhea in the previous week; if a longer period was used, data will be suspect, as mothers will forget mild episodes. Children from 0-6 years were studied. Numbers were greater in the youngest age group, but each age group had only a small number of children. Widely different age groups were combined in some of the analyses. We are not told in the report how the authors attempted to avoid confusing diarrhea present in the previous week from diarrhea beginning in that week.

These flaws in methodology make it impossible to accept the authors' conclusions, which differ from those of studies in which diarrhea incidence is determined on the basis of weekly or even more frequent home visits. Such studies show that diarrhea incidence remains the same in different nutritional states; only the duration of episodes changes, being longer in children with poor nutrition levels.

Active surveillance at the household is essential for studies of diarrhea incidence. Passive methods demanding that the mother travel or remember diarrhea episodes for more than a week, give false data and are not acceptable. RSN]


Recent clinical and field research provides evidence--but not proof--that vitamin A deficiency (VAD) causes increased incidence of diarrhea in children.
Demonstrated decreased absorption and intake of vitamin A during diarrhea, and the finding that a high proportion of xerophthalmia cases have had diarrhea recently (see Cohen et al. article in TLU, vol. II, no. 6), suggests that diarrhea may lead to VAD and xerophthalmia.

The author reviews critically the evidence from existing studies relative to these two possible conclusions. He concludes that the studies said to prove that diarrhea leads to xerophthalmia do not prove this relationship; it could be explained by confounding factors (e.g. socio-economic factors leading to a high incidence of both conditions) or by VAD being a cause of diarrhea. He says the studies showing a linkage between night blindness and prolonged and dysenteric diarrhea cannot be taken as final evidence that diarrhea is a risk factor for xerophthalmia because of possible confounding by general malnutrition (<80% weight-for-height).

VAD is known from clinical and lab studies to affect various functions of epithelial surfaces in the intestine and respiratory tract, such as bacterial colonization, and immune competence. Observational studies in Java, Indonesia, by Sommer showed high risk of mortality (3 to 9 times) in children with xerophthalmia, and a 3-fold increase in diarrhea incidence, even among well-nourished children. An intervention study in Sumatra by Sommer led to the conclusion that giving high-dose vitamin A capsules twice a year reduced mortality among the supplemented children by 34%. Diarrhea incidence or specific diarrhea mortality were not reported. Feachem notes the multiple expressions of criticism of the studies and their conclusions. He draws attention to the fact that VAD is usually much more prevalent in a population than the rate of observable xerophthalmia (night blindness or Bitot's spots), which may explain why the impact of VA capsule supplementation was so much higher than the observed prevalence of VAD. He concludes that it is likely, although not definitively proved, that the supplementation did reduce diarrhea mortality rates.

Feachem advises that it is not possible on the basis of existing evidence to recommend VA administration to all children with diarrhea, either as capsules or as VA fortification of ORS, to prevent xerophthalmia. It may be useful to treat children with multiple episodes of severe diarrhea with VA, in order to reduce their risk of subsequent diarrhea, as well as to reduce the severity of the current episode; but experimental studies of this policy are not yet completed. He concludes by reviewing studies in this area needing to be done.

[Editorial Comment: This is one of the series of WHO-CDD program-supported reviews of possible interventions to prevent diarrhea, and Feachem, as in previous reviews, carefully sifts through and weighs the existing evidence for a relationship between VAD and diarrhea, for treating diarrhea cases with VA, and for giving VA capsules to populations to prevent diarrhea. We in the business of]
controlling diarrhea would love to be told that merely passing out VA capsules, like a sort of nutritional immunization, would prevent death from diarrhea. Sommer's studies in Sumatra raised that hope. Feachem says we need more evidence before we can be confident advocates of this policy.

A broader question, one not discussed in the review, is whether VA might reduce diarrhea and other infections in populations where clinical VAD, such as xerophthalmia, is not widespread. At what degree of VAD might its effect on diarrhea incidence begin? Would extra VA make epithelial surfaces even more resistant to infection than normal? Answers to such questions will determine the extent to which VA supplementation may be useful in whole populations, or may need to be targeted to high risk groups, such as children with severe or recurrent diarrhea or with malnutrition.

This area has tremendous potential and deserves our continuing close attention. RSN]


Three methods of measuring behavior—direct observation, knowledge-attitude-practice (KAP) surveys, and recall questionnaires—were compared during a sanitation and hygiene study for their efficacy in determining sanitary practices related to water storage, handwashing, and defecation.

Conducted among 255 households in the slums of Dhaka, Bangladesh, between October 1984 and January 1985, the study was divided into three phases: the KAP questionnaire comprised the first; the second was the 24-hour recall of hygiene questionnaire, conducted 6-14 weeks after the KAP survey; and thirdly, on-site observations were held 1-3 months after the KAP survey. All phases focused on each household's primary caretaker of children and her handwashing and defecatory practices. The three measurement instruments were developed by a physician, an anthropologist, and local field staff, and were pretested for their appropriateness. To decrease the chance of biased responses and data recordings, interviewers and interviewees were not informed of the study's objective to compare the instruments' results.

The results from the KAP and recall questionnaires were not consistent with the data from direct observation. Because of the problems that could arise from using such inaccurate information, Stanton, et al. suggest that KAP and recall surveys should only be conducted when limited time and resources do not allow for direct observation.
[Editorial Comment: This elegant study demonstrates what we have long known but often choose to ignore: that people often do not actually do what they say they do.

How often this discrepancy occurs doubtless varies according to environment (e.g., urban vs. rural), respondent (e.g., rich vs. poor, educated vs. uneducated), and topic (e.g., ORT practices vs. sanitary practices). The authors conservatively confine their conclusions to urban Dhaka slum dwellers and sanitary practices. I suspect there are few circumstances, however, in which observation is not significantly more accurate than retrospective surveys, even the 24-hour recall type.

What implications should this have for the methods used to assess diarrhea disease control programs? Should we throw out all questionnaires and only do observation? The answer, of course, is no: cost and feasibility demand the use of surveys to cover large populations. But we must include in our evaluation methods enough observational studies to assure us that the conclusions being drawn from retrospective questionnaires are reasonably valid. That will require more observational studies—and more cost—than at present. RSN]
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The purpose of this study was to clarify the relationship between nutritional status and diarrhea, since previous studies have produced conflicting findings. During April-December 1976, the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), monitored 1,455 children in 12 villages for diarrhea, weight, and height.

