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NUMBER 2

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ORAL  
REHYDRATION  
THERAPY



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Specialized Bibliography Series No. 2

ANNOTATED BIBLIOGRAPHY ON  
ORAL REHYDRATION THERAPY



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## PREFACE

The Specialized Bibliography Series is part of the larger effort to establish an information network in the field of diarrhoeal diseases research -- an effort being carried out by the International Diarrhoeal Disease Information Service and Documentation Centre (DISC), run by the ICDDR,B. Number 1 of the series was on nutrient absorption and diarrhoea-malnutrition cycle. The present issue, the second of the series, includes 261 papers (114 abstracted) on oral rehydration therapy. Attempts were made to cover some historical papers, but emphasis was placed on papers dealing with clinical trials, impact and implementation. This is a subject of high current importance, and the reason for selecting the topic is explained in the Introduction by Dr A M Molla, an ICDDR,B scientist. The next bibliography under this series will cover papers on the composition of oral rehydration solutions.

This is not an exhaustive bibliography on the topic. The bibliography was compiled from our limited resources, and inadvertent omissions may have occurred.

We believe this bibliography will contribute towards generating greater interest and awareness in this field, and will facilitate user access to knowledge of the problems. Copies of articles abstracted here are available from DISC to interested persons/organizations. We will consider this attempt successful if the bibliography helps diarrhoeal disease researchers and practitioners. Suggestions for improvement of a future edition will be appreciated.

K M S Aziz, PhD

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## INTRODUCTION

The basic principle followed to save lives during diarrhoea is to replace the fluid and electrolyte that is lost in the stool. Before the discovery of oral rehydration therapy in 1967, fluid was replaced only through the intravenous route. Since the discovery of ORS, treatment of diarrhoea has become simple, inexpensive and available to more people suffering from diarrhoea. Oral rehydration is a unique therapy, because no other therapy in medicine is so broad-based. It is effective in almost all types of diarrhoea.

ORT, though very simple, brings together the child, mother, community workers and physicians in the same platform--all sharing the same concern. This is reflected by the huge amount of literature generated on this topic during this short time. Many practical problems have also been pointed out, and solutions need to be worked out, without which it may become impossible to develop and promote ORS any further. Questions about the measurement of one liter of water, the contamination of ORS if stored after preparation, the correct weight of salt and sugar with either the scoop or spoon, remain to be solved.

The twilight period of ORT seems to be over now. Time has come to evaluate critically what has been achieved over these nearly 2 decades of intensive research and application. ORS use rate is still very low and discouraging. Therefore, careful studies to identify what underlies the low use rate are needed. Perhaps it is necessary for us to turn back to the community and analyze why ORT is not yet widely used and also why medical practitioners have been reluctant to promote it. The answer may possibly lie within the community. Pre-packaged complete formula ORS may be theoretically better and desirable, but may not be logistically feasible in developing countries, where diarrhoea is the major health problem, to produce adequate number of packets and to cover all diarrhoeal episodes, not to speak of other problems involved with production, packaging, distribution and storage. Therefore, it is vital that the treatment of diarrhoea be brought to the home through home-made ORS, prepared with ingredients from the kitchen. This bibliography includes many abstracts on home-made ORS and the associated problems of ORS use.

The purpose of this bibliography is to bring together all the relevant work on this topic so that readers take appropriate decisions regarding future direction of research on ORT. The ICDDR,B has played an important role in the past by conducting extensive clinical and field trials with ORT. Results have helped ORT to find its place in the gamut of diarrhoea management and treatment. This annotated bibliography is yet another step in ICDDR,B's efforts in promoting ORT among the members of the community and within the health care delivery mechanism of institutions.

A M Molla, PhD

## USER'S GUIDE

The Specialized Bibliography Series includes papers and publications -- current as well as back materials -- from sources worldwide.

The bibliography is divided into subject and author sections. In the subject section, citations are arranged alphabetically by first author under a few headings. The sequential number in the subject section sometimes is followed by a sign (§), indicating that an abstract of the cited paper appears in the author section.

The author section contains citations arranged alphabetically by first author and then by paper title. Co-authors' names also appear in alphabetical order along with a cross-reference to the first author (e.g. Abbas N see Sugijanto). This will facilitate a search by co-authors' names.

Efforts have been made to present abstracts with all available information regarding the study's nature and objective, methods used, and major findings and conclusions.

The bibliography is in English. A title in parentheses indicates that the paper is in another language.



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AUTHOR SECTION

Abbas N see Sugijanto

Abdallah K see Lasch EE

Abed FH. Household teaching of ORT in rural Bangladesh. *Assign Child* 1983;61/62: 249-65

The Bangladesh Rural Advancement Committee (BRAC), through its Oral Therapy Extension Programme, seeks to disseminate to all rural Bangladesh households before 1990 information about ORT. Specifically, the aim of a 3-year program begun in 1980 is to teach mothers in 2.5 million households (14 million people) in five of Bangladesh's 20 districts, how to prepare ORS with local ingredients. For this purpose BRAC developed a health message called "seven points to remember", that explains how to prepare and use a "lobon-gur" ORS mixture (lobon=sodium chloride; gur=molasses. The resulting solution contains sucrose and potassium in approximately proper proportions). The message also includes some relevant nutritional and other knowledge. Reported here are the program characteristics, its evolution and organization, worker recruitment and training, its built-in monitoring and evaluation system, and some available results. Preliminary findings indicate that the program is developing as hoped, and has attained maturity in terms of teaching quality. Illiterate Bangladeshi mothers were able to understand the health message, and to prepare at home, using household ingredients and finger measurement, a safe, effective ORS. While the program is vertical, and has few links with other sectors, it provides valuable lessons in modes of community participation and in the methodology of face-to-face teaching of mothers.

Abed Y see Lasch EE

Abrutyn E see Cash RA

Adnan SW see Suharyono

Afonso E see Srinivasa DK

Agarwal A. A cure for a killer-but how to deliver it? *Nature* 1979;278:389-91

Agbonlahor DE see Coker AO

Ahmad K, Jahan K, Huq I. Decontamination of drinking water by alum for the preparation of oral rehydration solution. *Food Nutr Bull* 1984 Jun;6(2):54-7

This is the first report on the use of chemical agents in decontaminating potable water for the preparation of ORS. The study determines whether aluminium potassium sulphate (potash alum), used traditionally in Bangladesh for purifying tank, reservoir and household drinking water, would have an antibacterial effect on the total bacterial count in ORS prepared with the piped-supply water, and with pond water of high bacterial count. *Vibrio cholerae* at concentrations  $10^3$  and  $10^4$  per ml was killed between 1 and 2 h in 500  $\mu\text{g/ml}$  potash alum. Potash alum at a concentration of 1 mg/ml killed *V. cholerae* in water in less than 1 h. *Escherichia coli* from

## Oral Rehydration Therapy

stool ( $10^3$  and  $10^4$  per ml) had the same survival time in presence of 500  $\mu\text{g/ml}$  of potash alum. The pH of ORS fortified with 500  $\mu\text{g/ml}$  alum remained at 6.4. ORS made from well water or pond water, with or without potash alum, did not vary markedly in ionic concentration. Changes in  $\text{NaHCO}_3$  level were within allowable limits. There were sharp decreases in the total bacterial counts in ORS made with water collected from different sources when fortified with 500  $\mu\text{g/ml}$  of potash alum. Since diarrhoeal diseases are often caused by contaminated water, treating water before drinking or making ORS with potash alum during epidemics in rural or urban areas should decrease diarrhoeal morbidity and mortality.

Ahmed I see Coker AO

Ahmed SM see Islam MR

Akierman A see Ashley DEC

Ali MA, Wahed MA. Preparation and quality control of hand-packaged oral rehydration salt sachets. *J Diar Dis Res* 1984 Sep;2(3):162-7

The feasibility of a simple method for preparation of ORS packets suitable for cottage industry-scale production was tested over a 3-year period. Each packet contained ingredients to make 1 liter of solution, according to the WHO formula, except that glucose (20 g) was replaced with sucrose (40 g). In each batch, ingredients for 200 packets were mixed thoroughly in a bowl. Using a standardized scoop, 47.5 g (to make 1 L solution) was measured and sealed in polyethylene bags. Over 3 years, 3359 samples (3 to 5 packets from every batch of 200) were tested for weight and electrolyte content. Simple titrimetric method was developed for electrolyte estimation. The mean concentrations of  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$  and  $\text{HCO}_3^-$  were: 89.8, 19.8, 77.9 and 29.6 mmol/L, respectively. ORS packets' shelf life was tested in different seasons, under various conditions of temperature and humidity. Through time, the ORS mixture changed colour from white to light brown, and a soft lump was formed. The electrolyte concentrations, however, remained almost unchanged for up to 8-months storage. The titrimetric estimation of chloride in ORS provides a simple quality control method suitable for rural Bangladesh.

Ali MA see Islam MR

Alim ARMA see Taylor PR

Amara IA see Lasch EE

Amini JN see Barzgar MA

Andino R see Levine MM

Angle P see Black RE

Anzaldo FE see Ludan AC

Aperia A, Marin L, Zetterström R, Glunz H, Neyzi O, Saner G, Sökücü S. Salt and water homeostasis during oral rehydration therapy. *J Pediatr* 1983 Sep;103(3):364-9

This may be the first complete descriptive study on changes in sodium balance and urinary and stool sodium output during oral rehydration therapy. Studied.

## Oral Rehydration Therapy

were 22 well-nourished Turkish male infants, aged 2-13 months, with acute diarrhoea mainly of viral origin. The infants randomly received an oral electrolyte solution containing either 90 mmol Na/L (ORS<sub>90</sub>) or 40 mmol Na/L (ORS<sub>40</sub>). The composition of the two solutions were (in mmol/L): ORS<sub>90</sub>: Na 90, K 20, Cl 65, HCO<sub>3</sub> 45 and glucose 125 and ORS<sub>40</sub>: Na 40, K 20, Cl 35, HCO<sub>3</sub> 25, glucose 125. Twelve infants received ORS<sub>90</sub> and 11 ORS<sub>40</sub>, but one from the second group later was excluded from the study. Slight transient hypernatremia and hyponatremia were noted, respectively, in a few infants receiving ORS<sub>90</sub> and in a few receiving ORS<sub>40</sub>. In both groups, sodium balance increased most rapidly during the first 12 h of rehydration, and then more slowly due to increased urinary and stool sodium output. Sodium balance always was more positive after ORS<sub>90</sub> than after ORS<sub>40</sub>; but the difference did not change much from 12 to 36 h after therapy was started. Changes in fractional sodium excretion, urinary K/Na quotient and urinary aldosterone-creatinine quotient were used as indexes of changes in sodium balance. All values were interpreted to indicate that the sodium deficit on admission was corrected within 12-18 h after ORS<sub>90</sub>, and, in most cases, within 24-36 h after ORS<sub>40</sub>. Clinically, both groups responded well to oral rehydration therapy. The results suggest that the gut, even during acute diarrhoea, can play a regulatory role in salt homeostasis.

Araujo AG see Shields DS

Arora NK, Bhan MK, Ghai OP. Protracted diarrhea of infancy: its aetiology and management in 25 patients. *Indian Pediatr* 1981 Jun;18(6):373-8

A prospective study of infants with protracted diarrhoea with special reference to etiology and response to a hypoallergenic chicken meat based formula was performed. Twenty-five infants aged below 1 year with diarrhoea of more than 2 weeks duration referred to the All-India Institute of Medical Sciences, New Delhi, formed the subjects of this study. Etiological factors were identified in 19 (76%) of the 25 infants suffering from protracted diarrhoea seen over a period of eight months. Secondary disaccharide intolerance (32%) and milk protein intolerance (24%) were the commonest etiological factors. Fifty per cent of the latter patients were intolerant to soy protein. Radiological evidence of pneumonia was found in 5 infants. Four infants died, a mortality rate in the series of 16 per cent. Of the remaining 21 infants, 18 were successfully treated with enteral feeding with a hypoallergenic chicken meat based formula and 3 with a soy protein based formula.

Arora NK see Deorari AK

Ashley DEC, Akierman A, Elliott H. Oral rehydration therapy in the management of acute gastroenteritis in children in Jamaica. In: Holme T, Holmgren J, Merson MH, Mollby R, eds. *Acute enteric infections in children: new prospects for treatment and prevention*. Amsterdam: Elsevier, 1981:389-94

Azis AL, Soeparto P, Subijanto MS, Hardjadinata D, Kumiaiganto M, Salino H. Oral sugar salt solution using the "Blue Spoon" for acute infantile gastroenteritis. *Paediatr Indones* 1981 May-Jun;21(5-6):107-14

In a five-month study period between August and December 1979, 91 children aged 2-24 months with uncomplicated gastroenteritis were treated with home made oral sugar salt solution prepared by using the "Blue Spoon". Patients were selected from the out-patient Department of Child Health, Dr Soetomo General Hospital of Indonesia and were randomly divided into two groups: those whose feedings were

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stopped and those who were still permitted to have their normal feedings while on oral electrolyte therapy. To overcome the difficulty of measuring salt and sugar in preparing ORS at home, the government has advocated the use of the Blue Spoon, a plastic spoon with two scoops of different size. In this study, clinical observations were performed during the first and follow-up visit, which included nature/characteristic of diarrhoea and vomiting; degree of existing dehydration; meteorism; and possible occurrence of complications. A total of 4 children (4.4%) developed dehydration following administration of oral solution therapy. Vomiting was reversed in 24 out of 28 children following the administration of oral electrolyte solution. It appeared from the study that salt-sugar solution prepared by using the Blue Spoon was quite effective in the treatment and prevention of dehydration. The success rate was 95.6%. Almost all the mothers (95.8%) followed the instructions as how to use the Blue Spoon and when interviewed, stated that it was a simple and cheap means of making oral sugar electrolyte solution. There were no statistically significant failure rate differences; e.g., the development of dehydration, vomiting and meteorism, following oral electrolyte therapy between the two groups (with and without cessation of feeding). With this result, continued food intake along with oral salt sugar solution during diarrhoeal episodes is strongly recommended.

Aziz KMS, Beckett JL, eds. Proceedings of the National Workshop on Oral Rehydration, Dacca, 26-28 Sep 1979. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh, 1980. 23 p. (ICDDR,B special publication no. 9)

Aziz KMS see Islam MS

Aziz KMS see Samadi AR

Aziz KMS see Rahaman MM

Bagchi NG see Mahalanabis D

Bai KI, Kumar CR, Reddy CG. A study of oral rehydration therapy in childhood diarrhoea. *Indian J Pediatr* 1980 Jul-Aug;47(387):279-82

Ball D see Dugdale A

Bangladesh Rural Advancement Committee. Annual report 1980-81: oral therapy extension programme, phase I. Dhaka: Bangladesh Rural Advancement Committee, 1981. 36 p.

The Bangladesh Rural Advancement Committee (BRAC) has undertaken a nationwide program of educating the rural women on preparation and administration of ORS during diarrhoea. The program, begun in July 1980, is outlined in this annual report (phase-I). The preparation procedures and related information are contained in an educational package called the "Ten points to remember". Emphasis is on popularizing the home-made solution with a three-finger pinch of salt, and a four-finger scoop of molasses mixed in a half seer (467 ml) of water -- which gives a solution close to the scientific preparation.

Bangladesh Rural Advancement Committee. Oral therapy extension program: six monthly report (July-December, 1981). Dhaka: BRAC, 1982. 10 p.

The operations development and evaluations of the Oral Therapy Extension Program

## Oral Rehydration Therapy

run by the Bangladesh Rural Advancement Committee (BRAC), are herein presented. The program started in 1980 and during the first half of the 3-year phase, nearly half-a-million households were visited by workers teaching rural women how to prepare and administer ORS. Available evaluation results indicate that the program is well under control with respect to the quality of teaching. As to people's acceptance of the method, the results remain unclear. An anthropological study was being planned to determine the reasons where low acceptance existed, and efforts were being streamlined to increase acceptance. A large amount of baseline data were collected for impact evaluations, and formal evaluation were underway.