Each child's nutrition status was determined by measuring weight and height bi-monthly and calculating weight-for-age, height-for-age, and weight-for-height as percentages of the national median figures. Field workers questioned each mother weekly about whether the child had experienced any diarrhea (at least three watery stools per day) and how long the episode had lasted.
The study confirmed earlier studies' findings that there is a direct relationship between age and diarrhea incidence: the younger the child, the more prone he/she is to diarrhea. Results also indicated that a malnourished child does not have more bouts of diarrhea; however, malnutrition, as measured by both weight-for-age and weight-for-height, was associated with more prolonged episodes. Weight and height gain slowed in children who had diarrhea for more than 10% of the study period.

[Editorial Comment: This reports the first longitudinal diarrhea study in Matlab. The incidence of diarrhea was lower (1.3 episodes per year) than in other studies (4-5 per year), suggesting that mothers reported more severe cases only. The findings support previous conclusions that malnutrition does not increase the incidence of diarrhea, but does lend to more prolonged episodes, which then produce growth retardation. Here is that vicious cycle in action. RSN]


Boston pediatricians concerned about the ability of parents to follow instructions looked for hypernatremia and incomplete hydration in children treated with either WHO standard formula ORS (90 mmol Na per liter--Group I) or low sodium ORS (30 mmol Na per liter--Group II) at home. The patients were checked 24 hours after for serum sodium and dehydration. Volume of ORS consumed was assessed by history. Other feedings were not recommended during the first 24 hours, nor was administration of free water. Results showed that 55% of the dehydrated patients did not take enough ORS at home to repair their dehydration. No patients given WHO formula became hypernatremic, despite lack of free water. The investigators recommended that, in future, hydration of dehydrated patients be conducted under supervision for 4-6 hours to ensure adequate fluid intake. They conclude that the high sodium WHO formula is safe to give outpatients over 24 hours.

[Editorial Comment: It is encouraging to have U.S. hospitals studying these topics. Their conclusions are no surprise. WHO formula ORS has been used safely for rehydration, with no important hypernatremia, in all types of infants, even neonates. The observation of inadequate intake at home and incomplete repair of dehydration is important. It reinforces the idea that all patients with diarrhea should receive fluid at the treatment center, and those with some dehydration should be rehydrated under observation. Given that feeding usually improves absorption, hydration might have been even better at 24 hours had the parents been asked to resume feeding.
One should note that the ORS used in this study was pre-mixed, i.e., in liquid form. Thus, these investigators did not have to worry about hypernatremia resulting from preparation of a too-concentrated solution by incorrect mixing of a packet of ORS. Where packets are the norm, clear instructions about mixing with demonstration, as well as instruction on dosage, become critically important. RSN]


Admissions and deaths at the hospital of the ICDDR,B in Dhaka were analyzed. Shigella constituted 13% of admissions and 19% of deaths. The patients who died with Shigella were significantly more malnourished and had more associated complications (pneumonia, septicemia, meningitis) than other patients. The crude fatality rate overall was 6 deaths per 1000 patients attending the Outpatient Department, and 123 deaths per 1000 cases admitted to the hospital. The authors noted that the Dhaka admission policy selects complicated cases.

[Editorial Comment: The overall case fatality rates here should be remembered when evaluating the quality of care at hospital facilities or during cholera epidemics, keeping in mind the role of admission policies in affecting that. The crude fatality rate is only 9/1000 for admissions at the Matlab hospital, where uncomplicated cases are admitted.

The Shigella data reinforces my feeling about a close relationship between Shigella and malnutrition. We need studies to establish whether Shigella leads to malnutrition, or malnutrition to Shigella. RSN]


Daily surveillance studies showed that 10% of 392 diarrhea episodes lasted more than ten days, 3% more than two weeks. More than half (57%) resolved in three days, 84% in one week. No particular seasonality or etiology was identified for the prolonged episodes. All twelve diarrheal episodes lasting longer than two weeks occurred among the seven children with 16% or more of their total days spent with diarrhea.

[Editorial Comment: Other populations have up to 23% of episodes prolonged (>14 days). As diarrhea is more prolonged in malnourished children, the proportion should depend, at least in part, on the prevalence of malnutrition.

The authors raise the question about what period should be considered prolonged, e.g., 14 or 21 days. Recent
unreported studies from India (Rohde, personal communication) indicate that adverse nutritional outcomes, defined as >5% change in weight-for-age between weighings, increase substantially at 14 days duration. We await this data eagerly, as such a criterion seems very meaningful. RSN


In a double-blind trial in U.S. infants with gastroenteritis, an oral rehydration solution with 50 mmol Na per liter, 111 mmol glucose per liter, and 111 mmol glycine per liter was no better at reducing stool output or duration than the same solution without glycine. Four of the 31 hospitalized infants receiving the glycine solution developed hypernatremia.

[Editorial Comment: It looks as if glycine is not going to work well in ordinary pediatric diarrhea, despite its earlier good performance in cholera patients, and in one pediatric study. The problem seems to be osmotic load; there is no extra benefit per osmole as there is with cereal starches. I believe starches will be the basis for the Super ORS of the future.

P.S. Early feeding is the real "Super ORS." RSN]
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Five different instructions for preparing a sugar-salt solution for early home treatment of diarrhea were tested for their effectiveness in communicating to low-income mothers in Cape Town, South Africa, how to mix the solution correctly. The instructions compared use of a cup versus use of a liter container as the volume measure for the water, and pinches versus level teaspoons versus half-level teaspoons versus 5 ml medicine-dispensing spoonfuls as the measuring tools for the salt and sugar. Mothers were asked to prepare solutions according to one of five sets of instructions. The sugar and sodium concentration, the osmolality, and the volume of the measuring devices actually used by the mothers in making the solutions were then determined.
The results showed that instructions for use of a half-level teaspoon of table salt and eight level teaspoons of cane sugar in one liter of water produced the safest, most accurate solutions. The variation which resulted from use of the cup measure, the level teaspoon of salt, and the pinch of salt was so wide as to produce an unacceptably large percentage of hyper- and hypo-osmolar solutions. The 5 ml dispensing spoon had greater volume than the teaspoons provided by mothers (range of volume of the majority between 2.5 and 4 ml), and led to hyper-osmolar solutions. In the taste test, 16 of 25 mothers identified a sodium concentration of 140 mmol/l or more as tasting similar to their own tears, with nine of the 16 choosing a solution greater than 180 mmol/l. The authors concluded that using taste could lead to the administration of excessively salty solutions and should not be recommended.