Bangladesh Rural Advancement Committee. Oral therapy program: Ajmiriganj Thana. Dhaka: Bangladesh Rural Advancement Committee, 1979. 24 p.

Bangladesh Rural Advancement Committee. Oral therapy program. Dhaka: Bangladesh Rural Advancement Committee, 1979. 56 p.

Banwell JG see Pierce NF

Bardhan PK see Islam MR

Barker WH. Perspectives on acute enteric disease epidemiology and control. Pan Am Health Organ Bull 1975;9:148-56

Barnes G see Mackenzie A

Bartlett AV see Santosham M

Barua D, Thapalyal L. Oral rehydration: new weapon against cholera and other acute diarrhoeas. World Health 1976 Jul:30-1

Barua D see Mahalanabis D

Barzgar MA, Ourshano S, Amini JN. The evaluation of the effectiveness of oral rehydration in acute diarrhoea of children under three years of age in West Azerbaijan, Iran. J Trop Pediatr 1980 Dec;26(6):217-22

In 1972, a study among the West Azerbaijan population showed that during summer, 22.2% of under-5 children and 14% of the population (all ages) attending the small health posts had diarrhoea. The feasibility and effectiveness of the WHO-recommended ORS was evaluated in a controlled trial carried out in 1977 among children aged 3-36 months with acute diarrhoea in rural West Azerbaijan. Vomiting associated with diarrhoea was higher in the study community (27.3%) than in the controls (21.33%), but the difference was not statistically significant. The number of bloody stools in study and control communities, respectively was 7 and 2. Patients' appetite was significantly better ( $p < 0.01$ ) in the study community as compared to the controls. Average ORS consumption for each study child was 2.73 L and the mean duration of ORS consumption was 2.2 days. ORS produced speedier rehydration and during the first 72 h, the study group gained more weight than controls; but the difference was statistically significant only for under 1-year-olds. Compared to the controls, the mean weight gain after 6 months in study children was significantly high ( $p < 0.01$ ) for all age groups. Study children gained on average about 400 g more than the controls in the 6 month following their first or only diarrhoea episode. The study found ORS to be feasible at village level in Iran, and effective in producing speedier rehydration. It is

## Oral Rehydration Therapy

recommended that adequate supply and distribution of ORS, staff training and mass health education should be accorded high priority in health programs of countries where diarrhoea is prevalent.

Barzgar MA, Ourshano S, Amini JN. Evaluation of the effectiveness of oral rehydration in gastroenteritis in children under 3 years of age, West Azerbaijan, Iran, 1977, presented to the Regional Scientific Meeting on the Epidemiology of Enteric Infections of the International Epidemiological Association, Alexandria, 27-31 May 1978. Alexandria: Regional Office for the Eastern Mediterranean, World Health Organization, 1979. 17 p. (EM/SC.WG.MTG.DDC)

Baumgart S, Langman CB, Sosulski R, Fox WW, Polin RA. Fluid, electrolyte, and glucose maintenance in the very low birth weight infant. *Clin Pediatr* 1982 Apr; 21(4):199-206

Becket JI, see Aziz KMS

Bell DR. Cholera. In: Lecture notes on tropical medicine. Oxford: Blackwell, 1981:121-8

Benenson AS see Santosham M

Benenson W see Santosham M

Bennett FJ. Diarrhoeal disease control (editorial). *East Afr Med J* 1980;57(5): 293-8

Berquist EJ see Nalin DR

Berry RJ see Dibley M

Bertan M see Egemen A

Bertrando R see Santosham M

Bhan MK see Arora DR

Bhan MK see Deorari AK

Bhargava SK see Sachdev HPS

Bhatia S see Chen LC

Bhattacharya AK see Mahalanabis D

Biddulph J. Standardized management of diarrhoea in young children. *Pediatr Indones* 1971;11:37-46

Binder HJ see Dobbins JW

Birdsong M see Mitchell JE

Black RE, Merson MH, Taylor PR, Yolken RH, Yunus M, Alim ARMA, Sack DA. Glucose vs sucrose in oral rehydration solutions for infants and young children with rotavirus-associated diarrhea. *Pediatrics* 1981 Jan;67(1):79-83



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In a double-blind sequential trial of 784 children with rotavirus-associated diarrhoea treated in the Matlab Treatment Centre of the International Centre for Diarrhoeal Disease Research, Bangladesh the use of oral rehydration solutions containing essential electrolytes with either glucose (GORS) or sucrose (SORS) of equal osmolality was compared. The GORS and SORS groups were equally matched by age, sex, frequency of vomiting, duration of diarrhoea and vomiting before hospitalization, admission specific gravity, frequency of other pathogens in their stools, and nutritional status. The oral fluid failure rate was 11.5% for the SORS and 7.3% for the GORS group (a non-significant difference). Vomiting was a significantly more common cause of failure for the SORS group (1 in GORS and 12 in SORS group) and was associated with an increased rate of intake of the sweeter SORS. There was no difference in the purging rates of the 2 groups. The oral fluid failure rates for children in the most underweight category (60% of expected weight for age) were not different from those for other groups, although as assessed by purging rate and initial dehydration, the stool losses of members of this group constituted a greater proportion of body weight. It was indicated that sucrose can be substituted for glucose in oral rehydration treatment solution with only a minimum loss of efficacy. On the basis of some factors, including cost and availability of ingredients and comparative efficacy, it was suggested that although glucose is preferred, sucrose can as well be used in an oral solution which is safe and effective for the treatment of diarrhoea.

Black RE, Levine MM, Clements ML, Angle P, Robins-Browne R. Proliferation of enteropathogens in oral rehydration solutions prepared with river water from Honduras and Surinam. *J Trop Med Hyg* 1981;84:195-7

To formulate judicious recommendations for preparing and storing ORS, the authors assessed the ability of recognized bacterial enteropathogens to survive and proliferate in solutions made either with sterile distilled or river water, from two developing countries (Honduras and Surinam). Shigella flexneri, an enteropathogen typically transmitted by fecal/oral contact rather than by water or food, survived poorly. In distilled water and Surinam river water Shigella could not be recovered after 24 h inoculation, while its concentration was only  $10^2$ /mL in Honduran river water. In contrast, Vibrio cholerae and enterotoxigenic Escherichia coli, pathogens classically associated with transmission by food and water, reached a concentration of  $10^3$ - $10^4$ /mL by 12 h; and  $10^4$ - $10^6$  by 24 h after inoculation of solutions made with river water. V. cholerae and E. coli grew less rapidly in solutions made with distilled water. In field situations, children already are ingesting high levels of bacteria in drinking water and food; and ORS probably would add little to their exposure. While ORS should be prepared fresh each day with water as free from fecal pollution as possible, where there exists a lack of fuel to boil water and/or scarce supply of glucose/electrolyte packets, ORS nevertheless should be administered promptly to infants with diarrhoea.

Black RE see Chen LC

Black RE see Levine MM

Black RE see Roy SK

Black RE see Sack DA

Black RE see Taylor PR

Blackwell RQ see Phillips RA

## Oral Rehydration Therapy

Blum D see Kahn A

Blum D see Levine MM

Boineau FG, Lewy JE. Maintenance fluids and the management of diarrheal dehydration. *Pediatr Ann* 1981;10:280-8

Bollag U. Cup and spoon rehydration of children with acute diarrhoea. *J Trop Pediatr Environ Child Health* 1977 Dec;23(6):268-70

Over 9 months, 16 children aged under 5, suffering from sporadic, non-specific diarrhoea, were treated with oral glucose-electrolyte rehydration solution at a child care centre in Jamaica. Food was given from disease onset, if the child would eat. Severe dehydration was avoided, and stools, in all cases, became normal in 1-2 days. The authors emphasized early treatment, using a cup and spoon, not a bottle; and said the fluid should be administered frequently round-the-clock in small amounts. If oral rehydration is introduced as a self-help method in a community, the mixture must be simple and cheap, and the ingredients should be available in every household.

Booth IW, Harries JT. Oral rehydration therapy: an issue of growing controversy. *J Trop Pediatr* 1982 Jun;28(3):116-23

Briesman MA. Knowledge and practice of New Zealand mothers in the treatment of infantile diarrhoea. *NZ Med J* 1984 Jan 25;97:39-42

One hundred and ninety-four mothers in the Christchurch area, New Zealand were questioned concerning their knowledge on treatment of infantile diarrhoea. Results showed that although traditional ideas have changed and there is some awareness of the need to use fluid replacement, there is a lack of appreciation of the importance of solutes in ORS. The study highlights the need for health education especially for mothers in a number of areas in treatment of childhood diarrhoea. Mothers should be made aware of the dehydration symptoms and, particularly in primipara, the potential seriousness of the condition. They should be made aware of part played by hygiene in food handling habits in preventing diarrhoea. It is the responsibility of all medical and nursing personnel to be involved in this educational process.

Brigham KL see Pierce NF

Bryceson ADM. Rehydration in cholera and other diarrhoeal diseases. *Proc R Soc London (B)* 1977;119:109-14

Bryden RN see Kuberski T

Bucknall CA see Hosking DJ

Budiarso AD see Sunoto

Butler T see Sack RB

Byers HD see Taitz LS

Bygbjerg IBC. Making oral glucose-salt solutions (letter). *Lancet* 1978 Mar 18; 1(8064):611-2

## Oral Rehydration Therapy

Caranasos GJ see Pierce NF

Carrera E see Santosham M

Carpenter CCJ. Oral rehydration: is it as good as parenteral therapy? (editorial). *N Engl J Med* 1982 May 6;306(18):1103-4

In the world's densely populated areas, acute diarrhoeal illness causes about half of childhood mortality and probably is the major cause of death globally. Acute diarrhoeal death, regardless of etiologic agents, almost always can be prevented by adequately correcting intestinal fluid losses. For the past half century, intravenous fluid was the treatment of choice to correct fluid losses in acute diarrhoea in both children and adults. Recent studies demonstrated that a glucose/electrolyte ORS is equally effective for most acute diarrhoeal illnesses, including those caused by Vibrio cholerae, rotavirus and enterotoxigenic Escherichia coli. The potential of ORS in acute diarrhoea is discussed.

A recent study demonstrated that WHO-recommended ORS (with 90 mmol Na/L and 20 mmol K/L) does not cause complications such as hypernatremia and hyper- or hypokalemia. ORS also has been proved an effective acute diarrhoea therapy in well-nourished children in developed countries. Serious complications were found in patients receiving intravenous fluid therapy, while complications with oral therapy were minor. The author suggests ORS should be accepted not only as an equal, but perhaps as the superior means of treating acute diarrhoea, both in sophisticated, sanitized and rural medical facilities.

Carson D see de Zoysa I

Carter NW see Turnberg LA

Casellas JM see Taubenslag L

Cash RA, Nalin DR, Rochat R, Reller LB, Haque ZA, Rahman ASMM. A clinical trial of oral therapy in a rural cholera-treatment center. *Am J Trop Med Hyg* 1970 Jul; 19(4):653-6

This paper reports on the large-scale clinical field trial that proved that ORT alone could successfully maintain rehydration in cholera patients. The efficacy of ORS was assessed in 135 cholera patients over age 15 with severe dehydration and no underlying disease. They were patients at a rural treatment centre in the then-East Pakistan (now Bangladesh), run by the Cholera Research Laboratory (now the International Centre for Diarrhoeal Disease Research, Bangladesh). Clinical assessment, weight and fluid balance measurements were obtained for all patients, who had bacteriologically-proven Vibrio cholerae, Inaba-type infection. They were treated with tetracycline. Initially, they were rehydrated with IV therapy, but were given ORT, both oro- and naso-gastrically, as soon as they were alert. Each liter of solution contained sodium (120 mEq), chloride (72 mEq), sodium bicarbonate (48 mEq), citrate (15 mEq), potassium (15 mEq) and glucose (110 mEq). ORT successfully maintained fluid and electrolyte balance in 133 of 135 patients. Twelve moderately dehydrated patients were successfully rehydrated with ORT alone. Compared to 135 persons treated with IV therapy during a previous epidemic, the present trial showed a 70% reduction in IV fluid use. This trial proved not only that ORT worked and dramatically reduced the need for IV, but that ORT was an effective therapy even in a rural field hospital typical of those in the developing world.

## Oral Rehydration Therapy

Cash RA. Oral therapy for diarrhea. Trop Doct 1979;9(1):25-30

Cash RA, Nalin DR, Forrest JN, Abrutyn E. Rapid correction of acidosis and dehydration of cholera with oral electrolyte and glucose solution. Lancet 1970 Sep 12;2:549-50

This study examines whether oral therapy alone could correct initial acidosis and dehydration in patients not in severe shock. Five adults, hospitalized at Matlab, East Pakistan (now Bangladesh) with severe acidosis and dehydration due to diarrhoea, were treated with ORS containing ions (in mEq/L):  $\text{Na}^+$  120,  $\text{HCO}_3^-$  48,  $\text{Cl}^-$  87,  $\text{K}^+$  15 and glucose (110 mmol/L). Four control patients were given occasional sips of water and no I.V. Dehydration and acidosis in the ORS group were corrected within 6 h, while control patients' conditions remained unchanged. The differences between 0 and 3 h, 3 and 6 h, and 0 and 6 h in all categories were statistically significant at the 5% level. The data suggest that oral therapy, if given at the onset of symptoms, might obviate the need for I.V. in cholera patients.

Cash RA see Hirschhorn N

Cash RA see Nalin DR

Cassels J see Sack RB

Chakrabarti GC, De SK, Roy B, Chakraborty S. Treatment of small bowel diarrhea with electrolyte glucose drink. Indian Pediatr 1976;13:517-20

Chakraborty B. Management of infants and children with acute diarrhoea. J Indian Med Assoc 1977;69:280-3

Chakraborty J, Yunus M, Zimicki S. Bari mothers: home based 'experts' for home-prepared oral rehydration solution (abstract). In: Abstracts of the Twenty-Fourth SEAMO-TROPMED Seminar on Diarrhoeal Diseases of Children in Southeast Asia in the Context of Primary Health Care, Bangkok, 9-12 Nov 1981. Bangkok: Faculty of Tropical Medicine, Mahidol University, 1981:T4

Chakraborty J. Report on Bangladesh oral rehydration programme. Seminar on Integrated Oral Rehydration into Community Action Programme: what role for private and voluntary organization, Washington, DC 19-21 Mar 1980.

Chakraborty J see Chen LC

Chakraborty J see Snyder JD

Chakraborty J see Yunus M

Chakraborty S see Chakrabarti GC

Chatterjee HN. Control of vomiting in cholera and oral replacement of fluid. Lancet 1953 Nov 21;2:1063

This historic study involving oral rehydration therapy was done in Calcutta. Attempting to control vomiting in cholera, in order to reduce dehydration and prevent shock, the author, during two cholera epidemics, in 1952 and 1953, used an anti-emetic, avomine on, respectively, 59 and 127 cholera patients. Of these

## Oral Rehydration Therapy

186 patients, 33 had "mild" dehydration and 153 "moderately severe" dehydration. As avomine does not reduce diarrhoea, the author successfully used the juice of the raw leaf of an Indian plant, *Coleus aromaticus*. When vomiting and diarrhoea thus had been substantially controlled, lost fluids/electrolytes were restored successfully--without need for intravenous fluids by oral rehydration alone in the 33 mildly dehydrated patients (blood sp. gr. 1.062 or less and a good pulse); and by oral plus rectal rehydration in the 153 moderately severe cases (blood sp. gr. 1.062-1.064). The solution contained 4 g sodium chloride and 25 g glucose in 1,000 mL water. When a free urine flow had been established in the patients, 2 g potassium chloride was added to each liter of fluid. All 186 patients thus treated recovered without IV. This landmark study demonstrated the potential usefulness of non-IV glucose/electrolyte solutions for treating cholera.