[Editorial Comment: This simple, but elegant, study is an excellent example of the kind of study needed by most DDC program managers to make decisions about messages on home therapy. In this environment, the liter measure was more accurate; in another, the cup, glass, or other culturally dependent measure may be more likely to be correct and consistent. That is why such studies are needed in each different cultural setting.]

The taste studies disappointed me. I had thought that this very human and homely approach was probably useful. This study shows that it is not, that most mothers in this setting did not pick the correct solution. I might point out that, in similar fashion, mothers in certain cultures use home-available solutions to treat diarrhea which have either too much or too little salt and/or sugar.

The sad conclusion must be that indigenous cultural practices are not always appropriate physiologically, and need careful study and, perhaps, modification. RSN]


A national-level anthropological study of knowledge, attitudes, and practices related to diarrhea was carried out in Bangladesh to provide the basis for an effective program to market ORS there. The study used open-ended questions and probing techniques to obtain a wider range of answers. Four different types of diarrhea, each with a different name, were identified by respondents: cholera-like, bloody, greenish/yellowish diarrhea with mucous, and "simple" diarrhea. Bloody diarrhea was often seen as more dangerous than vomiting diarrhea (cholera). Forty-two percent said diarrhea might usefully purge bad elements from the body, but purgatives do not seem to be used as treatment.

Although most (75%) recognized that diarrhea leads to weakness and/or fatigue, the symptom of a sunken fontanelle was virtually unknown. There was no term commonly used to express the idea of dehydration.
Ninety-two percent of the respondents recognized ORS, and 86% said ORS was used to cure or treat diarrhea; only 16% said ORS overcomes water loss. Fifty-nine percent had used sugar-salt solution, 58% ORS. Some respondents said ORS is too expensive for them.

Seventy-four percent said babies in their families refuse or do not like ORS, but 36% of this group nevertheless forcefeed ORS to their children. Seventy-one percent said ORS is as good or better than pills. Solid foods are restricted during diarrhea by 75% of the respondents. Only 8% said they restrict breastfeeding.

Most respondents seek help from allopathic practitioners, either trained or untrained, if diarrhea is serious. Radio is a source of information about diarrhea for 60% of respondents.

[Editorial Comment: Once again, it is precisely this kind of anthropologically derived marketing study which is needed by every diarrhea control program if its communication efforts are to be successful. RSN]


Of the 245 strains of Vibrio cholerae E1 Tor isolated in Kenya in 1983, 184 were resistant to tetracycline, streptomycin, and ampicillin. All were sensitive to chloramphenicol and nalidixic acid.

[Editorial Comment: With the traditional treatment for cholera being tetracycline, this finding is a problem. Chloramphenicol has dangerous side effects, and nalidixic acid is expensive. Trimethoprim-sulfamethoxazole was not tested and is a potential alternative.

The presence of drug resistance makes the availability of effective rehydration facilities even more important. Even with drug-sensitive cholera, the first priority in preventing death is rehydration. Feeding along with ORS will reduce stool output and duration of cholera, just as use of effective antibiotics will. RSN]


The knowledge and attitudes about ORT and diarrhea management of community health volunteers in Haryana State, India, was assessed with a questionnaire. Three groups of 30-34 CHVs had been trained differently. A fourth served as the control group.

The results showed that almost none of the CHVs who attended only a broad, three-month basic training course and were not furnished with ORS, could prepare ORS or home
solution correctly. In fact, a majority of those CHVs who were given refresher training three times in the year after initial training prepared ORS incorrectly (only about one-third knew how). Those given repeated retraining and furnished with ORS knew ORS preparation and use well, but only one-third could prepare home solution. Ability to remember signs of dehydration increased with refresher training. Despite even the maximum training, half of the CHVs would restrict foods, compared with 80% in the control group, and 29% to 58% of the trained CHVs would restrict breastfeeding, 93% in the control group.

[Editorial Comment: This is exactly the kind of practical, operational study that diarrhea program managers need in order to make informed decisions about how they do training, and how much follow-up is needed. As might be expected, the study shows that a single training course has little long-lasting impact. Follow-up, either through refresher training or monitoring, can make a real difference.

The study also shows that special attention is needed for certain subjects where widespread cultural norms conflict with the desired lesson -- in this case, feeding during diarrhea.

It is interesting to note that Bentley's study in India showed that while mothers often said they restricted feeding, observation of actual practice showed that almost all continued feeding, and all continued breastfeeding during diarrhea. RSN]


[Editorial Comment: This review, dealing primarily with developed-country patients, nicely emphasizes the importance of high-solute feedings (high-lactose, for example) prior to a diarrhea episode in leading to hypernatremic dehydration when diarrhea occurs. The kidneys are already overloaded and cannot handle the extra burden of loss of hypotonic diarrhea fluid, especially in children younger than six months. If such diarrhea patients then receive a hypertonic rehydration fluid -- as happened during the 1950s in the U.S. with hytren (5% glucose), and with apple juice and Coca Cola today (osmolarity ±600, twice normal osmolarity, and no sodium chloride) -- their kidneys cannot compensate, and they become hypernatremic. WHO-standard ORS formula has been used by Pizzaro in such hypernatremic and dehydrated children with safety and food correction of hypernatremia. We must consider carefully our recommendations to mothers so that we do not push hyper-osmolar fluids (high in sugar, usually) on children with diarrhea.

Walker-Smith goes on to point out that post-diarrhea "lactose intolerance" may be more related to the use of high-solute milks (i.e., iatrogenic) than to a functionally commanding lactose deficiency. This corresponds to
experience in developing countries. But his assumption that post-diarrhea problems are due to a difference in allergenicity of milk in the developed versus the developing world, with diagrams blaming this on mucosal IgA deficiency, seems overly imaginative, and no data are cited. His recommendation of cow's milk-free formulas for diarrhea patients in the developing world is quite inappropriate. Breastmilk should take first priority, and other simple starchy foods second priority. Pushing any formula, implying the use of feeding bottles, is not a good idea, in general. These specific types of formulas are so expensive as to make their use by other than the few rich children in developing countries quite out of the question. RSNJ
TECHNICAL LITERATURE UPDATE

A MONTHLY REPORT OF CURRENT LITERATURE ON ORT & RELATED HEALTH ISSUES

These monthly bibliographical listings consist of selected annotated articles and/or other information which our Technical Editor, Dr. Robert Northrup, feels should be circulated to individuals concerned about ORT and related health issues. His comments, where appropriate, are appended in brackets.

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The efficacy of flavored vs. non-flavored ORS was tested in 112 children, aged 9 months (mean), with diarrhea and dehydration (mild to moderate). The solution being tested was offered either ad libitum or every 10 minutes, with the alternate being offered if the child refused on three consecutive offerings. Breast-feeding or half strength formula was started after initial hydration.

The two solutions were equally effective in correcting the initial dehydration. During maintenance over the first 24 hours, however, children in group B (flavored ORS) consumed 116% of the amount needed compared to 98% by group A. More in Group B developed hypernatremia (21% vs. 8%) and overhydration with edema (20% vs. 4%).
[Editorial Comment: This study is worrisome, as it provides the first documented evidence which I have seen that use of flavored ORS may, in fact, lead to overconsumption and consequent complications (hypernatremia, and puffiness of the face or generalized edema). We may wonder whether this would have occurred had the children not been in a hospital setting with someone pushing their mothers to give fluid every 10 minutes, and had full feeding been encouraged as actively as the fluids being studied. Nevertheless, in a situation during which many sicker children may be treated, these undesirable complications occurred.

This study does not deal with the question raised in our recent TLU Extra (Vol. II, No. 9). The bad taste of non-flavored ORS to mothers and its rejection by children not yet rehydrated may lead to the possibility that many children who need ORS will not be offered it for the current episode or a future one, and thus will become dehydrated. That problem may disappear if doctors believe strongly in ORS and communicate their conviction to mothers, so that mothers will continue to give it even though it does taste bad and the child initially rejects it.

Many commercial flavored ORS preparations also have a lower sodium concentration than the standard WHO preparation. Would the initial hydration phase have been less successful with a solution of lower sodium? Would the undesirable complications seen in the maintenance phase have occurred?

We look forward to further studies in populations, as well as in individual patients, and with alternative fluid and feeding regimens, in order to confirm and extend these important findings and provide the basis for a confident policy decision on the use of flavoring in ORS. RSN]


This article reviews a study undertaken to investigate the bacterial and viral aetiology of acute diarrhea in 245 children less than three years old in an outpatient clinic in southern India.

At least one agent of diarrhea was found in 55% of the children studied. Bacteria formed 50% of all the isolates, and viruses accounted for 32%. The single most common agent was rotavirus, followed by enteropathogenic Escherichia coli (EPEC), Shigella, and Campylobacter. Cholera and helminthiasis were rare. No child had amoebiasis.

Clinical findings were useful in the etiological diagnosis of shigellosis and rotavirus infection. Shigella infection was associated with the syndrome of classical dysentery. This occurred in children who were less than six months old and were not breast-fed. Those with watery stools were less likely to have a Shigella infection.
Vomiting was highly associated with rotavirus infection. Only 20% of the children had diseases caused by organisms that can be effectively treated with antimicrobials.

(Refer to Huq, et al., for Editorial Comment.)


(Refer to Huq, et al., for Editorial Comment.)


The Children’s Hospital in Dammam, Saudi Arabia, conducted a study to compare the incidence of rotavirus infection between 150 children aged 1-60 months with gastroenteritis and a similar non-diarrhea control group.

Results showed that 62% of the children had watery diarrhea, 39% were vomiting, 72% percent had a fever, and 30% had an associated respiratory illness. Of infants aged 7-12 months, 39.6% had rotaviruses, compared to only 7.5% of the control group. None of the control children over 36 months yielded rotavirus in the stool, whereas 15% of the diarrhea children of the same age had rotavirus. Almost 19% of the diarrhea children yielded Shigella ssp, compared to 3% of controls.

[Editorial Comment: This triplet of papers shows again the complexity of diagnosing the organisms that cause diarrhea. The Indian paper did not include any techniques to pick up toxin-producing E. coli, and hence recovered potentially causative organisms in only 55% of cases. Other more elaborate studies in similar circumstances will push that to about 75%. Still, 25% usually go undiagnosed, and most studies, including the Mohandas study here, do not use controls. The presence of many of the same organisms in healthy children as in diarrheic ones makes the use of cultures for managing cases and directing antibiotic therapy a waste of money and time in the average acute watery diarrhea case.

Because such uncontrolled epidemiological studies can be done with little additional effort in a clinic setting, they are popular among faculty members. Unfortunately, they are not likely to advance the state of medical knowledge much unless they incorporate all the known lab techniques and some new ones.

The Thai study was controlled and aimed to demonstrate that adherence of E. coli to HeLa cells could be a useful technique to differentiate pathogenic from non-pathogenic E. coli. In several children under 6 months of age there was
some—but not strong—evidence that adherence might be a useful marker: 12% of this age group with diarrhea were positive, as opposed to only 3% in controls. Still, no major breakthrough, it appears, and the fact remains that the treatment is the same in any case, i.e., oral rehydration and continued feeding.

From a clinical point of view, the Indian study confirmed once again that antibiotics are useful in dysentery (to treat Shigella) but not in ordinary acute watery diarrhea.

All three of these studies reconfirm my opinion that such microbiological studies are not currently of high priority in our efforts to control diarrhea. RSN

Colebunders, R.; Francis, H.; Mann, J.; et al. PERSISTENT DIARRHEA, STRONGLY ASSOCIATED WITH HIV INFECTION IN KINSHASA, ZAIRE. American Journal of Gastroenterology, 1987, vol. 82, no. 9, 859-864.

This study, performed at Mamo Yemo Hospital in Kinshasa, Zaire, was undertaken to ascertain the frequency and characteristics of persistent diarrhea in human immune deficiency (HIV)-infected African patients and to determine the predictive value of such diarrhea for the diagnosis of HIV infection and AIDS. Persistent diarrhea was defined as at least two stools per day of a looser consistency than usual for 30 days or more during the previous two months.

The study showed that persistent diarrhea is a common manifestation among Africans with HIV infection; 40% of the AIDS in-patients had had diarrhea lasting at least one month, and 63% of the patients had had at least one episode of diarrhea. HIV infection has become the most common cause of persistent diarrhea in Kinshasa.

Eighty-four percent of 128 consecutive patients presenting with persistent diarrhea were found to be HIV seropositive; an additional two patients had positive lymphocyte cultures for HIV despite being seronegative. Therefore, the positive predictive value of persistent diarrhea for HIV infection is at least 85%.