Chaudhury A see De S

Chavalittamrong B, Pidatcha P, Thavisri U. Electrolytes, sugar, calories, osmolarity and pH of beverages and coconut water. Southeast Asian J Trop Med Public Health 1982 Sep;13(3):427-31

In Thailand, a comparative study was done of soft drink beverages and coconut water which are relatively hygienic, to evaluate these liquids' effectiveness as oral fluids when glucose electrolyte solution is unavailable. Analyzed were 102 samples, consisting of 77 samples of beverages and 25 of coconut water. It was found that coconut water had significantly higher levels of the electrolytes sodium, potassium, chloride, calcium and magnesium than did soft drinks ( $p < 0.001$ ). As for the beverages, their potassium content was very low, while their osmolarity (693 mOsm/L) was significantly higher ( $p < 0.001$ ) than for coconut water (288 mOsm/L), as was the beverages' sugar content (8.7 gm/dl versus 1.1 gm/dl), a difference of ( $p < 0.001$ ). By pH, the beverages (pH 3.1) were more acidic ( $p < 0.001$ ) than was the coconut water (pH 5.4). Carbonated beverages showed a higher sodium and chloride content but less potassium than did non-carbonated ones. Colored carbonated drinks (Pepsi-Cola and Coca-Cola) have more calcium and phosphate than do colorless drinks (Team Sprite and Seven-up) or do non-carbonated drinks. Sugar was high in non-carbonated drinks. Comparing Thai versus U.S. beverages, sodium was higher in the Thai ones and potassium was very high in U.S.-made Coca-Cola. However, overall sugar and calories were lower in Thai beverages. It was concluded that all beverage brands would provide more calories due to their high sugar content but that coconut water is more readily absorbed than are soft drink beverages--and thus coconut water is more suitable for oral rehydration.

✓ Chen LC, Black RE, Sarder AM, Merson MH, Bhatia S, Yunus M, Chakraborty J. Village-based distribution of oral rehydration therapy packets in Bangladesh. Am J Trop Med Hyg 1980;29(2):285-90

The distribution of sucrose-electrolyte ORS packets (to make 1 liter) by community-based workers in a rural Bangladesh population of 157,000 was evaluated. A similar population of 134,000 was the control. The locally-produced packets containing NaCl (3.5 g), NaHCO<sub>3</sub> (2.5 g), KCl (1.5 g) and sucrose (40.0 g) showed satisfactory chemical compositions, with a shelf-life of up to 3 months and a cost of US \$0.05. After 4 months, health workers were distributing an average of 70 packets/1,000 population per month. Most patients used 1 packet for each diarrhoea episode; 13% of children used 2 packets, and 15% and 8% of adults used, respectively, 2 and 3 packets. The workers prepared solutions which, on average, had satisfactory compositions. However, mothers tended to prepare more diluted

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solutions, in which both Na and HCO<sub>3</sub> levels were significantly lower (both  $t = 3.5$ ,  $p < 0.01$ ) than in solutions prepared by the workers. No solution was markedly hyperconcentrated. Diarrhoea hospitalizations during the 4-month ORS distribution were compared. In the comparison area, hospital visits changed from 14.3/1,000 in 1977 to 12.0 in 1978, or by 16%. The rate for the ORS area declined from 8.2/1,000 to 4.5, or by 45%. Thus, the reduction for the ORS area was 29% greater than for the comparison area ( $Z = 2.66$ ,  $p < 0.01$ ). This suggests the health impact of the distribution effort.

Chernchit L see Varavithya W

Chernjitra L see Varavithya W

Chigtery CV. Oral rehydration and vitamin A absorption in children with diarrhoea (summary). Hyderabad: National Institute of Nutrition, 1980. (M.Sc. Dissertation)

Absorption of massive dose of vitamin A given along with electrolyte solution was studied in 4 apparently normal children and 6 children with diarrhoea in India. An oral dose of 2-3  $\mu\text{Ci}$  of 11-12<sup>3</sup>H<sub>2</sub> retinyl acetate was given to each child. This was followed by the administration of ORS containing 200,000 I.U. of vitamin A. Vitamin A absorption and retention were significantly lower in children with diarrhoea than in normal subjects. No label was detected in the unsaponifiable fraction of urine, but, in feces, a significant proportion of radioactivity was found in unsaponifiable fraction, both in normal and diarrhoeic children. Following the administration of massive vitamin A doses, the plasma vitamin A levels increased significantly in both groups. These results suggest that vitamin A supplementation along with ORS may be an effective method for the control and prevention of xerophthalmia.

Chithralekha S see Thomas K

Choudhuri AB see Mahalanabis D

Chowdhury A see Sack RB

Chowdhury AMR, D'Souza S. A design and field methods for monitoring impact on mortality of an oral therapy programme. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh, Jul 1982. 23 p. (ICDDR,B working paper no. 27).

Desiring to set up a low cost surveillance system that can detect changes in mortality due to diarrhoea in the 1.4 year-age group, a design and field method for monitoring the impact of an oral therapy programme on mortality was presented. The design for studying the impact of oral rehydration on mortality envisaged a double stratification of thana, an administrative unit (one geographic and one on the basis of "female liability"), a sliding selection of two unions from each strata. A baseline survey in each union, followed by retrospective multi-round surveys in the selected unions, has been planned. The stratification, determination of an adequate sample size and selection of unions were discussed. For the baseline survey, two sets of questionnaires were developed. Field operations, mapping, interview training, data collection and supervision of field work and data processing were also discussed briefly.

Chowdhury AMR. The retention of knowledge about home-made oral rehydration solution: a survey in rural Bangladesh. *Sylhet Med J* 1982 Aug;6(5):11-5

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The Bangladesh Rural Advancement Committee (BRAC), undertook a nation-wide program in 1961, to educate the rural populace, particularly women, on how to prepare and administer ORS for diarrhoea. The object of this program is to make the simple technology of the pinch and scoop method accessible to the rural poor. In this report the accuracy with which the ORS was prepared by women three and six months after being taught was assessed. A three-finger pinch of labon (common table salt) and a four-finger scoop of gur (molasses) when mixed in a half seer (467 ml) of water give a fluid which approximates the WHO recommended preparation. Preparation of this solution was taught to these rural women. 250 samples of ORS prepared by two groups were collected after three months and six months and were analyzed for sodium at the International Centre for Diarrhoeal Disease Research, Bangladesh. Nearly 90 per cent of the ORS samples were in the safe and effective range with sodium concentrations of 30-99 mmol/L, and less than 3 per cent had a concentration of 120 mmol/L or above.

Cleek JL see Jones R

Clements ML. Oral rehydration therapy. In: New development in tropical medicine Washington, DC: National Council for International Health, 1982: 63-8

Clements ML see Black RE

Clements ML see Levine MM

Coello-Ramirez P see Lifshitz F

Coker AO, Agbonlahor DE, Solanke EO, Ogunbi O, Ahmed I. Oral rehydration of children with diarrhoea: Nigerian experience. *J Trop Pediatr* 1983 Apr;29(2):124-7

The efficacy of WHO-recommended oral glucose-electrolyte therapy in diarrhoea management was evaluated in 28 infants (21 males and 7 females) aged under 6 months hospitalized in Nigeria. Patients had moderate dehydration with such symptoms as reduced skin turgor, sunken eyes, dry mouth and depressed anterior fontanelle. Successful rehydration with oral therapy alone, and without adverse complications, was achieved in 25 (89.3%) infants. The few failures (10.7%) were given intravenous fluids. Etiological agents identified in the study include enteropathogenic Escherichia coli in one patient, enterotoxigenic E. coli in two, Shigella sonnei in one, Giardia lamblia in one, and Entamoeba histolytica in one. Hypernatremia was not found in any patient. Excessive weight gain and puffiness of the face and eyelids were present in 6 of 28 (21%) cases. There is a potential risk of fluid retention and hypernatremia if the glucose-electrolyte mixture alone is given to very young infants. However, the report confirms the efficacy of oral fluid therapy and that the oral fluid was acceptable to both mother and infant.

Cole TJ see Rowland MG

Conteh S, McRobbie I, Tomkins A. A comparison of bottle tops, teaspoons and WHO glucose-electrolyte packets for home made oral rehydration solutions in the Gambia. *Trans R Soc Trop Med Hyg* 1982;76(6):783-5

Three methods of preparing oral rehydration solution were taught to 58 Gambian mothers, and the sodium concentrations and osmolality of the solutions prepared were estimated. Most of the solutions (51/58, 88%) made up by using a WHO glucose-electrolyte mix had a satisfactory sodium content (80 to 120 mmol/L),

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and osmolality (250 to 350 mosm/kg). Of the sugar and salt mixtures prepared by using a teaspoon as a measure, 50% had 80-120 mmol/L of sodium and 48% had an osmolality of 25-350 mosm/kg, while 17% were hypertonic (>120 mmol/L) and 24% were hyperosmolar (>350 mosm/kg). This may have been due to the variation in teaspoon size. Nearly all the sugar and salt solutions prepared by using a soft drink bottle-top as a measure had 30-88 mmol/L of sodium and none was hyperosmolar. Bottles and bottle-tops provide a useful means of preparing simple ORS in a community, as soft drink bottles are widely available, even in remote areas in Gambia. The authors suggest trials of such techniques using locally suitable measures, to find appropriate and accurate ways of making simple ORS.

Contreras-Gutierrez ML see Lifshitz F

Cook R. Measures to control diarrhoeal diseases. Pt. C. Treatment and oral rehydration. Alexandria: Regional Office for the Eastern Mediterranean, World Health Organization, 1978. 26 p.

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Corrales G see Levine MM

Cowley A. see Hosking DJ

Crane RK. Na<sup>+</sup>-dependent transport in the intestine and other animal tissues. Fed Proc 1965 Sep-Oct;24(5 Pt.1):1000-6

The mechanism of Na<sup>+</sup>-dependent transport in the intestine and other animal tissues is discussed, with a comprehensive literature review on the possible involvement of sodium in the transmembrane movement of organic substrates.

Curran PF. Sodium, chloride, and water transport by rat ileum in vitro. J Gen Physiol 1960;43:1137-48

Cutting WAM, Harpin VA, Lock BA, Sedgwick JR. Can village mothers prepare oral rehydration solution? Trop Doct 1979 Oct;9:195-99

Both pre-packaged and domestic ORS have received wide publicity, but there had been little evaluation of how accurately mothers prepare the mixture. To measure this in field conditions, studies were conducted in India and Trinidad by medical students from London. The first study quantified the size variability of a three finger pinch of salt. The second measured the different concentrations when mothers diluted a standard glucose-electrolyte packet in domestic vessels. The finger-pinch test employed 3 grades of salt (crude, crude-crushed, and refined) in an Indian village, and 2 varieties (both refined) in Trinidad. In India, the mean pinch-size (1.63 g) was considerably larger than in Trinidad (0.96 g). Indian mothers picked up most of the refined salt and least of the crude. The range of means was very wide, and the variations among both these and observers were not statistically correlated with any test variety. In the packet dilution study, concentrations varied widely, but more than 83% of mothers mixed the solution within reasonable limits (correct value  $\pm$  40 mmol/L). Mothers tended to make too concentrated a mixture, possibly because smaller vessels were used for measuring, or they were not full of water. The risk would be diminished if packet-size could be standardized to be mixed in the smallest common drinking vessel. Cultural variations and environmental limitations require that simple techniques, such as hand



## Oral Rehydration Therapy

measurements, be field-tested in each area, modified to local circumstances, and promoted with practical instructions.

Cutting WAM. Management of babies with diarrhoea (letter). Br Med J 1976 Jan 31; 1(6004):283

Cutting WAM, Ellerbrock TV. Homemade oral solutions for diarrhoea (letter). Lancet 1981 May 2;1(8227):998

Cutting WAM. Management of diarrhoea in children at the primary care or peripheral level. Ann Soc Belg Med Trop 1979;59:221-35

Cutting WAM. Management of gastroenteritis at home (letter). Br Med J 1981 Dec 12;283(6306):1606

Cutting WAM. Oral rehydration and mortality from diarrhoea in Bangladesh villages (letter). Lancet 1979 Dec 1;2(8153):1186

Cutting WAM. Oral treatment of diarrhoea in children. J Med Child Health 1979; 4:276-81

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Darrow DS, Pratt EL, Flett J, Jr., Gamble AH, Wiese HF. Disturbances of water and electrolytes in infantile diarrhea. Pediatrics 1949 Feb;3(2):129-56

Daum RS see Santosham M

De S, Chaudhury A, Dutta P, Dutta D, Sircar BK, De SP, Sil J, Nath J, Pal SC. Oral fluid therapy for cholera and non-choleraic diarrhoeas in children. J Commun Dis 1975;7:124-8

De S. Oral glucose-electrolyte solution in the treatment of cholera and other diarrhoeas. J Indian Med Assoc 1975;65:230-2

De SK see Chakrabarti GC

De SP see De S

de la Cruz F see Ludan AC

de la Cruz R see Ludan AC

de Souza MA see Shields DS

de Zoysa I, Carson D, Feachem R, Kirkwood B, Lindsay-Smith E, Loewenson R. Home-based oral rehydration therapy in rural Zimbabwe. Trans R Soc Trop Med Public Health 1984;78:102-5

## Oral Rehydration Therapy

The acceptability, feasibility and accuracy of sugar-salt solutions for rehydration were assessed and child care practices relating to diarrhoea management at home were investigated in 4 rural areas of Zimbabwe. A total of 402 respondents were interviewed from 367 households. Only 5% of respondents gave the child a sugar-salt solution at home during the described illness, yet a majority (52%) knew of ORT techniques. A great variety of recipes were described; while 46% of respondents knew of a recipe for a solution containing sugar and salt, only 12% were able to describe the standard recipe for sugar-salt solutions. Those aware of preparation methods were asked to prepare a sample for chemical analysis; of those who prepared a sample, 26% had solution; with both sucrose (50-149 mmol/L) and sodium (30-100 mmol/L) concentrations within the safe and effective ranges. Therefore, 12% (26% x 46%) of rural adults were able to prepare a safe and effective ORS, despite the fact that there was no concerted program to promote home-based ORT in Zimbabwe. The standard method of preparation was taught to 129 respondents who had no previous knowledge of sugar-salt solutions. Recall of the standard method was good; when revisited after 11 to 26 days, 64% remembered the correct recipe and 84% prepared a solution with safe and effective sucrose and sodium concentrations. Ability to recall decreased as the time between first and second visit increased ( $p < 0.05$ ). Ninety-two percent of all households had a teaspoon, sugar and salt and 88% had all the required items: a 750 ml bottle, a teaspoon, sugar and salt. It is concluded that home-based ORT using sugar-salt solutions is useful for early management of acute diarrhoea and should be promoted in rural Zimbabwe. Glucose-electrolyte solutions, when available, should be used by health workers for efficient treatment of dehydrated cases.

de Zoysa I, Kirkwood B, Feachem R, Lindsay-Smith E. Preparation of sugar-salt solutions. *Trans R Soc Trop Med Hyg* 1984;78:260-2

Correct measurement techniques are essential for preparation of ORS, but dangerous or ineffective solutions may result from the inherent variability of the method and ingredients. This study from rural Zimbabwe, compares the reliability of three ORS preparation methods, and assesses the influence of sugar and salt grades available in Zimbabwe. The three methods for measuring sugar and salt in a 750 mL bottle of water were: (i) 6 level teaspoons sugar and half a level teaspoon salt, (ii) 3 heaped teaspoons sugar and half a level teaspoon salt, and (iii) 3 level measures sugar and salt with a double-ended spoon. The mean concentration of sucrose differed significantly according to the method used ( $p < 0.01$ ) and also among extension workers ( $p < 0.05$ ). The teaspoon and 750 mL bottle methods produced reliable results. Heaped teaspoons of sugar gave more reproducible sucrose concentrations than did level teaspoons, i.e., method-ii had a significantly lower ( $p < 0.05$ ) inherent variability than did method-i. The double-ended spoon gave a significantly higher ( $p = 0.001$ ) mean sodium concentration than did methods i and ii. Under field conditions, the level teaspoon method gave more variable results. The ranges were, however, acceptable: 45 to 131 mmol/L for sucrose and 15 to 76 mmol/L for sodium. The authors recommend the use of a domestic teaspoon and a standard 750 mL bottle to prepare home-based ORS in rural Zimbabwe.