Cryptosporidia were found in 22% of the HIV positive patients with persistent diarrhea. Bacterial enteric pathogens were found in only 7% of the 76 seropositive and in none of the 14 seronegative patients with persistent diarrhea in whom stool cultures were performed.

Fifty-two percent of all seropositive patients reported that diarrhea had been the first symptom of their AIDS. Persistent diarrhea is most often an indicator of HIV infection among adults in central Africa, but researchers are uncertain as to the cause of the diarrhea.

[Editorial Comment: The definition of persistent diarrhea employed by the study used a 30-day cut-off, rather than the more usual 2-week time frame. Nevertheless, even with this more stringent definition, persistent diarrhea is much more common in African AIDS patients than in Americans—only 6% of American homosexual patients with AIDS-related complex...
(ARC) had diarrhea lasting more than two weeks. This may be related, like the higher incidence of diarrhea in developing country children, to environmental contamination.

AIDS-related diarrhea responds poorly to treatment. In countries where AIDS is increasingly prevalent, we have already received reports that mothers have been discouraged by this fact from taking children with diarrhea to the hospital, believing that treatment has become a waste of effort for any diarrhea. This kind of psychological response may become a significant obstacle to the success of ORT programs in countries where AIDS is growing in magnitude.


"Soy protein formulas are often poorly tolerated by infants with chronic nonspecific or postinfectious diarrhea syndrome. We found that these adverse responses may be prevented by using lactose, instead of sucrose or dextrimaltose, in soy formula. We studied 40 infants diagnosed [clinically] as soy intolerant. They were given soy formula [containing different] carbohydrate [sources] in a randomized, blinded prospective study. Stool output, stool sodium content, and symptoms were significantly improved in infants receiving a soy-lactose formula; no difference was seen in formulas with [soy and either] sucrose or maltose. Improvement occurred in three to five days in most infants. Furthermore, the characteristic frequency distribution of the favorable response to lactose suggested a specific mechanism for the inhibition of water and electrolyte losses through the bowel. The results indicate that, in the absence of lactose intolerance, a soy-lactose formula could be useful in treating chronic diarrhea and secondary protein intolerance." (From the article's abstract, p. 1069.)

[Editorial Comment: I include this paper from a sense of irony. Much attention is given to lactose intolerance as a cause of persistent or chronic diarrhea, and in developed countries and among wealthier patients in developing countries, soy-based formula is often prescribed as the treatment. Some doctors routinely recommend such shifts away from lactose-containing formulas during acute diarrhea, in contrast to current WHO treatment guidelines.

This paper shows where this direction leads: to apparent intolerance in some of those same patients to the soy formula and the need to return to lactose, that is, to a more natural product.

The study clarifies that the intolerance is apparently to sucrose or dextrimaltose, not to soy; but still, I continue to be impressed with the complexity of the causes of chronic diarrhea, and the difficulty of finding a single simple answer in that area. RSN]
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"An attempt was made to detect Clostridium difficile and its toxin from the stools of 20 patients with antibiotic-associated diarrhea (AAD), 35 with colitis, six with chronic diarrhoea and 300 with watery diarrhoea. Two toxigenic and three non-toxigenic strains were isolated from patients associated with anti-microbial therapy. All 400 stools from watery diarrhoea patients, not associated with antibiotics, were negative for Cl. difficile and its toxin. We conclude that Cl. difficile might be a cause of AAD in Bangladesh." (Reprinted from the article, p. 189.)

An excellent review article summarizing studies in this area, the importance of which increases as the indiscriminate use of antibiotics spreads.

[Editorial Comment: These two articles are included to emphasize the real dangers of casual antibiotic use in managing diarrhea. Such therapy kills normal bacteria in the colon that customarily inhibit or suppress the pathogenic bacteria, C. difficile. With these inhibitors gone, the pathogen is able to multiply and produce toxins which damage intestinal cells and the epithelium of the colon, resulting in colitis or inflammation of the colon. While this may produce only a few loose stools in mild cases, it may present as bloody dysentery, as toxic megacolon with severe toxicosis, fever, and prostration, or as perforation of the bowel, and may be fatal. Treatment of this avoidable and often doctor-produced complication is complex and expensive, demanding vancomycin, bacitracin, and metronidazole, along with extensive supportive therapy in the more ill patients. Relapses occur in 25-50% of patients. Most commonly used antibiotics have been associated with AAD.

In short, antibiotics not only have no beneficial effect in most types of acute watery diarrhea, they may produce serious complicating colitis and a persistent, hard-to-eliminate infection. Their use in diarrhea should be confined to only those circumstances when they are useful: dysentery and cholera, primarily. RSN]
[Editorial Comment: I disagree with these conclusions. While they may apply to most cases of diarrhea, they are not appropriate in cases with more severe purging, especially when continued over some days, such as with cholera cases. I personally recall cases given adequate volumes of non-base-containing fluids at other hospitals and referred to our hospital in Dhaka with apparent renal shutdown or failure to correct vascular hypotension. Arterial pH in these cases was sometimes below 7.0! Administration of nothing but bicarbonate intravenously resulted in the restoration of renal functioning and correction of hypotension and blood flow.

A major concern of WHO’s Control of Diarrheal Diseases program is to avoid a multiplicity of ORS preparations. If we accept that base or base precursor is needed to manage more severely purging cases, then we should include it in the basic ORS preparation which is being distributed, even though it may not be strictly necessary in less severe cases. It seems quite inappropriate to recommend use of intravenous bicarbonate in more severely purging patients or those with low pH, worsening acidosis, or renal shutdown, as the authors do, and then to argue that base should be eliminated from ORS preparations that might be used in the home or peripheral clinic to prevent or reduce the severity of dehydration and metabolic derangement in such severe cases.

In short, despite the various problems which the inclusion of base in ORS may create, we should not eliminate it. RSN]


Three hundred children aged 5-24 months were enrolled in a longitudinal study in Teknaf, Bangladesh, to study the relationship of dysentery and watery diarrhea to different types of malnutrition. Each house was visited weekly by a health assistant. Five anthropometric surveys were done at six-month intervals over two years. Dysentery was defined as diarrhea plus mucous and/or blood in the stool.

The investigators found the incidence of watery and dysenteric diarrhea to be the same. They confirmed the previously reported lack of association between diarrhea or dysentery incidence rates and any anthropometric indicator of malnutrition. The duration of episodes of watery diarrhea was unrelated to nutritional status. Dysenteric diarrhea, however, lasted significantly longer in severely underweight and stunted children. The degree of stunting was the strongest anthropometric predictor of the length of a dysentery episode.

The authors conclude that the key elements in the relationship between diarrhea and nutritional status are the invasive type of pathogen and chronic malnutrition.
[Editorial Comment: This paper sharpens our understanding of the interaction between recovery from diarrhea and malnutrition in hosts of varying nutritional status. Previous studies had not differentiated between types of diarrhea. Here, the investigation did, with the finding that dysentery, perhaps related to its greater damage to the intestinal mucosa, does persist longer in malnourished children, while watery diarrhea does not.

On the surface, this finding seems reasonable. Yet one element is puzzling: stunting, the child's relative height-for-age, was more closely related to the observed effect of delayed healing than wasting (low weight-for-height). Other than the influence of an unmeasured and extraneous variable, I cannot think of a mechanism to explain this relationship. Certainly it needs more exploration in the future.

What can be concluded is that malnourished children with dysentery need, first of all, to be identified. That means working hard to be sure that at least all children with dysentery are assessed nutritionally and those who are malnourished are given special attention to ensure adequate treatment of their dysentery and feeding during and after the episode.

This paper suggests that we should emphasize measurement of height rather than weight, a yardstick or meterstick rather than a scale. I am somewhat reluctant to make this shift yet, and will stick with weighing (or arm circumference) because of its greater sensitivity to acute weight loss, until further data on stunting and diarrhea are available.

One aspect of this paper does make me uneasy: the identical incidence of "dysentery" and watery diarrhea. I suspect that this is related to including cases with only mucous in the stool in the dysentery group, instead of the tighter definition of dysentery as diarrhea with blood in the stool. Most epidemiological studies suggest that Shigella dysentery comprises usually around 15-20% of diarrhea cases, and we use blood in the stool as the indicator to use antibiotic treatment. What would the results have been if "true dysentery," i.e., blood in the stool only, had been used? Should we use "stool with mucous" as a sign that special nutritional attention is needed, even though antibiotics are not? More study is needed! RSN]


[Editorial Comment: This paper summarizes the government's approach to control cholera outbreaks in Tanzania since 1950. The paper is quite general and non-specific, but it does allow me to make a few observations on this topic.

Much effort was expended in attempting to interrupt transmission of the disease by quarantining cases and their neighbors. The epidemiology of cholera, however, indicates that the most likely route of transmission is by means of healthy carriers, who often pass through quarantine
barriers with one excuse or another. As many as 99% of persons infected with Vibrio cholerae el tor organisms will have no clinical illness, but are quite capable of spreading their infection to another location by the usual fecal-oral means.

The "mortality" rate (probably case fatality, in fact) was stated to be 8% for the outbreaks overall. The author observes correctly that this could be brought below 1% with effective treatment. A similar reduction in fatality figures could probably be achieved by improving the reporting of cholera cases, resulting in an increase in the denominator of the fatality ratio and, therefore, a fall in the rate.

The paper reports customary use of antibiotics in treating cholera cases during these epidemics. This is quite appropriate, even though cholera cases will recover perfectly well without antibiotics if kept adequately hydrated throughout the course of their illness. Antibiotics have the role in cholera of reducing duration and volume of the diarrhea by approximately half. Once the existence of an epidemic has been established by doing stool cultures on some suspected cases, future cases do not need cultures done prior to treatment. In such epidemic conditions, antibiotics are given to patients who come for care with symptoms typical of cholera (acute, watery diarrhea, large volumes of stool often accompanied by vomiting, presence of dehydration).

A cholera epidemic offers an ideal opportunity to convince the public that oral rehydration is indeed the most effective method for treating all acute watery diarrheas, as mothers can see for themselves how ORT produces a miraculous recovery from dehydration and its accompanying symptoms. Thus, health personnel should emphasize educating the public about ORT during epidemics, promoting the message that ORT is good for all diarrheas, even after the epidemic is over. RSN]


This metabolic balance study investigates whether use of ORS would enhance food consumption and absorption of nutrients in two similar groups of children with acute cholera. One group received intravenous fluid only throughout the 72-hour study period, while the other received a combination of ORS and IV fluid. Feeding regimens were the same for both groups during the study period.

In the ORS group, only 40% of the fluid requirement was supplied as ORS, because of a high amount of vomiting. Energy and carbohydrate absorption was similar for the two groups, though consumption of fat and protein was slightly--though significantly--lower for the ORS/IV group. A much lower nitrogen intake was recorded in the ORS/IV
Within two weeks of recovery, the two groups had consumed the same level of nutrients. The authors conclude that patients with acute diarrhea can ingest a good amount of food, despite their also being given ORS. Therefore, there is no reason to withhold food during acute diarrhea.

[Editorial Comment: This study is about cholera--severe cholera at that--and not about children with the more usual case of acute watery diarrhea. As such, the results are applicable primarily to diarrhea cases with quite severe purging, not to routine treatment of diarrhea. Note that in the orally treated group, only 40% of the fluid could be given orally. This is more extraordinary when you realize that it was calculated from the time of admission to the study, when initial rehydration in the severely dehydrated cases had already been carried out intravenously. In routine cases, all of the fluid needs can be given by mouth.

Because of this, as suggested by the authors' conclusion, it was a surprise to find that the orally treated kids could actually squeeze in some food in addition to the huge amounts of oral fluids they were ingesting, although the extra volume this added did lead to greater vomiting in that group.

These are not the sort of patients studied by Brown (Peru) or Vesikari (Finland) who investigated whether oral treatment would enhance the nutritional outcome of diarrhea compared to IV. In those less severely purging patients, the effect of oral treatment in overcoming anorexia and enhancing food consumption could be seen. The Bangaldeshi children in this study had little room for food, making it hard to allow a difference in food consumption to develop between the groups.

In fact, the ORS/IV group may have been sicker, by chance, even though admission characteristics were similar, since their absorption of nitrogen was lower.

My conclusions from this study are that in clinical cholera or other severely purging patients, IV treatment may be necessary, in addition to oral fluids and food, to keep up with fluid loss while allowing adequate feeding to occur. During the most acute phase, restoring and maintaining hydration are the primary responsibilities and challenges to the clinician in this kind of diarrhea. It does not shed relevant light on the question of whether the orally treated child with less severe diarrhea will ingest and absorb more nutrients than the intravenously treated case. RSN]

Summary:
The authors conducted a one-year death survey of children under the age of seven in a rural region of The Gambia. There is good Infant Immunization coverage, despite scarce medical resources in the region.