Deb BC, Sircar BK, Sengupta PG, Mondal S, Gupta DN, Ghosh S, Pal SC. Long-term impact of oral rehydration in diarrhoea on nutrition of children in Calcutta slums. *Indian J Med Res* 1983 Dec;78:808-13

A group of 383 children aged below 5 in two typical urban slums in Calcutta, India was studied for 3 years (1977-80), to determine at a community level the impact of diarrhoea on overall nutritional progress. The two areas were comparable in eco-

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conomic conditions, mothers' education and water supply, while there was a big difference in sanitary latrine facilities. In one area, 181 children received prompt oral rehydration therapy (ORT) and feeding advice as soon as diarrhoea began. This group's nutritional progress after three years was not significantly different from that of the control children. Observations were similar even when the nutritional gains in diarrhoeal children only were analyzed separately. However, when treated promptly with ORT and given feeding advice, 31.6% of children nutritionally deficient initially, showed statistically significant nutritional gains ( $p < 0.01$  for weight and  $p < 0.05$  for height), compared to the controls. Diarrhoeal incidence was higher in malnourished children in both areas, compared to the children with normal nutrition.

Deenadayulu K see Santhanakrishnan BR

Del Mundo J see Ludan AC

Denny KM see Hirschhorn N

Deorari AK, Bhan MK, Arora NK, Ghaj OP, Kumar R, Stinzing G. Safety of oral rehydration solutions in non-cholera diarrhoea. *Indian J Med Res* 1984 Jan;79:96-102

The safety of two oral rehydration solutions containing respectively, 60 and 90 mEq/l of sodium, was evaluated in children with mild-to-moderate dehydration secondary to non-cholera diarrhoea. Fifty patients, (39 males and 11 females) aged below 5 years and hospitalized between March 1981 and June 1982, were divided into two groups. One patient (3.7%) in the high sodium group developed hypernatremia (serum sodium 155 mEq/l at 8 h, 160 mEq/l at 24 h, and 145 mEq/l at 36 h after initiation of therapy). However, the risk of hypernatremia and hyponatremia in the two groups did not differ significantly. Five (10.2%) patients, all malnourished, had hypokalemia ( $K^+ < 3$  mEq/l) prior to rehydration. While serum potassium became normal in these patients, three other patients (6.1%) showed hypokalemia 24 h after ORS was begun. It was concluded that, while ORS formulas containing both 90 mEq/l and 60 mEq/l of sodium are safe, an increase in potassium concentration needs to be considered, particularly in developing countries where malnutrition is common.

Deren JJ see Levine MM

Dibley M, Phillips F, Mahoney TJ, Berry RJ. Oral rehydration fluids used in the treatment of diarrhoea: analysis of the osmolalities, and sodium, potassium and sugar contents of commercial and home-made products. *Med J Aust* 1984 Mar 17;140 (6):341-7

The osmolalities and sodium, potassium and sugar contents of various commercial and home-made clear fluid preparations were analyzed to allow physicians to evaluate their therapeutic usefulness in diarrhoea treatment. Analysis of 91 commercial dietary clear fluids, including carbonated beverages, cordials, powdered drinks, jellies, fruit juices, fruit juice drinks, syrups and soups showed a range of 0-175 mmol/L of Na, 0-52.1 mmol/L of K, 0-839 mmol/L of reducing sugars and an osmolality of 50-914 mmol/kg water. Home-made ORS prepared by groups of mothers and medical members also showed an unacceptably wide composition range in terms of constituent proportions. The composition of products specially indicated for diarrhoea treatment was also remarkably diverse with a range of 24-100 mmol/L of Na, 14.2-21.0 mmol/L of K, 45-326 mmol/L of glucose, and 170 to 460 mmol/kg water osmolality. The Na levels of the glucose-electrolyte solutions differed significantly from the sugar recipe solution ( $\chi^2=15.1$ ;  $p < 0.005$ ). Based

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on current knowledge of water and electrolyte absorption, neither the commercial dietary clear fluids nor the home-made solutions can be recommended for diarrhoea treatment. Of the therapeutic products, only the UNICEF-ORS had been subjected to clinical trials and found safe and effective. However, the formulation of "DioLyte" also appears appropriate for the treatment of mild diarrhoeal dehydration.

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Dodge JA see Price HV

Dodge JS. Oral rehydration (letter). *NZ Med J* 1979;90:264

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Drash AL see Hyman CJ

Dugdale A, Lovell S, Gibbs V, Ball D. Refeeding after acute gastroenteritis: a controlled study. *Arch Dis Child* 1982 Jan;57(1):76-8

Dutta D see De S

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Edmin W. Mild infantile diarrhea treated by simple dietetic measures and oral potassium. *S Afr Med J* 1951;25:329-32

[Effect of oral rehydration salts in diarrhea with dehydration in children]. *Chung Hua Nei Ko Tsa Chih* 1982 Aug;21(8):452-4

Egemen A, Bertan M. A study of oral rehydration therapy by midwives in a rural area near Ankara. *Bull WHO* 1980;58(2):333-8

✓ ORT was practised in a rural district near Ankara, Turkey, to evaluate its acceptability to parents and its efficacy in managing mild and moderate dehydration due to diarrhoea. A total of 746 children in the treatment group and 491 controls were followed up for 16 months. In the treatment group, auxiliary nurse-midwives gave fluid therapy to diarrhoeic children at home. Monthly weight gains were 230.2 g and 189.9 g, respectively, in treatment and control groups; the difference was significant. In the treatment group, fewer antibiotics were used ( $p < 0.001$ ) and less referrals were made to health centres ( $p > 0.001$ ). During and after the study, it was observed that mothers' attitudes towards ORT were highly favorable. ORT was found convenient and effective in managing diarrhoea in the rural areas of Ankara.

El-Akkad N see El-Mougi M

## Oral Rehydration Therapy

El-Hadi M see El-Mougi M

El-Mougi M, Santosham M, Hirschhorn N, El-Hadi M, El-Akkad N, Khalek HA, Hosni H. Accuracy of mixing oral rehydration solution at home by Egyptian mothers. *J Diar Dis Res* 1984 Sep;2(3):159-61

One limitation of ORS is concern about the accuracy of mixing the packet contents in proper amount of water. Over-dilution makes ORS less effective, while over-concentration may make it dangerous. Therefore, the accuracy of mixing ORS at home by illiterate Egyptian mothers was examined. A special 200 ml cup was supplied to 25 mothers of infants with acute diarrhoea, and its impact on mixing accuracy was determined. A control group (26 mothers) was not given the cup. Five minute standardized verbal instructions on mixing were given to both groups. The median capacity of home containers used by the control group was 160 ml. The mean ORS sodium concentration for the group supplied with the specified container (98 mmol/L) was significantly lower than that (123 mmol/L) of the group using home containers ( $p < 0.02$ ). It is recommended that, when pre-packaged ORS is distributed to mothers it would be useful to provide graduated measuring containers with appropriate instructions.

Ellerbrock TV. Oral replacement therapy in rural Bangladesh with home ingredients. Dhaka: Bangladesh Rural Advancement Committee, 1979. 17 p.

Ellerbrock TV. Oral replacement therapy in rural Bangladesh with home ingredients. *Trop Doct* 1981 Oct;11(4):179-83

Despite the obvious advantages of oral therapy over intravenous therapy in a village situation in the developing countries, its application has presented some problems with regard to education and the availability of materials. A program had been designed to train women in a remote rural area in a method of making oral replacement solution which is safe, cheap, simple, acceptable and available to all. A concise, educational message and a simple organization framework were used as the essential elements of the program. The core of the program was a simple, concise but comprehensive health message entitled "Ten Points to Remember". It was a condensation of all that a village woman needs to know to treat diarrhoea with oral therapy. Women were taught to make oral solution by adding one three-finger pinch of salt (exactly up to the first finger crease of the index finger) and two four-finger scoops of gur (locally available unrefined sugar containing sucrose, a substantial amount of potassium and small amounts of bicarbonate) to one-half seer of tubewell or boiled water. Results showed that after 39 days of field work, 98% of the 1,079 sample women interviewed knew 7 or more of the 10 points of the health message and all those sampled knew how to make the solution correctly. The women who were interviewed were also asked to make the oral solution which was analyzed for the concentration of sodium, potassium and sucrose. The program demonstrated that village women in Bangladesh, who are predominantly illiterate, can learn oral therapy, including how to make oral solution correctly from locally available substances using finger measurements. It also provides an example of a workable system to supervise and administer a rural health program in a developing country based on achievements of educational objectives.

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Elliott H see Ashley DEC

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Field M. New strategies for treating watery diarrhea (editorial). *N Engl J Med* 1977 Nov 17;297(20):1121-2

Finberg L, Mahalanabis D, Nalin DR. Oral therapy for dehydration in acute diarrhoeal diseases with special reference to the global diarrhoeal diseases control programme. Geneva: World Health Organization, 1979. 6 p.

Fisher RB. Glucose movements across the wall of the rat small intestine. *J Physiol* 1953;119:210-23

Flett J, Jr. see Darrow DS

Fordtran JS see Turnberg LA

Forrest JN see Cash RA

Fortin J, Parent MA. Dehydration scoring system for infants. *J Trop Pediatr Environ Child Health* 1978 Jun;24(3):110-4

Foster S see Santosham M

Fox WW see Baumgart S

Gairdner D. Tablets of sodium-potassium chloride for preparing electrolyte solutions for oral use. *Br Med J* 1956 Apr 14;1:843

During diarrhoea, among infants and young children, water and electrolyte equilibrium can be maintained by oral electrolyte solution. The tonicity of such solutions should not be higher than one-third that of physiological saline, while sodium (Na) and potassium (K) should be provided in roughly equal proportions. This communication reports the usefulness of tablets containing NaCl (0.28 g) and KCl (0.21 g). When one tablet was dissolved in 5 oz (140 ml) of water, the resulting solution had NaCl 0.20% and KCl 0.15%. This solution had a tonicity of 108 mEq/L and contained (in mEq/L): Na 34, K 20 and Cl 54. For infants glucose or sucrose (50 g to 1 L) was usually added, while for older children the tablets could be dissolved in a flavored drink. The tablets were particularly found useful with infantile gastroenteritis when treated in home. Tablet dispensing was convenient compared to administering large volumes of electrolyte solution. The solution is likely to be more effective than the improperly prepared home-made saline. In hospital practice, a general-purpose electrolyte solution can be prepared by using these tablets.

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## Oral Rehydration Therapy

Gerson CD. Failure of oral glucose therapy in short-bowel syndrome. *Lancet* 1972;2:353-5

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Ghai OP see Deorari AK

Ghatikar KN. Oral rehydration therapy - an overview. *Q Med Rev* 1980 Oct;31(4):1-12

Ghosh S see Deb BC

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Grand RJ. Fluid and electrolyte replacement in infantile diarrhea. *Gastroenterology* 1981 Jan;81(1):183-4

Greenough WB, III. Directions of future research on ORT. In: *Proceedings of the International Conference on Oral Rehydration Therapy, Washington, D.C., 7-10 Jun 1983*. Washington: AID, 1983:199-201

Greenough WB, III. Need people die any more of cholera?: causes, concerns, and control (interview). *Future* 1983 Autumn;(8):21-3

Greenough WB, III. Oral replacement therapy in diarrhea: consensus and controversy. In: Field M, Fordtran JS, Schultz SG, eds. *Secretory diarrhea*. Bethesda, Md: American Physiological Society, 1980:179-85

Greenough WB, III. Principles and prospects in the treatment of cholera and related dehydrating diarrheas. In: *Cholera and related diarrheas*. Basel: Karger Press, 1980:211-8 (43rd Nobel Symposium)

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Günöz H see Aperia A

Gupta BD see Sachdev HPS

Gupta DN see Deb BC

Halim S see Purba MD

Haneef SM. Hospital management of acute diarrhoea. *Pak Pediatr J* 1979 Mar;3(1):83-97

This paper discusses various aspects of infantile diarrhoea, including its patho-

## Oral Rehydration Therapy

physiology, physiological basis of ORT, treatment objectives, patients assessments, ORS types, feeding during diarrhoea, and drug use. The observations strongly favor a change of doctor out-looks and community attitudes towards diarrhoea and its treatment. Diarrhoea accounts for a quarter of all illnesses in Pakistani children, and the same proportion of family physicians' and medical officers' work, as well as half the work of pediatric departments. Instead of using drugs to reduce stool frequency, treatment should consist of fluid, electrolyte and nutritional maintenance by early ORT, and continued feeding--measures which could be life-saving and economic. Properly-conducted home management could reduce the pressure on hospitals.

Hansen JPL. The outpatient or home treatment of severe gastroenteritis with dehydration in infants. *S Afr Med J* 1952;31:45

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Haque ZA see Cash RA

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Hardjadinata D see Azis AL

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Harrison HE. The treatment of diarrhea in infancy. *Pediatr Clin North Am* 1954; 1:335-48

Hassall IB. Mothers' knowledge of treatment of infantile diarrhoea (letter). *NZ Med J* 1984 Mar 14;97(751):166

Hassan NA see Lasch EE

Hatcher G. Diarrhoea. *Br Med J* 1976;1:571-3

Hendratta L, Rohde JE. Oral rehydration: where we go from here? In: Jelliffe DB, Jelliffe EFP, eds. *Advances in international maternal and child health*. Oxford: University Press, 1981. Chapter 5.

Hendratta L see Rohde JE

Hernawan, Sunoto, Pusponogoro TS, Suharjono. Treatment of acute infantile gastroenteritis dehydration acidosis with Ringer's lactate and glucose-electrolyte solution. *Paediatr Indones* 1978 Mar-Apr;18:83-90

Fifty infants aged 1-18 months hospitalized in Indonesia were studied, to determine the efficacy of Ringer's lactate solution (RL) in the treatment of acute gastroenteritis with severe dehydration and acidosis. Ringer's lactate was given parenterally in an amount of 30 mL/kg body weight in the 1st hour and 70 mL/kg body weight or 10 mL/kg/h in the following 7 hours. After 8 h of parenteral therapy, the children were given either glucose-electrolyte solution or milk formula in  $\frac{1}{2}$  dilution. Clinical evaluation was based on the general condition of patients, rehydration state, blood gas analysis, electrolyte examination and observation of complications. After 8 h therapy with RL, 44 patients (88%) were completely rehy-



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drated or only mildly dehydrated and 2 patients (4%) required 24 h to achieve rehydration. While 1 patient improved after 5 days of parenteral therapy, 3 others died (mortality rate: 6%), one due to encephalitis, one to potassium deficiency ( $K=2.1$  mEq/L) and the third due to dehydration, as the child was admitted in a moribund stage. The authors conclude that RL solution can be useful, particularly in areas where facilities and choice of parenteral fluids are limited.

Hirschhorn N. Decrease in net stool output in cholera during intestinal perfusion with glucose containing solutions. *N Engl J Med* 1968;279:176-80

Hirschhorn N. Diarrhoeal control: opportunities and constraints as illustrated by development of an oral therapy programme. Geneva: World Health Organization, 1978.