Although many of the children had received various vaccinations, the mortality rate was high: of 3,398 children monitored during the year, 194 died (infant mortality rate [deaths within the first year of life] of 142 per 1,000 and child mortality rate [deaths in 1-4 year olds] of 43 per 1,000). Acute respiratory infections (ARI), malaria, and chronic diarrhea with marasmus caused most deaths. Acute diarrhea caused fewer deaths than expected, perhaps because of a national ORT campaign conducted at the beginning of the study.

Data indicated that infant and childhood mortality probably would change little with increased immunization coverage, in which case a primary health care system is needed to provide improved treatment.

Editorial Comment:
This is an important paper, as it depicts the challenge to efforts to reduce child mortality in the second phase, after the "shortcuts" to better survival have been put into place (Immunization, ORT), but malnutrition remains widespread and curative medical services are still inadequate. Treating chronic diarrhea often requires both some laboratory facilities and the ability to monitor patient responses to various attempts at treatment, including manipulating the diet. There is no "simple solution" like ORS. Preventing chronic diarrhea will probably demand raising the level of nutrition in the population.

In most places, we have a long way to go before medical and home treatment of acute diarrhea becomes adequate. This report suggests what we will face after we get there. (RSN)

Summary:
Although dehydration causes most of the deaths associated with diarrhea, rehydrated diarrheal patients still die because of pneumonia, marasmus, and hypoglycemia. This study, which took place at the Dhaka Hospital of the International Center for Diarrheal Disease Research, Bangladesh, analyzed autopsies of 140 patients who had died in the hospital following rehydration. Children under five constituted 74% of the patients. The diarrheal pathogens identified were Shigella spp. in 27%, enterotoxigenic E. coli in 17%, Entamoeba histolytica in 16%, Campylobacter jejuni in 12%, Salmonella spp. in 4%, Vibrio cholerae in 4% and Giardia lamblia in 4%.

The most common underlying causes of death were colitis in 44% and pneumonia in 38%. Immediate causes of death were most commonly found to be septicemia in 27%, hypoglycemia in 9%, and hypokalemia in 9%. Kwashiorkor or marasmus was found in 59% and fatty degeneration of the liver in 61% of the cases.

Editorial Comment:
This article again shows us the residual problems after dehydration deaths are eliminated. Gross malnutrition was present in the majority of cases and, doubtless, less severe malnutrition in many of the remainder. This predisposes to decreased resistance to invasion by pathogenic organisms, leading to fever, septicemia, and pneumonia.

The more invasive diarrheagenic organisms take on greater importance when examining diarrhea-associated mortality than when looking at diarrhea morbidity. Colitis, shigellosis, campylobacteriosis, and amebiasis were prominent.

Both of these types of problems demand that the system provide more than ORT, as already noted above relative to the Gambian experience. In particular, making antibiotic treatment for bloody diarrhea accessible to a wider population will be critical to stopping dysenteric infections early, before they become serious. Likewise, earlier diagnosis and selective antibiotics could have prevented fatalities from pneumonia and septicemia. (RSN)

Smith, L. "TEACHING TREATMENT OF MILD, ACUTE DIARRHEA AND SECONDARY DEHYDRATION TO HOMELESS PATIENTS." Public Health Reports, September-October 1987, vol. 102, 539-542.

Editorial Comment:
While this article describes an educational program aimed at a homeless U.S. population, the educational principles and methods it cites are fundamental to successful teaching about dehydration, ORT, and diarrhea management anywhere in the world. Be-
'Effective learning requires active participation.' Shelter residents may find it difficult to grasp the relevance of the information because their current circumstances are formidable. Participation will help to focus thoughts and increase the likelihood that all strategies will be successful.

"A comfortable and inviting atmosphere was established by providing refreshments and arranging chairs in a circle.

"Participants were asked if their children had experienced bouts of diarrhea, vomiting, or both. A definition of diarrhea was requested by inquiring 'How do you know when your child has diarrhea?' The definition should include all characteristics listed in objective 1; omissions should be corrected by the instructor. The definition was recorded on a flip chart page entitled "Diarrhea" that was subsequently taped to the wall as a reference. Next, common causes of diarrhea were read aloud by the instructor but not recorded.

"Dehydration was introduced by asking 'Why do we become concerned when a small child has diarrhea?' Dehydration was described by the instructor as being dried out. Several reasons for increased fluid loss during diarrheal episodes can be recited but not recorded: loss of fluid and electrolytes in frequent watery stools, loss when there is frequent vomiting, fever and rapid breathing, continued renal loss...'. The instructor assisted the group in generating a list of four signs of dehydration that was to be taped to the wall.

"Participants were asked what they had done to treat diarrhea at home. All treatments were recorded, and the list was taped to the wall. Ineffective or dangerous treatments were added... A handout with details was given out to the participants. The instructor stated that good handwashing is essential to curtail the spread of diarrhea.

"During a discussion, the group listed the following signs on a flip chart page entitled 'Transport to clinic if': temperature higher than 103 degrees F for more than 2 days, unable to eat regular foods after 3 days of home treatment, severe stomach pain, bloody stools, increased frequency of diarrhea stools, and signs of dehydration. The list was taped to the wall and the group informed that these signs mean home treatment is not working, and it is time to seek professional help. The final group assignment was to generate a list of local medical facilities available for pediatric care that was also taped to the wall.

"The five lists on the wall facilitated a problem-solving exercise of how to treat a girl with diarrhea." (See box).

Final Comment:

Signs of dehydration should be tailored to those which can be recognized in a certain culture, and the treatment recommendations made consistent with foods and liquids available in the location of the training. This will require some investigation before the training. Blackboards instead of flip charts can be used, and pictures instead of words used for recording for an illiterate audience. The principles, however, are the key to success: leading the trainees through a logical progression based on their own knowledge and experience, finishing up with a problem solving exercise which leads them through the decisions they will have to make in the future.

The response to the questions about diet on page 2 of the flip chart (see box) require comment. Children with diarrhea should receive extra fluids, including breast milk for breast-fed infants, and an oral rehydration fluid like oral rehydration salts or food-based fluids, given after each stool. Ideally, feeding should
be continued without interruption, although some reduction in dietary intake or small delay might be necessitated due to decreased appetite. Heavily sweetened foods or fluids may make the diarrhea worse and should be avoided—in this regard, the applesauce. If sweetened, in the BRAT diet may not be a good "diarrhea food."

There is considerable controversy over the need to avoid lactose-containing milk during diarrhea in non-breast milk- or formula-fed infants. Clinically significant lactose malabsorption is uncommon. However, in patients with obvious problems handling lactose in the diet, a temporary change in diet (such as diluting milk, mixing milk formulas with other food, or using non-milk formulas) may be required. (RSN)

**Summary:**

Egypt's Epidemiology Study Center conducted a two-year study of 309 rural Egyptian families in eight villages to determine the incidence of diarrhea. Families with newborn children participated. They were visited twice per week to monitor diarrheal illness in the children.

Rates of diarrheal illness were highest in the first year of life, with children aged 6-12 months having the most episodes (5.9 per year), those less than 6 months second highest (5.3 per year), and those 1-4 lowest (2.1 per year). Overall, there was little seasonal variation in incidence rates, though there was an age-specific difference in seasonal occurrence. Diarrhea incidence and its distribution by age, sex, and season were consistent with data from other regions of the world. However, the case-fatality ratio of 0.3 deaths/100 episodes of diarrhea is half that of similar populations. The authors attribute this difference to the distribution of ORT by the research team.

**Editorial Comment:**

Studies of this sort are complex and costly, yet usually leave us wanting to know more. The authors attribute the low case-fatality ratio to availability of ORT, but it may be that the study population was better nourished than comparison populations. The report does not provide clinical details about the type of diarrhea or other problems in the cases who died, except for the duration of illness. In particular we know nothing about the treatment given to the diarrhea cases, either the ones who died or the ones who did not. Given the immense effort required to collect this sort of longitudinal data, perhaps the most important conclusion should be that the possible uses of the results should be specified clearly before the study, and the design altered to make those results directly usable by programs where possible, not just items for academic musings. (RSN)


**Summary:**

This case report describes studies of electrical activity from the smooth muscle of the small bowel correlated with the occurrence of peristaltic contractions in a 70 year old patient with watery diarrhea of three months' duration. Complexes of action potentials moved slowly down the small intestine. This motility pattern occurred frequently during the period the patient had diarrhea, and disappeared with the disappearance of the diarrhea. The pattern was seen only once in studies of 10 normal control subjects.

**Editorial Comment:**

There appears to be increasing interest in the role of intestinal peristalsis in diarrhea. This patient's diarrhea was clearly secretory in nature, yet the abnormal motility pattern was present. While the contractions of the intestine may be merely responses to the presence of fluid, some investigators suggest that the toxins or chemicals which lead to hypersecretion may also stimulate the smooth muscle.

Clinically useful techniques may eventually come from this research direction. At present, however, the focus of treatment of the secretory diarrheas of infectious origin—the main diarrhea problem in developing countries—remains squarely on replacement of the secreted fluid and healing of the bowel, not on medication to alter bowel motility. (RSN)
NEW WHO CDD PROGRAM POSITION ON FLAVORING IN ORAL REHYDRATION SALTS

Until recently, the WHO CDD Program has actively discouraged countries and ministries of health from using flavored preparations of oral rehydration salts (ORS), emphasizing in their interactions with governments the desirability of using preparations with only the four basic ingredients (NaCl, KCl, NaHCO₃, and glucose). In addition to the potential for added flavor raising the price, the strongest arguments against the flavored preparations have been the desirability of having a single preparation on the market (to reduce confusion among purchasers as well as health workers), and the possibility that added flavor may lead to children drinking too much of the solution and thereby developing hypernatremia. Previous issues of the TLU have discussed this subject.

Manufacturers of ORS, however, have almost uniformly wanted to add flavoring, based on their own assessment of the flavor of the plain product, and complaints from parents either that they thought it tasted bad, or that their child refused to drink it because of its taste. Many flavored preparations of ORS are already on the market.

In the most recent issue of CDD Update, an occasional publication of the CDD Programme, we see for the first time some relaxation of the previous position. While continuing to recommend the simplest ORS product, the Programme has laid out clearly the potential advantages of flavoring in increasing acceptability and use of ORS. It has also declared publicly that there is no documented evidence that flavoring will either lead to overconsumption and consequent hypernatremia, or lead to underconsumption. Recognition that the slight additional cost may bring proportionate benefits by leading to greater acceptability and increased use is also clearly stated.
This step opens the door to governments more freely allowing private manufacturers to distribute and sell flavored products, and to reconsidering whether they will promote officially both flavored and unflavored products. While we will all await evidence scheduled to come from studies of the possibility of overconsumption or underconsumption, this gives us the possibility of responding more positively at present to the wishes of consumers and producers of ORS for flavored preparations.

In view of the importance of this development, we quote the complete text of the relevant portion of the CDD Update (No. 2, November 1987):

With the aim of making an essential drug available at a low price, WHO and UNICEF have consistently recommended the use of ORS compositions that contain the four basic ingredients needed to yield an effective solution. Many commercially available products, however, contain a flavouring agent, and some a colouring agent.

The theoretical advantage of flavoured ORS is greater acceptability (to care providers and children) and consequently increased use. The most important role of ORS is to treat dehydrated diarrhoea cases. In such cases taste has not been found to be a problem (and flavouring is thus irrelevant). In achieving widespread popular use of ORS, however, particularly in the prevention of dehydration and in post-rehydration maintenance therapy, improved taste may be an advantage. These comments could apply equally well to colouring of ORS.

The theoretical disadvantage of flavouring or colouring that gives rise to the greatest concern is the risk of overconsumption and consequent hypernatremia; however, there is no documented evidence that this is, in fact, a problem. WHO is supporting a study to investigate this issue. Additional studies would be welcome. It is also possible that flavoured ORS could in certain cases result in underconsumption, as patients requiring large volumes of ORS, particularly adults, may find flavoured ORS unpalatable after ingesting large amounts. Again, this has not been documented.

Colouring of ORS has lead (sic) to changes in stool or urine colour and consequent confusion in diagnosis in a few cases.

The addition of flavouring and colouring agents adds to the cost of ORS; however, it is possible that it may bring proportionate benefits. Any added substances should be shown not to adversely affect the safety or the stability of the product.