Hirschhorn N, Cash RA, Woodward WE, Spivey GH. Oral fluid therapy of Apache children with acute infectious diarrhoea. *Lancet* 1972 Jul 1;2:15-8

Fifty-two Apache Indian children, (26 of each sex; 1-42 months old) hospitalized with acute diarrhoea of diverse etiology, were treated successfully with nutritive oral glucose-electrolyte solutions. On admission, dehydration was evident in 29 children: 5 were in shock with clinical signs of fluid-loss (grade 3); 24 had signs of dehydration (grade 2) without shock. The important biochemical abnormalities were acidosis and shock (61% of children tested had serum sodium  $<130$  mEq/L). Two solutions were used. One, containing glucose and electrolytes in water, was used primarily for rehydration and replacement of large volume fluid loss. The other, a commercial formula "Pregestamil" (Mead-Johnson), containing casein-hydrolysates, medium-chain triglycerides, electrolytes and glucose, was used mainly for maintenance and replacement of small fluid loss. Three liters of I.V. fluid, was used compared with 66 L in a similar group of hospitalized patients treated the previous summer. Early oral glucose-electrolyte rehydration allowed the patients to replace diarrhoeal losses, with little need for parenteral fluid, to gain weight during diarrhoea, and, perhaps, to suffer fewer relapses. This is desirable, especially in areas where diarrhoea is endemic and undernutrition is common. An additional benefit of early feeding with glucose may be the induction of intestinal disaccharidases.

Hirschhorn N, Denny KM. Oral glucose-electrolyte therapy for diarrhea: a means to maintain or improve nutrition? *Am J Clin Nutr* 1975 Feb;28:189-92

Early, rapid replacement of volume loss and correction of electrolyte imbalance, with extensive use of glucose-electrolyte ORS, can quickly restore well-being and appetite to most children with acute diarrhoea. Repeated bouts of diarrhoea--with attendant anorexia, fasting and secondary malabsorption--potently contribute to malnutrition. Regular fluid therapy, proved in hospital settings, can ameliorate many adverse diarrhoea consequences. Since cultural attitudes vary widely, proper adaptation to local beliefs may allow ORS to be successful in most areas. The ingredients should be packaged properly, to ensure stability for a reasonably long time. This review suggests collaborative work between physicians, anthropologists, chemists, marketing experts and health educators, to determine the impact of ORS on children's acute diarrhoea, malnutrition and mortality.

Hirschhorn N, Westley TA. Oral rehydration of children with acute diarrhoea (letter). *Lancet* 1972 Sep 2;2(7775):494

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Hirschhorn N, Kinzie JL, Sachar DB, Taylor JO, Northrup RS, Phillips RA. Reduction of stool output in cholera by glucose and electrolyte lavage. In: Proceedings of the Symposium on Cholera, Palo Alto, 26-28 Jul 1967:195-6

Hirschhorn N. The treatment of acute diarrhoea in children: a historical and physiological perspective. Dacca: International Centre for Diarrhoeal Disease Research, Bangladesh, 1980. 62 p. (ICDDR,B special publication no. 6)

This review examines the historical, physiological, clinical and epidemiologic evidence to support a method of therapy for children's diarrhoea that may be recommended for general acceptance. Using a carefully designed glucose-electrolyte ORS, physiologically correct treatment may now be so simplified and inexpensive as to be readily available to the remote areas of the world where most of the morbidity exists; and be useful as well to more sophisticated settings. Data obtained from six independent lines of physiologic and clinical research have given ORS a broader significance with regard to both medical science and health care delivery. The treatment method recommended here has several important departures from traditional teaching. It advocates rapid extracellular fluid restoration with a polyelectrolyte solution containing sodium, base and potassium; use of an ORS for repletion of those not in shock and for maintenance; use of a single ORS for all age groups, regardless of diagnosis; and quite early feeding with tolerated foods. Sodium loads given are generally higher than those advocated by standard pediatric teaching. The origins of that teaching and support for the newer approach accrue from detailed analysis of current knowledge in the epidemiological, clinical and physiological aspects of diarrhoea.

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Hirschhorn N see Pierce NF

Hirschhorn N see Sack RB

Holley HP see Nalin DR

Hollowell JG, Paul JR, Jr. Oral electrolyte therapy for diarrhea: a clinical study of 65 patients with mild diarrhea and dehydration. *J South Carolina Med Assoc* 1969;55:335-7

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Hosking DJ, Cowley A, Bucknall CA. Rehydration in the treatment of severe hypercalcaemia. *Q J Med (Ser N)* 1981;50:473-81

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Hutchins P, Matthews THJ, Manly JE, Lawrie B, Walker-Smith JA. Comparison of oral sucrose and electrolyte solutions in the out-patient management of acute gastroenteritis in infancy. *J Hyg* 1979;82:15-9

Hyman CJ, Reiter J, Rodnan J, Drash AL. Parenteral and oral alimentation in the treatment of the nonspecific protracted diarrheal syndrome of infancy. *J Pediatr* 1971 Jan;78(1):17-29

This paper reports 10 cases of nonspecific, protracted infantile diarrhoeal syndrome, and clinical experience in managing these infants, in whom diarrhoea started before the age of 3 months. The first 7 patients died; clearly identifiable pathologic entity was not established, and treatment was ineffectual. The last 3 patients were studied prospectively, according to a uniform pre-arranged protocol for diagnosis and therapy. The therapeutic regimen included hypertonic I.V. solutions of protein hydrolysate, dextrose, and alcohol and orally fed medium-chain triglycerides. This combined regimen was able to supply up to 400 cal/kg/day, and there was a progressive increase in weight and linear growth. Brain growth, as assessed by increasing head circumference and developmental progress, was seen in these patients. They tolerated the therapy for up to 18 weeks without any serious problems. A specific diarrhoea cause in the 3 children who recovered could not be demonstrated. However, after recovery, each had an adverse reaction, temporarily associated with a change from Nutramigen to Enfamil or whole milk feedings. This suggests a milk protein allergy.


Ilagan NB see Ludan AC

International Study Group. Beneficial effects of oral electrolyte-sugar solutions in the treatment of children's diarrhoea. 1. Studies in two ambulatory care clinics. *J Trop Pediatr* 1981 Apr;27(2):62-7

Studied were nearly 2,000 diarrhoea episodes in ambulatory children under age five, in two peri-urban Philippine villages. The subjects were treated with an oral rehydration solution of electrolytes and sugar, coupled with early feeding. The results: 1). After one year of intensive ORS use, dehydration incidences due to insufficient intake were reduced. 2). Weight gain occurred both across an average episode and, for part of the study, over a several month period. Children with prolonged diarrhoea bouts seemed especially protected from weight loss. 3). Non-specific anti-diarrhoeal drugs provided no added benefit to use of ORS: 4). Though use of glucose-ORS was associated with a somewhat shorter diarrhoea duration compared to sucrose-ORS, the clinical outcomes were not significantly different. 5). It was concluded that ORS may be used widely and safely.

International Study Group. Beneficial effects of oral electrolyte-sugar solutions in the treatment of children's diarrhoea. 2. Studies in seven rural villages. *J Trop Pediatr* 1981 Jun;27(3):136-9

The effect of ORS in the treatment of children's diarrhoea by mothers was studied in seven rural Philippine villages. In each community, one or two women or men were chosen. Designated "local ORS deliverers" (LODs), they were trained by project staff in the clinical manifestations of diarrhoeal disease, ORS fluid therapy and nutritional requirements. In turn, the LODs instructed mothers. Mothers were



## Oral Rehydration Therapy

supplied with WHO foil packets of ORS, as well as with empty beer bottles or half-liter intravenous bottles, to assure accurate mixing. A pre-and post-survey of 347 households was conducted, with regard to parents' knowledge, attitude and practice in treatment of diarrhoea. Results demonstrated that: mothers had a high degree of acceptance, understanding and proper use of ORS; lower hospitalization and death rates occurred (0.7% for each); and there was an improved perception by mothers that continued feeding during diarrhoea was beneficial.

Introduction (on diarrheal disease). In: Basumslag N, Mason LG, Davis R, Sabin E, eds. Diarrheal disease and oral rehydration: an annotated bibliography. Washington: USAID, 1979:i-vii

Islam MR, Ahmed SM. Oral rehydration solution without bicarbonate. Arch Dis Child 1984;59:1072-5

The efficacy of ORS without bicarbonate was compared with the WHO-ORS in 98 children aged below 5, in a double blind, randomized clinical trial at the ICDDR,B. These children had varying degrees of dehydration and acidosis due to acute watery diarrhoea. The mean serum bicarbonate concentration on admission was 13.3 mmol/L in the group receiving ORS without bicarbonate and 13.1 mmol/L in the WHO-ORS group. All but 3 children who received the ORS without bicarbonate were successfully treated; 3 treatment failures were attributed to persistent vomiting and severe diarrhoea (greater than 10 ml/kg/h). The non-bicarbonate treated group consumed less ORS than the WHO-ORS group, and also passed less liquid stool, but this difference was not statistically significant. Among those who vomited (17 in non-bicarbonate and 15 in WHO-ORS group), the mean volume of vomitus/kg body weight was more ( $p < 0.001$ ) in the non-bicarbonate group (22 ml/kg) than that in the WHO-ORS group (12 ml/kg). Acidosis correction was slower among non-bicarbonate treated than those in the WHO-ORS group during the first 24 h of treatment ( $p < 0.001$ ). By 48 h, however, acidosis was corrected and mean bicarbonate had risen to 17.1 mmol/L compared to 18.9 mmol/L in the WHO-ORS group ( $p > 0.05$ ). Some failures due to sustained acidosis and persistent vomiting and diarrhoea could be expected. ORS without bicarbonate may be used where complete formula solution is not available.

Islam MR, Samadi AR, Ahmed SM, Bardhan PK, Ali A. Oral rehydration therapy: efficacy of sodium citrate equals to sodium bicarbonate for correction of acidosis in diarrhoea. Gut 1984 Aug;25(8):900-4

The efficacy and acceptability of ORS containing sodium citrate was compared with that containing sodium bicarbonate in terms of shelf life and in the treatment of dehydration from diarrhoea and acidosis. At the ICDDR,B, 51 patients (children and adults) with moderate dehydration and acidosis due to acute watery diarrhoea were treated randomly with either WHO-ORS which included 2.5 g/L sodium bicarbonate or an ORS where the sodium bicarbonate was replaced by 2.94 g/L sodium citrate. Twenty-one of 28 cases (75%) in the citrate group and 19 of 23 (83%) in the bicarbonate group were successfully rehydrated ( $p > 0.05$ ). There were no significant differences in intake, output, gain in body weight, fall in hematocrit and plasma specific gravity, and correction of acidosis between the two groups within 48 h of therapy initiation. Treatment failure was mostly due to inability to drink enough of either ORS because of excessive vomiting and purging. The citrate base solution was as effective, safe and acceptable as WHO-ORS for diarrhoeal rehydration and acidosis correction. In addition, the citrate-based salt is convenient for longer storage and also for tablet formulation.

Islam MR see Nalin DR

## Oral Rehydration Therapy

Islam MR see Samadi AR

Islam MS, Rahaman MM, Aziz KMS, Patwari Y, Rahman M. Variations of oral therapy volume measurement in rural Bangladesh. In: Aziz KMS, Becket JL, eds. Proceedings of the National Workshop on Oral Rehydration, 26-28 Sep 1979. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh, 1980:11

To determine the variations of volume measurement, an oral therapy field trial was conducted in Bangladeshi villages -- 2 (population 6,000) in Matlab and 1 (population 7,000) in Teknaf. Villagers were taught to administer ORS to all acute diarrhoea cases. ORS powder was provided in 60 ml bottles for dilution in 980 ml or one seer (local unit of measure) of water. A properly mixed solution would contain 120 mEq/L Na. Solutions prepared by the villagers had average Na concentration of 140 mEq/L for Matlab and 95 mEq/L for Teknaf. Sodium was higher than 140 mEq/L in 28 of 71 samples in Matlab, compared to 6 of 54 in Teknaf. In Matlab, the mean Na level decreased to 122 mEq/L ( $p < 0.05$ ) when the seer volume used was measured and corrected at the onset of treatment. To determine if volumetric errors were responsible for high Na concentration in Matlab, a survey was carried out in 4 other villages not involved in the ORS trial. Of 128 households, 111 had a measuring container and the mean seer volume was  $959 \pm 121$  ml (range 720 - 1270 ml). Twenty-three percent of the households with a measure produced a volume less than 90% of the correct volume. A similar survey in Teknaf revealed that mean seer volume seemed to produce more accurate Na concentration, these values did not correlate with actual volume of the measure as calibrated by the field workers in Matlab. Households using  $\frac{1}{2}$  seer measures produced more accurate volumes than did those using  $\frac{1}{4}$  seer measures. Indiscriminate ORS use, in the absence of adequate training, may expose infants to the risk of hypernatremia. Before ORS is freely marketed or distributed in unsupervised settings the relative risks should be better defined in larger field trials.

Ismail R see Mawardi J

Jacobs B see Mahalanabis D

Jacobs B see Sack RB

Jahan K see Ahmad K

Jain A, Khatri PC, Jain S, Yadav SP. Oral rehydration therapy. J Indian Med Assoc 1980;75:120-3

Jain NK see Kumar V

Jain S see Jain A

Jalan KN see Patra FC

Jelliffe DB. Rehydration centers in developing countries (editorial). J Trop Pediatr 1969;15:1-3

Jones R, Phillips RW, Cleek JL. Hyperosmotic oral replacement fluid for diarrheic calves. J Am Vet Med Assoc 1984 Jun 15;184(12):1501-5

## Oral Rehydration Therapy

Kahn A, Blum D, Mozin MJ, Vis HL. Glucose electrolyte solutions in a European context (letter). Lancet 1981 Aug 15;2(8242):360-2

Kahn A, Blum D. Hyperkalaemia and UNICEF type rehydration solutions (letter). Lancet 1980 May 17;1(8177):1082

Kamel H. Home management of early dehydration in children. Saudi Med J 1981;2 (Suppl 1):56-8

A previous observation of the author at Jeddah General Hospital that 70% of a series of 900 consecutive cases of infants with severe dehydration following gastroenteritis died, led him to undertake the present study of early oral rehydration at home. As Saudi mothers had no faith in polythene packed ORS, the author used a line of management of dehydration in which the main features were: (1) entrusting the mother with the treatment of her own infant; and (2) changing the role of the doctor to that of a provider of ample health education. Saudi infants of less than 1 year old with diarrhoea, inconspicuous vomiting and mild dehydration, and who had illiterate mothers were chosen as the sample in the study from the outpatient clinic of the Children's Hospital of Riyadh. Over a period of 3 years 1200 cases fulfilling the criteria were included, and the importance of fluid and electrolyte loss was explained to the mothers in a simplified diagrammatic way. Mothers were also shown a set of photographs and drawings demonstrating the preparation and feeding of oral rehydration solution made from salt, sugar, oranges and preboiled water using measuring bottles and glasses that are common in Saudi Arabia. The results of this study showed that 63.5% of the 1200 cases had responded to oral rehydration when assessed within three days. The three causes of failure were: no-adherence to instructions; vomiting precluding oral therapy; and not reporting within 3 days but reporting after deterioration of condition. The mortality rate was 36.5%. In the author's view these failures could have been largely avoided if more time had been available to talk to the mothers to convince them of the need to adhere to the instructions. It was also suggested that all methods including mass media should be used to encourage parents to take their infants to clinics at the stage of mild dehydration, and instruct them about the simple and successful rehydration procedure.

Karo-Karo M see Saragih M

Kasemsarn P, Varavithya W. Oral rehydration in diarrheal infants and children. J Med Assoc Thai 1980;63:646-50

Kashemsant C see Varavithya W

Keimowitz RI see Mondal A

Keimowitz RI see Pierce NF

Keusch GT see Keusch LS

Keusch LS, Keusch GT. Growth of toxigenic Escherichia coli in oral rehydration solutions. Diagn Microbiol Infect Dis 1984;2:139-43

Khalek HA see El-Mougi M

Khan MA. Infantile diarrhoea and the use of oralyte (abstract). Pak Pediatr J 1979;3:103

## Oral Rehydration Therapy

Khan MU. Preparing oral rehydration salt solutions (letter). *Nature* 1979 Aug 9; 280(5722):444

Khan SR. Home management of infantile diarrhoea. *Pak Pediatr J* 1979;3:77-82

Khatoon M see Molla AM

Khatri PC see Jain A

Khin-Maung U see Thane-Toe

Kielmann AA, McCord C. Home treatment of childhood diarrhea in Punjab villages. *J Trop Pediatr Environ Child Health* 1977 Aug;23(4):197-201

Diarrhoea was the main cause of death among preschool children under surveillance in a combined nutrition/infectious disease control program in Punjab, India. Case fatality rate was low (0.7-4.1 deaths per 1,000 cases), but incidence was very high, averaging 41.0 episodes/100 children/month. The criterion for a diarrhoea episode was more than 3 watery bowel movements per 12 h for one day or more. Diarrhoea incidence was highest in the hot, dry season, generally rising to more than 60 episodes/100 children/month between March and June. According to the clinical criteria of diarrhoea and dehydration, two types of oral fluid were used: 6 teaspoons sugar with 1 level teaspoon salt per liter of water; and a centrally-prepared mixture of sodium and potassium chloride (no bicarbonate) with sucrose added from household supply. Initial efforts at home treatment with ORS were unsuccessful, but an intensive training program for supervisors, village level workers, and mothers significantly reduced diarrhoea mortality, though not incidence. Training emphasized classification of cases into treatment categories according to defined criteria, and making auxiliaries and mothers responsible for treatment of all but the most severe cases.

Kinzie JL see Hirschhorn N

Kirkwood B see de Zoysa I

Kourany M see Santosham M

Kuberski T, Roberts A, Linehan B, Bryden RN, Teburae M. Coconut water as a rehydration fluid. *NZ Med J* 1979;90:98-100

Kuiper DH. Oral solutions for cholera (letter). *Ann Intern Med* 1969 Oct;71(4): 868

This letter refers to an earlier study (see Pierce *et al.*) on replacement of water and electrolyte losses in cholera by a glucose-electrolyte ORS. Ten percent dextrose in 0.9% NaCl was administered orally to a patient with copious watery diarrhoea (3-4 L/h) secondary to small bowel lymphoma. The patient, as well as physicians who sampled the solution, found it nauseating. Patient acceptance was increased by mixing Tang, a flavouring agent, and ice cubes with each ORS serving.

Kumar CR see Bai KI

Kumar R see Deorari AK

## Oral Rehydration Therapy

Kumar V. Community implementation of oral rehydration therapy. *Indian J Pediatr* 1984;51(408):1-6

This paper discusses various aspects of ORT, used to solve the operational problems of implementing ORT programmes aimed at controlling acute diarrhoeal diseases. Included is use of single versus multiple formula; the suitability of alternative ingredients and their concentrations; measuring accuracy; water purity; amount of ORS required; training and education of health workers and parents; treatment and delivery facilities, including home preparation, and evaluation of ORS.

Kumar V, Monga OP, Jain NK. The introduction of oral rehydration in a rural community in India. *World Health Forum* 1981;2(3):364-6

The Department of Community Medicine of the Postgraduate Institute of Medical Education and Research, Chandigarh, India, collaborating with a district primary health centre in Haryana State, successfully introduced oral rehydration therapy, combined with health education, in diarrhoeal disease treatment as part of a rural area's health services. Teaching materials and a methodology were developed, to increase acceptance and efficacy of ORT among 112,000 people in 158 villages. The standard WHO-recommended glucose-electrolyte mixture was used, pre-packaged at a central point into two polythene bags (one containing only bicarbonate), to prolong shelf-life. These were sent to village volunteers, along with smaller bags, plastic measures and a cheap (US \$ 2.50) sealing machine. Volunteers were able to prepare more than 100 packets daily, each costing about US 4 cents. Requirements varied with season, from 1,000 to 2,000 packets monthly. Trained in small groups were 350 community health workers, who trained mothers, primary school teachers and community elders, in home management of diarrhoea. Folk media, such as fairs and puppet shows, were used to inform the public about ORS. The results: repeated health worker training is important. Rural mothers' attitudes about and hence treatment of diarrhoea improved, as well as knowledge among teachers and children. An indication was the finding that the diarrhoea fatality rate in six villages was 1:267, compared to 1:50 in villages where ORS had not been introduced. There also was a dramatic drop in diarrhoea referrals. Factors influencing these successes were use of the available health infrastructure; community involvement simplification of ORS by using local volunteers to package and deliver; integration of the program into the available health care delivery system; repeated staff retraining; and use of folk media and existing educational facilities to inform about ORS. Still, many operational problems need to be solved, to find the best way of bringing such technical advances to the populations most in need.

Kumar V. Oral rehydration therapy for diarrhea in children. *Indian Pediatr* 1980 Sep;17(9):739-43

This paper discusses the role of ORS in treating diarrhoea, with particular reference to India. The basis of WHO-recommended composition is reviewed, and safety measures are outlined to avoid the risk involved in using a single formulation. Since the sachets available in India do not conform to WHO recommendations and are expensive (Indian Rs. 3-6 per liter), alternative packaging of uniform formula in sturdy plastic bags is suggested. Home-made ORS should also be assessed objectively for composition consistency and risk. ORS distribution must be combined with education and training of health auxiliaries, volunteers and mothers, in proper usage of ORT, recognition of danger signals, timely referral of sick children, importance of feeding during diarrhoea, and adoption of hygienic mea-



## Oral Rehydration Therapy

asures in preventing diarrhoea. To bring ORT close to people's reach, a national diarrhoeal disease control program should be launched in India.

Kumaijanto M see Azis AL

Langman CB see Baumgart S

Lasch EE, Abed Y, Guenina A, Hassan NA, Amara IA, Abdallah K. Evaluation of the impact of oral rehydration therapy on the outcome of diarrheal disease in a large community. *Isr J Med Sci* 1983;19(11):995-7

The availability of a well-organized health service in Gaza, Israel provided an excellent opportunity to institute a large-scale project. This project evaluated the effectiveness of early ORS therapy in reducing diarrhoea-related hospital admissions, mortality and malnutrition. A 3-year program was initiated in 1978, encompassing all community health centers and including intensive community education on ORS use. Compared with the pre-study year 1977, diarrhoea-related hospital admissions were reduced by 35.3% in 1980 and by 42.0% in 1981. Child mortality from all causes in 1-35-month-old children decreased by 28.7% in 1980 and by 41.7% in 1981, while gastroenteritis-associated fatalities decreased by 35.6% and 53.2%, respectively. Post-neonatal mortality due to acute diarrhoeal diseases decreased by 37.2% and 52.2%, respectively, in 1980 and 1981. The results firmly establish the clinical effectiveness of ORS therapy in child diarrhoea. The study also succeeded in establishing active community and family participation.

Lclean SJ see Cutting WAM

Levine MM. Oral therapy for diarrhoea: past, present and future (editorial). *J Trop Med Hyg* 1981 Oct;84(5):185-7

Levine MM, Clements ML, Black RE, Hughes TP, Blum D, Andino R, Corrales G. A practical, reliable method for preparing simple sugar/salt oral rehydration solution. *J Trop Med Hyg* 1981;84:73-6

The variation inherent in the two previously-described methods of preparing ORS (pinch-scoop and household glass-teaspoon), even when practiced by experienced, technically-sophisticated nurses under optimal conditions, was unacceptable. This study searched for a simple, practical method of preparing sugar/salt ORS, utilizing the readily-available 5 mL teaspoon and 1.0 liter container, that would repeatedly yield solutions with safe, efficacious  $\text{Na}^+$  and sucrose concentrations. One level teaspoonful of table salt and four heaping teaspoonfuls of sugar were added to a 1.0 liter bottle filled with water. Quadruplicate solutions prepared by 5 U.S. nurses experienced in oral rehydration gave 61-93 mmol  $\text{Na}^+$ /L and 2.6-3.7 g% sucrose. Solutions prepared by 20 (mostly illiterate) rural Honduran mothers ranged in  $\text{Na}^+$  level from 60-145 mmol/L and in sucrose from 1.3-3.7 g%, all within the safe, effective range.  $\text{K}^+$  levels did not exceed 0.7 mmol/L in any solution. This method should be suitable in many areas as an interim measure, before optimal formula ORS packets become widely available.

Levine MM, Deren JJ, Steiger E, Zinno R. Role of oral intake in maintenance of gut mass and disaccharide activity. *Gastroenterology* 1974 Nov;67(5):975-82

## Oral Rehydration Therapy

Levine MM see Black RE

Levine MM see Mohs E

Levine MM see Nalin DR

Levine MM see Pizarro D

Lewy JE see Boineau FG

Liao MTP see Ludan AC

Lifshitz F, Coello-Ramirez P, Contreras-Gutierrez ML. The response of infants to carbohydrate oral loads after recovery from diarrhea. *J Pediatr* 1971 Oct;79(4): 612-7

The capacity to tolerate carbohydrate oral loads was tested in 46 infants after recovery from severe diarrhoea at a Mexican hospital. During the acute stage, all were glucose-tolerant, 8 were lactose-tolerant, 20 were intolerant to lactose, and 18 intolerant to all disaccharides. When carbohydrate was included in oral feedings during diarrhoea, the 38 intolerant patients had a stool pH under 6.0 and a carbohydrate content over 0.25%. Patients with carbohydrate malabsorption during diarrhoea continued to have carbohydrate intolerance in the first week after recovery from diarrhoea. This impairment disappeared within 2 months. No patient demonstrated a glucose metabolism impairment. Diarrhoea induction and excretion of feces with an acid pH, reducing substances, and glucose were the bases for diagnosing carbohydrate intolerance. The elevation in blood/reducing sugar levels induced by carbohydrate oral loads was variable, and was not correlated to the stool pattern in response to the tolerance test. Dietary treatment of diarrhoeal infants is discussed.

Lindsay-Smith E see de Zoysa I

Linenhan B see Kuberski T

Lionel J, Steinhoff MC, Pereira SM. Commercial oral rehydrating solutions and hypernatremia. *Indian Pediatr* 1984 Aug;21(8):595-9

Two hypernatremia cases prompted the authors to investigate the composition and package instructions of commercial ORS available locally in India. Seventeen different products were examined. Of them, 35% had the WHO recommended composition and 53% had excessive glucose. The widely variant, non-standardised composition and packaging entail mixing and administration errors leading ultimately to hypernatremia. It is suggested that manufacturing, packing and dispensing of ORS should be uniform. There should be at most 2 formulations for oral fluid therapy: one with 90 and another with 25-50 mmol/L of sodium. Instructions should be illustrated and preferably in the local language.

Lishnevsky MS, Pottier R. Oral rehydration treatment benefits Lao children with diarrhoea. *WHO Chron* 1977;31:421-2

Lizano C see Nalin DR

Lloyd-Evans N see Watkinson M

## Oral Rehydration Therapy

Lock BA see Cutting WA

Loebis S see Purba MD

Lowenson R see de Zoysa I

Loria AR see Nalin DR

Lovell S see Dugdale A

Ludan AC, Del Mundo J. The efficacy of oral electrolyte fluid in the therapy of diarrhea. *J Philipp Med Assoc* 1973;49:243-52

Ludan AC, Ilagan NB, Ochoa C, de la Cruz F. An oral electrolyte mixture for out-patient rehydration therapy. *Philipp J Pediatr* 1979;28:63-72

Ludan AC, Anzaldo FE, de la Cruz R, Manalo JS, Santos-Ocampo PD, Liao MTP, Coronel VD, Sanes-Quialo S. The use of modified coconut water for oral rehydration. *J Philipp Med Assoc* 1981 Mar;57(3):55-61

The use of indigenous sources of oral rehydration fluid especially in areas where these sources abound might close the gap of the health delivery system of a country. With this objective, efficacy of modified coconut water in diarrhoeal dehydration was studied in the Philippines. Pure coconuts water obtained from 8-10-month-old coconut was modified by diluting with equal volumes of distilled water to reduce the  $K^+$  concentration by 50%, and adding 1 g NaCl, 2.5 g  $NaHCO_3$  and 15 g glucose to 1000 ml of the mixture. A total of 58 infants and children (39 male, 19 female) was included in the study, of whom 43 had mild, 6 mild-to-moderate, and 9 moderate dehydration. Weight change, clinical assessment of state of dehydration, frequency of diarrhoea, vomiting and urination, acceptance and side effects, serum  $Na^+$ ,  $K^+$ ,  $CO_2$  and blood glucose were the parameters observed in this study. As delineated by the clinical criteria 43 patients (74%) displayed satisfactory clinical response while 15 (26%) were considered to be treatment failures. The group with satisfactory clinical response showed significant weight gain, no relapse of diarrhoea, and significant elevation in serum  $Na^+$ ,  $k^+$  and  $CO_2$  while the non-responders showed a slight decline in weight, marked increase in the frequency of diarrhoea and no significant change in serum  $Na^+$  and  $K^+$ . Modified coconut water was well accepted and tolerated by the patients, the mean intake of 58 patients being 223.7 ml/kg/day. In the group of non-responders, in addition to the increase in stool frequency, 3 patients developed hypernatraemia, but it was suggested that these side effects could easily be corrected by stopping the modified coconut water as soon as a side effect appeared. It was concluded that modified coconut water was highly recommended in areas where there is scarcity or absence of suitable oral rehydration mixtures, provided that the modification procedure used in this study is followed strictly, that the volume of modified coconut water given particularly for infants is closely monitored, and further that oral intake of modified coconut water be stopped immediately as soon as there is an indication of relapse of diarrhoea.

Luque S see Santosham M

McCord C see Kielman AA

Mackenzie A, Barnes G. Oral rehydration. *Aust Paediatr J* 1984 Mar;20(1):7-8

## Oral Rehydration Therapy

McRobbie I see Conteh S

Mahalanabis D, Choudhuri AB, Bagchi NG, Bhattacharya AK, Simpson TW. Oral fluid therapy of cholera among Bangladesh refugees. *Johns Hopkins Med J* 1973 Apr;132(4):197-205

In this classic paper, the effectiveness of ORS in treating cholera without hypovolemic shock was confirmed by a crucial field trial, during a massive cholera outbreak in the summer of 1971 among Bangladesh war refugees at Bongaon, West Bengal, India. Extremely adverse logistic and administrative conditions prevailed. A total of 3,703 patients, including severe cases treated initially with limited I.V. supplies and mild-to-moderately severe cases treated with ORS alone, were admitted to the Bongaon treatment centre. The overall case fatality ratio was 3.6%, which compared favorably with the results of standard I.V. therapy in well-organized modern treatment centres. Moreover, a special demonstration unit treated 1,190 of these patients, with a case fatality ratio of only 1%. The ORS contained sodium 90 mEq/L, bicarbonate 30 mEq/L and chloride 60 mEq/L, with 22 g/L of glucose, prepackaged for mixing with water in the field. Potassium supplementation was given orally on an individual basis. Sample surveys during the epidemic showed that 38% of the patients were under age 6. About 79% of the 108 rectal swabs yielded *Vibrio cholerae*, with 92% of the isolates being the classical biotype. Advantages of ORS included local availability of ingredients, reduced cost, ease of administration, safety in the hands of inexperienced personnel after only brief instructions, early accessibility of treatment, and reasonable effectiveness when given early in the disease course. In severe cases, considerable sparing of I.V. fluids resulted from the adjunct use of ORS.

Mahalanabis D, Merson MH, Barua D. Oral rehydration therapy -- recent advances. *World Health Forum* 1981;2(2):245-9

One of the most important advances in diarrhoeal disease research has been the discovery that dehydration associated with acute diarrhoea, irrespective of etiology and age, can be treated orally with a simple glucose-electrolyte solution. This paper discusses the scientific basis of oral rehydration therapy, its nutritional benefits and experiences in treatment centres of different countries. The authors stress the need to develop national diarrhoeal disease control programs, to ensure continued availability of ORS and the training and education of health workers and families so that diarrhoea-related mortality and malnutrition can be prevented.

Mahalanabis D, Sack RB, Jacobs B, Mondal A, Thomas J. Use of an oral glucose electrolyte solution in the treatment of pediatric cholera - a controlled study. *J Trop Pediatr* 1974;20:82-7

Mahalanabis D see Finberg L

Mahalanabis D see Patra FC

Mahoney TJ see Dibley M

Mahothorn K see Varavithya W

Manalo JS see Ludan AC

Manji PM see Pierce NF

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Manly JE see Lawrie B

Mar-Mar-Nyein see Thane-Toe

Marin L see Aperia A

Mata L see Nalin DR

Mata L see Pizarro D

Matheny S see Nalin DR

Mathur R, Reddy V. Bacterial contamination of oral rehydration solution prepared from well water. *Indian J Med Res* 1983 Dec;78:814-8

ORS, prepared either with untreated well water or boiled water, was examined to determine the bacterial growth rate during storage. After 12 h, the bacterial count was significantly higher ( $p < 0.01$ ) in ORS prepared with contaminated well water than with clean well water. ORS prepared with boiled water also showed increased bacterial counts after 12 h, but the number of presumptive coliforms and *Escherichia coli* were significantly lower than in ORS prepared from untreated well water. Diarrhoeal morbidity was similar in both groups of children in a village near Hyderabad, India, who consumed ORS made from contaminated and clean water. However, it is safer to boil water for ORS, when clean water is unavailable. Since there is significant bacterial growth after 12 h of storage, it is desirable to use ORS fluid within this period.

Mathur R, Reddy V. Oral rehydration solution (ORS) and bacterial contamination. *Nutr News* 1983 Nov;4(6):1-2

Matthews THJ see Hutchins P

Mawardi J, Ismail R. Oral rehydration therapy: sugar-salt solution using special scoop measurement vs glucose-electrolyte solution. *Paediatr Indones* 1981 Mar-Apr; 21(3-4):61-8

This study evaluates the efficacy of the sugar-salt solution in oral rehydration where the "Blue Spoon" is used for measuring. A total of 222 children aged between 6 months and 2 years with body weights of more than 70% of the Harvard standard (weight for age) suffering from acute diarrhoea in the out-patient clinic of an Indonesian hospital between August 1979 and March 1980 was included. The children were divided into 2 groups, one receiving standard ORS and the other receiving sugar-salt solution using a special scoop (Blue Spoon). The patients were asked to come again for follow-up on the second, third, fourth and seventh day. On every visit the weight and height, frequency of diarrhoea, skin elasticity, consciousness, fontanel, lips, pulse, respiration rate, and presence or absence of meteorism, hypotonia or cardiac arrhythmia were recorded. The effectiveness of the solution was assessed by comparing the degree of dehydration on the second and third day and changes of body weight in the seventh day in two groups. The efficacy of the sugar-salt solution measured by the special scoop was not significantly different from the standard glucose electrolyte solution. Likewise, the side effects were similar in the two groups. The special scoops used in this study were cheap, and quite accurate as a measurement of sugar and salt. Considering the reservations of some concerning the use of sugar-salt solution for oral rehydration, it was suggested that the results of this study

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provide further information on which to base wider scale clinical and field trials of the sugar-salt solution.

Mazumdar H, Zingde KD. Oral rehydration in gastroenteritis in children. *Indian Pediatr* 1973 May;10:315-22

Mehta MN, Patel DS. The role of oral rehydration in management of acute diarrhoea in children. *J Trop Pediatr* 1984 Apr;30:83-7

The role of oral electrolyte fluid (OEF) in preventing dehydration and in reducing the hospitalization period and the time required for rehydration were studied in Bombay, India, in 150 out-patient and 95 in-patient children with diarrhoea. Out-patients were divided into 3 comparable groups: those given OEF with antibiotics, OEF without antibiotics, or antibiotics alone. Children hospitalized with more severe diarrhoea likewise were grouped: those given initial IV fluids, followed by OEF maintenance plus antibiotics; those given the same, without antibiotics; and those given IV fluids and antibiotics, but no OEF. Early use of OEF effectively prevented moderate and severe dehydration, thereby halving the number of patients requiring admission. There was no difference between the groups in immediate improvement of stools' watery consistency. Given to hospitalized patients, along with initial IV fluids in severely dehydrated children, OEF helped correct dehydration earlier (55% of cases within 1 day and 100% by 3 days); and reduced both morbidity and length of hospitalization. No complications were associated with OEF use. OEF is a cheap (in terms of money and skilled manpower), simple, safe means of dehydration management, and should be routinely recommended. Routine antibiotic use in uncomplicated cases has no significant advantage.

Melamed A, Segall M. Spoons for making glucose-salt solution (letter). *Lancet* 1978;1:1317-8

Merritt C see Sack RB

Merson MH see Chen LC

Merson MH see Mahalanabis D

Merson MH see Taylor PR

Mitchell JE, Donald WD, Birdsong M. A review of three hundred ninety-six cases of acute diarrhea in which early oral feedings were employed in treatment. *J Pediatr* 1949 Nov;35(5):529-39

Mitra RC see Caranasos GJ

Mitra RC see Pierce NF

Mitra RC see Sack RB

Mohan M see Sachdev HPS

Mohs E see Nalin DR

Mohs E see Pizarro D

## Oral Rehydration Therapy

Molla A see Molla AM

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Nalin DR, Cash RA. Oral or nasogastric maintenance therapy for diarrhoea of unknown aetiology resembling cholera. *Trans R Soc Trop Med Hyg* 1970;64(5):769-71

Previous studies established the value of ORS, consisting of electrolytes with glucose or with glucose and glycine, in maintaining the fluid/electrolyte balance in cholera patients. This study shows that patients with severe dehydration due to diarrhoea clinically resembling cholera also can be maintained on ORS, after initial I.V. corrects dehydration and hypotension. Patients receiving the glucose/glycine ORS had much lower total stool volumes than did those receiving ORS containing only glucose (2.7 L versus 10.0 L,  $p < 0.01$ ). They also had a shorter duration of diarrhoea (over 75 ml/h): 16.9 h compared with 23.5 h,  $p < 0.05$ . Both solutions eliminated 80% of the I.V. requirements in severe cases, thus reducing the cost and increasing the availability of diarrhoea treatment in developing countries.

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Nalin DR, Cash RA. Oral or nasogastric therapy for cholera. In: Principles and practice of cholera control. Geneva: World Health Organization, 1970:73-6

Nalin DR, Levine MM, Mata L, de Cespedes C, Vargas W, Lizano C, Loria AR, Simhon A, Mohs E. Oral rehydration and maintenance of children with rotavirus and bacterial diarrhoeas. *Bull WHO* 1979;57(3):453-9

The efficacy of oral-glucose electrolyte therapy was studied in dehydrated infants with rotavirus or bacterial diarrhoea, in a setting where such patients routinely receive intravenous fluids. Fifty-eight of 62 (94%) Costa Rican infants, 3-15-months-old with acute diarrhoea and 5-10% dehydration who received a simple WHO-recommended ORS regimen, were rehydrated with ORS alone. Success rates among the different etiological groups were similar: 92% in rotavirus, 93% in *Escherichia coli*, 96% in idiopathic diarrhoea, and 100% in *Salmonella* and *Shigella*. The safety of oral therapy was confirmed by rapid improvements in a wide range of electrolyte abnormalities present on admission, including hyponatremia, hypernatremia, hypokalemia and increased anion gap. Oral therapy is safe and effective for treating viral and bacterial diarrhoea in infants with 5-10% dehydration. The proportion of rotavirus patients with stool glucose levels over 27.75 mmol/L at 0 and 6 h was significantly higher than that of non-rotavirus patients ( $p=0.05$ ); nevertheless, rotavirus patients absorbed enough oral solution for successful rehydration.

Nalin DR, Levine MM, Hornick RB, Bergquist EJ, Hoover D, Holley HP, Waterman D, VanBlerk J, Matheny S, Sotman S, Rennels M. The problem of emesis during oral glucose-electrolytes therapy given from the onset of severe cholera. *Trans R Soc Trop Med Hyg* 1979;73(1):10-4

This is the first report of whether ORT given from the onset of cholera could prevent dehydration and eliminate the need for I.V., in cases severe enough to be potentially fatal if untreated. Fifty-seven adult volunteers, aged 18-36 (39 males) who experienced induced clinical cholera during a vaccine development program, were treated from diarrhoea onset with glucose-electrolyte therapy. In 44 (77%) with mild to moderately profuse diarrhoea (<8L total volume), it was possible to maintain a normal water and electrolyte balance with ORS alone. Results obtained with Dhaka formula (in g/L: glucose 20; NaCl 4.2; NaHCO<sub>3</sub> 4.0; and KCl 1.8) and WHO formula (in g/L: glucose 20; NaCl 3.5; NaHCO<sub>3</sub> 2.5; and KCl 1.5) were similar. In 13 (23%) individuals with severe diarrhoea (>8L total volume), it was not possible to maintain a balance with ORS alone, due chiefly to emesis during the first day of illness. They required I.V. fluids. Emesis contributed to, but was not caused by, negative balance, acidosis or dehydration per se. Since emesis precludes early oral therapy in severe cases, home-based oral therapy is unlikely to eliminate cholera mortality. Rural diarrhoea treatment centers using ORT with limited amounts of I.V. when needed, could reduce case fatalities from cholera and related diarrhoeas virtually to zero, with the least expense. To reduce I.V. needs and diarrhoeal morbidity further, by using ORS, research on the pathophysiology and control of emesis is needed.

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Oral glucose/electrolyte therapy for acute diarrhoea (editorial). Lancet 1975 Jan 11;1(7898):79-80

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Oral rehydration in acute diarrhoeal diseases. Lancet 1980 Feb 23;1:435

Up to 6 million deaths, mainly in under-5 children, are attributable yearly throughout the world to acute diarrhoeal diseases, including cholera. A WHO group meeting emphasized the need for wider ORS use in developing countries. To make ORS accessible to at least 25% of developing world children is a reasonable target to achieve by 1983. This campaign should, of course, be supported by better feeding and hygienic practices. More than 60 countries have expressed interest in making diarrhoeal disease control a part of national primary health care programs. Among developing countries already producing ORS, or about to do so, are: Afghanistan, Bangladesh, Burma, Egypt, India, Indonesia, Morocco, Nepal, Pakistan, Philippines, Syria, Thailand and Turkey.

Oral rehydration with dirty water? Diar Dialog 1981;(4):7

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Oral therapy for acute diarrhea (editorial). *Lancet* 1981 Sep 19;2(8247):615-7

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Patra FC, Mahalanabis D, Jalan KN. Stimulation of sodium and water absorption by sucrose in the rat small intestine. *Acta Paediatr Scand* 1982 Jan;71(1):103-7

The absorption of sodium, chloride, potassium, water and sugars from an isosmotic sucrose electrolyte solution was evaluated in the rat small intestine, taking the whole length of the jejunum and ileum. Absorption of these substances was compared with absorption from solutions containing glucose and mannitol instead of sucrose. The study was done in Calcutta, India. Nine male albino rats were studied by an in vivo perfusion technique, and the net transport of water, electrolytes and sugars was calculated from the changes in the polyethylene glycol concentration and the solute concentration. The composition of the solutions was similar to those of the oral rehydration solutions currently used for treating acute diarrhoeal diseases. The study indicates that sodium, potassium and chloride absorption is significantly higher from an isosmotic sucrose electrolyte solution than from a glucose-containing solution. However, water absorption was significantly lower from the former solution, presumably due to the osmotic drag of water back into the intestinal lumen, caused by the slowly absorbed fructose liberated from sucrose hydrolysis. Under clinical situations, such a solution may cause disproportionately higher sodium absorption compared to water. Use of a hyposmotic sucrose electrolyte solution in oral rehydration was suggested to obviate this shortcoming.

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Pierce NF, Banwell JG, Mitra RC, Caranasos GJ, Keimowitz RI, Mondal A, Manji PM. Effect of intragastric glucose-electrolyte infusion upon water and electrolyte balance in Asiatic cholera. Gastroenterology 1968 Sep;55(3):333-43

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Pierce NF, Hirschhorn N. Oral fluid - a simple weapon against dehydration in diarrhoea. WHO Chron 1977;31:87-93

Pierce NF, Banwell JG, Mitra RC, Caranasos GJ, Keimowitz RI, Mondal A, Manji PM. Oral maintenance of water-electrolyte and acid-base balance in cholera: a preliminary report. Indian J Med Res 1968 May;56(5):640-5

This study determines whether glucose absorption from a cholera patient's small bowel is accompanied by enhanced sodium and water absorption. The effectiveness of ORS with varying glucose concentrations (40 and 160 mmol/L) in maintaining water, electrolyte, and acid-base balance was examined in 9 adult males with severe cholera due to *Vibrio cholerae*, biotype ElTor. The patients were divided into groups of 4 and 5 (for low and high glucose-ORS). All were studied for 3 consecutive 12 h periods: an initial control period, treated with I.V. only; a study period, when ORS was given; and another control period of I.V. only. Stool composition did not differ significantly between the groups in the initial control period. In both groups, significant water and electrolyte absorption from ORS was apparent from the marked reduction in net losses during the study period. Positive water balance was achieved in 8 of the 9 patients. The low-glucose group required significantly more ORS ( $p < 0.02$ ) for equal improvement in net water balance. The actual stool volume during the study period also was significantly greater in

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this group ( $p < 0.02$ ). In both groups, during this study period, water and electrolyte outputs exceeded those of the initial control period, indicating that a portion of ORS contributed to stool volume. One patient in each group received I.V. supplementation (160 ml/h) during the study period.

The results suggest that increasing the glucose content of ORS from 40 to 160 mmol/L, significantly reduces the amount of fluid required to approximate balance. The cholera-infected gut generally retains its capacity for active glucose absorption, which, in turn, is linked with increased absorption of water, sodium and other electrolytes. Glucose-electrolyte ORS may be valuable in clinical cholera management, but this report does not recommend its general use.

✓ Pierce NF, Banwell JG, Mitra RC, Sack RB, Brigham KL, Fedson DS, Mondal A, Manji PM. Oral replacement of water and electrolyte losses in cholera. *Indian J Med Res* 1969 May;57(5):848-55

This early classic paper describes a controlled trial, in which glucose-electrolyte ORS was compared with a standard I.V. regimen in maintaining water, electrolyte, and acid-base balance, in severe cholera. Twenty adult males with bacteriologically-confirmed severe cholera due to *Vibrio cholerae*, biotype El Tor were studied. All were hypotensive and dehydrated, and passed more than 800 mL of stool in the first 6 h after admission. Water, electrolyte and acid-base balance was maintained adequately by an orogastric infusion of ORS after initial I.V. rehydration for 6 h. Nine of ten patients given ORS required no further I.V. The control group continued to receive I.V. replacement of all stool losses, until diarrhoea ceased. Duration of diarrhoea and *Vibrio* excretion were not altered by orogastric infusion. Mean stool output in the orogastric group exceeded that of the control group during each 6-h period in the first 30 h, but the difference was significant only 18-24 h after admission ( $p < 0.05$ ). ORS can reduce I.V. dependence in cholera; but it is unlikely that the need for I.V. can be eliminated. Further studies are required before an optimal regimen involving glucose-electrolyte ORS for cholera therapy can be evolved. The fluid replacement method should be given a carefully-supervised trial in a rural setting, before ORS is recommended for routine cholera therapy.

Pierce NF. Oral solutions for cholera (reply). *Ann Intern Med* 1969 Oct;71(4):868-9

This is a reply to the letter (see Kuiper DH) on oral solutions for cholera. The ORS that caused nausea was markedly hypertonic with respect to plasma, containing about 900 mOsm/L. Such hypertonicity could contribute to nausea by 3 possible mechanisms: (1) fluid accumulation in the stomach, due to slow gastric emptying; (2) upper small bowel distension by the rapid fluid movement from plasma to lumen, due to large osmotic gradient across the bowel mucosa; or (3) poorer taste of the hypertonic, compared to an isotonic solution. Chilling and favouring of ORS -- without altering composition or osmolality -- is worth attempting when conditions permit. The use of glucose-electrolyte ORS to replace diarrhoeal losses in disorders other than cholera may have considerable merit. Since their success apparently depends on the retained capacity of the small bowel to rapidly absorb glucose, small-bowel glucose absorption should be evaluated before attempting oral replacement in patients with non-cholera diarrhoea.

Pierce NF, Sack RB, Mitra RC, Banwell JG, Brigham KL, Fedson DS, Mondal A. Replacement of water and electrolyte losses in cholera by an oral glucose-electrolyte solution. *Ann Intern Med* 1969 Jul;70(6):1173-81

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The efficacy of a glucose-electrolyte ORS in replacing stool water and electrolyte losses in severe cholera was evaluated in a controlled therapeutic trial. Twenty adult males, aged over 20 and hospitalized in Calcutta, India with clinically-severe cholera, were divided equally into study and control groups. In the study group, I.V. fluids were discontinued after initial rehydration, and water and electrolyte losses were replaced by ORS administered via nasogastric tube. Water, electrolytes and acid-base balances were maintained adequately in 9 patients by this method until diarrhoea ended. One patient with very severe diarrhoea required a small amount of additional I.V. to maintain water balance. Compared to the controls (I.V. only), the orogastric group had a small increase in stool output during ORS administration. The difference was significant only 18-24 h after admission ( $p < 0.05$ ). Comparison of stool composition during I.V. and orogastric maintenance showed significant difference between the groups, in chloride content at 18 h ( $p < 0.01$ ) and 30 h ( $p < 0.05$ ), and in osmolality at 18 h ( $p < 0.02$ ) and 30 h ( $p < 0.01$ ). Calculated ORS absorption was 87%. Diarrhoea duration and *Vibrio cholerae* excretion was not prolonged by ORS. The role of glucose in water and sodium absorption by the small bowel is discussed. The study suggests a useful role for such glucose-electrolyte ORS in cholera management. Further studies are necessary before an optimal regimen can be developed.

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Pioh H see Sunoto

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Pizarro D, Posada G, Mohs E, Levine MM, Nalin DR. Evaluation of oral therapy for infant diarrhoea in an emergency room setting: the acute episode as an opportunity for instructing mothers in home treatment. Bull WHO 1979;57(6):983-6

To minimize the need for hospital stay and to evaluate the safety and efficacy of continuing ORT at home after training mothers, 100 infants, (56 males, age: 18 days-20 months) with 1-10% dehydration due to acute watery diarrhoea, were treated in an emergency room setting with glucose-electrolyte ORT. The ORT formula followed WHO-recommendations, except that the potassium content was increased from 20 to 27 mmol/L. The acute phase was utilized to instruct mothers in ORT techniques for diarrhoea. After the first 6 h, normally-hydrated infants whose stools were not very voluminous or totally watery were discharged, and mothers were instructed to continue ORT as needed at home and to resume milk feedings. Ninety-two percent were successfully rehydrated during the initial visit without any I.V. Rapid weight gain ( $0.32 \pm 0.002$  kg by 6 h,  $n=84$ ,  $p=0.001$ ;  $0.39 \pm 0.002$  kg by discharge,  $n=87$ ,  $p=0.001$ ) and disappearance of clinical signs of dehydration indicated ORS absorption. Eight percent required I.V., because of persistent vomiting or refusal to take ORS in the face of significant diarrhoea. Mothers brought back 13 infants with recurrent dehydration and continued diarrhoea; 6 of them were again rehydrated orally, and 7 received I.V. ORT alone was successful in 85% of cases. The mean hospital stay was reduced, and 74% stayed less than 24 h, compared with 36% in previous studies at the same hospital.

Pizarro D, Posada G, Levine MM. Hypernatremic diarrheal dehydration treated with "slow" (12-hour) oral rehydration therapy: a preliminary report. J Pediatr 1984 Feb;104(2):316-9

To diminish the possibility of convulsions in infants with hypernatremic dehydra-

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tion, two modifications were instituted in the ORT regime: (1) the rate of offering ORT was halved; and (2) in a series of infants, fluid deficits were replaced with glucose-electrolyte solution (90 mEq/L sodium) alone without plain water. Thirty-five infants hospitalized in Costa Rica with hypernatremic diarrhoeal dehydration were given slow ORT, with deficits replaced over 12 h. Twenty-four of them received glucose-electrolyte solution for 8 h, followed by plain water for 4 h in a volume ratio of 2:1, 11 other infants received equivalent volumes of glucose-electrolyte solution alone over 12 h. Serum sodium levels returned to normal at similar rates in both groups. None of the 35 infants manifested convulsions. The average weight gain after rehydration was  $0.51 \pm 0.05$  kg. Preliminary results call for further evaluation and research on slow oral rehydration in infants with hypernatremic dehydration.

Pizarro D, Posada G, Villavicencio N, Mohs E, Levine MM. Oral rehydration in hypernatremic and hyponatremic diarrheal dehydration: treatment with oral glucose/electrolyte solution. *Am J Dis Child* 1983 Aug;137(8):730-4

The safety and efficacy of ORT in hyper- and hyponatremic dehydration were examined. Ninety-four well nourished, bottle-fed infants with hypernatremic (N=61) or hyponatremic (N=33) diarrhoeal dehydration were treated with ORT. In 61 hypernatremic and 25 hyponatremic infants, two thirds of the fluid volume were given as glucose/electrolyte solution containing 90 mmol/L  $\text{Na}^+$  and one third as plain water; the other 8 hyponatremic infants were given glucose-electrolyte solution alone. Fluid deficits were successfully and rapidly replaced with oral therapy alone in all 61 hypernatremic infants (mean  $\pm$  SEM,  $8.5 \pm 0.6$  h) and in 31 of those with hyponatremia (mean  $\pm$  SEM,  $10 \pm 1.2$  h). Two hypernatremic infants required some I.V. fluids. The mean serum  $\text{Na}^+$  levels fell in the hypernatremic infants and rose in those with hyponatremia. Only five (8%) of the 61 hypernatremic infants manifested convulsions during oral rehydration; this compared favorably with the 14% convulsion rate encountered previously, when I.V. was used. All 5 infants with convulsions had serum  $\text{Na}^+$  160 mmol/L or greater, while only 14 (25%) of those who did not convulse had similar serum  $\text{Na}^+$  levels ( $p < 0.003$ ). In well nourished bottle-fed infants with hyper- or hyponatremic dehydration oral rehydration can be safely and effectively accomplished with treatment regimens that use a glucose-electrolyte solution (90 mmol/L  $\text{Na}^+$ ), alternating with plain water, irrespective of the admission serum  $\text{Na}^+$  level.

Pizarro D, Posada G, Levine MM, Mohs E. Oral rehydration of infants with acute diarrhoeal dehydration: a practical method. *J Trop Med Hyg* 1980 Dec;83(6):241-5

Pizarro D, Posada G, Mata L, Nalin D, Mohs E. Oral rehydration of neonates with dehydrating diarrhoeas. *Lancet* 1979 Dec 8;2:1209-10

ORT was used to treat acute diarrhoeal dehydration, for the first time in neonates who previously had been treated with I.V. Thirty-nine of 40 patients (20 female), aged 7-30 days with mean dehydration equivalent to 6.7% of body weight, were rehydrated with ORS containing (in g/L): NaCl 3.5,  $\text{NaHCO}_3$  2.5, KCl 2.25, and glucose 20.0. Only one patient required I.V. Hypernatremia (serum  $\text{Na}^+ > 150$  mmol/L) and acidosis present on admission were corrected within a few hours without complications. Mean rehydration time was  $8.2 \pm 0.8$  h (range: 2-25 h), and was  $< 6$  h in 45% and  $< 15$  h in 90%. Hospital stay was  $13 \pm 1$  h (range: 5-29 h) and weight-gain was  $187 \pm 1$  g during this interval ( $p < 0.001$ ). There was no death. Oral rehydration and maintenance therapy seems to be suitable for neonates as well as for children and adults.

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Pizarro D. Oral therapy for neonates with dehydrating diarrhoeas (discussion). In: Holme T, Holmgren J, Merson MH, Møllby R, eds. Acute enteric infections in children: new prospects for treatment and prevention. Elsevier, North Holland, 1981:319-22

Oral rehydration was attempted in 122 of 127 neonates (mean age  $19.4 \pm 0.9$  days) with dehydration due to acute watery diarrhoea. The ORS contained (in mmol/L): glucose 111;  $\text{Na}^+$  90;  $\text{K}^+$  30;  $\text{HCO}_3^-$  30; and  $\text{Cl}^-$  90. Patients had a mean dehydration of  $5.26 \pm 0.2\%$ . The mean total ORS intake (glucose/electrolyte solution plus water) was  $460 \pm 20$  mL (range 120-1,350 mL), and the ingestion rate was  $27 \pm 1$  mL/kg/h with a  $6.9 \pm 0.4$  h therapy. The other 5 of the 127 patients required I.V. fluids for rehydration. Hyponatremia and severe acidosis present on admission were corrected within a few hours. Only one patient had convulsions from hypocalcemia. Oral rehydration and maintenance therapy is as effective, suitable and safe for neonates as it is for older children.

Pizarro D, Posada G, Nalin DR, Mata L, Mohs E. [Rehydration by the oral route and its maintenance in patients from birth to 3 months old dehydrated due to diarrhoea]. Bol Med Hosp Infant Mex 1980;37(5):879-91

Pizarro D, Posada G, Mata L. Treatment of 242 neonates with dehydrating diarrhea with an oral glucose-electrolyte solution. J Pediatr 1983 Jan;102(1):153-6

In 1978, ORS was used successfully for the first time in neonates. Four years' experience (1978-'81) with glucose-electrolyte solution for dehydration therapy in Costa Rican neonates (aged 28 days or less) within a controlled setting is summarized. ORS was successful in 234 (96.7%) of the 242 neonates with a mean dehydration of 5.1% body weight. Eight (3.3%) required intravenous fluid. Emesis was not a serious obstacle to successful rehydration, and vomiting diminished as infants became rehydrated. Fluid ingestion in neonates was as high as that in older children, and this permitted rapid correction of dehydration in a mean time of 7.44 h. The mean weight gain was  $0.16 \pm 0.01$  kg (5.63% body weight), determined by the difference between discharge and admission weights. Hyponatremia ( $>150$  mmol/L), hyponatremia ( $<130$  mmol/L), and acidosis ( $\text{pH} < 7.10$ ) present on admission in respectively, 19, 5, and 18 patients, were corrected in a few hours. ORS is an entirely satisfactory choice for treating uncomplicated dehydration in neonates.

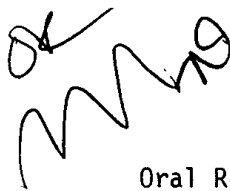
Polin RA see Baumgart S

Posayanond P see Varavithya W

Posada G see Pizarro D

*oel* A positive effect on the nutrition of Philippine children of an oral glucose-electrolyte solution given at home for the treatment of diarrhoea. Report of a field trial by an International Study Group. Bull WHO 1977;55(1):87-94

This report examines whether a rapid and complete replacement of water and electrolyte losses during acute diarrhoea provides protection from under-nutrition. The study included Philippine children of up to age 5, who reported to an out-patient clinic with diarrhoea, from 2 separate communities designated 'study' and 'control'. WHO-recommended glucose-electrolyte mixture (Oresol) was administered at home, only to the study community children. Compared to the control group, Oresol was



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associated with a greater average weight gain during both a diarrhoeal attack and over a 7-month period. The increase due to Oresol was significant in 1-5-year-olds ( $p < 0.001$ ). The increase in relative weight was greater (5%) in the study children with 2 or more diarrhoeal attacks than in those with only one attack. The increased weight gain with Oresol may reflect improved appetite and food intake due to better hydration, lower catabolism or both. There was no adverse effect, except for one child, who may have had glucose intolerance. Hospitalization, however, could not be reduced significantly by administering Oresol. Where ORS ingredients are not available, or prescribed, pre-packaged powders like Oresol could prove useful in serious dehydration cases.

Potassium losses and replacement in diarrhoea. *Diarr Dialog* 1980 Nov;3:7-8

Pottier R see Lishnevsky MS

Poudyal L, Thapa R. Home-made oral rehydration solutions: feasibility study in Nepal. *WHO Chron* 1980 Dec;34(12):496-500

Pratt EL see Darrow DC

Price HV, Dodge JA, Thomas MK. Oral rehydration without added bicarbonate for childhood gastroenteritis. *Br Med J* 1984 Sep 1;289(6444):532

Agueous bicarbonate solutions have been found to gradually decompose and form carbonate, and then react chemically with their glass containers. On heating, glucose solutions become discolored and produce furfural and other deposits; bicarbonate accelerates these reactions, thereby making it different and expensive to produce sterilized preparations containing both bicarbonate and glucose. These stability problems were overcome in Cardiff (UK) by using a prepacked bicarbonate-free sterile ORS. Fifty boys and forty girls all aged under 5, hospitalized in UK for gastroenteritis were studied. Rehydration was carried out with a sterile ORS containing (in mmol/L) Na 34, K 30, Cl 54 and glucose 183. Eighty-two children were treated with ORS alone, and 8 received I.V. within 2 h of admission. None of those managed with ORS required sodium bicarbonate supplements or I.V. fluids. Standard formula or low lactose feed was resumed after rehydration. It is suggested that in Britain and other developed countries, childhood gastroenteritis can be treated advantageously with a prepacked, bicarbonate-free, sterile ORS.

Purba D see Purba MD

Purba MD, Loebis S, Purba D, Halim S, Sutanto AH, Siregar H. Hypopotassemia in infantile diarrhoea treated with half strength Ringer's lactate in dextrose 2.5%. *Paediatr Indones* 1982 Sep-Oct;22(9-10):181-4

Pusponegoro TS see Hernawan

Pusponegoro TS see Sunoto

Putthiponsiriporn S see Varavithya W

Qureshi AA see Rizvi MH



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✓ Rabbani GH, Gilman RH, Spira WM. Intestinal fluid loss in Shigella dysentery: role of oral rehydration therapy (letter). Lancet 1983 Mar 19;1(8325):654

Although Shigella infection may lead to significant fluid losses requiring treatment with ORS, the volume of fluid lost has not been measured. This letter reports on the intake and output of fluids of 85 inpatients (47 children, 38 adults) with severe Shigella dysentery who were taking part in an antibiotic trial. Their case records were reviewed. The patients were rehydrated with ORS, were given ampicillin (100 mg/kg) as a single or multiple dose regimen, and fluid intake-output was recorded every 8 h for 7 days. After 4 days, the dysentery had much improved. During this acute phase, in under-5 children, total fecal volume was 27 ml/kg daily, a very small volume compared with figures seen for V. cholerae (180 ml/kg), ETEC (108 ml/kg) or rotavirus (100 ml/kg). Corresponding daily ORS intake also was small (33 ml/kg) -- a fluid amount that would have been replaced with normal fluid intake, without ORS. Probably, the patients had not lost a significant amount of fluid before hospitalization, because their serum-specific gravity was normal. Thus, severe Shigella infection in the tropics seems to be associated with bloody mucoid diarrhoea with very little fluid loss. In most cases, rehydration can be achieved by encouraging normal fluid intake early in the illness. Fluid loss may be of little clinical consequence in severe Shigella dysentery, but severe malnutrition is of paramount importance. In such cases, therapy should be aimed at fighting the infecting agents and, if necessary, malnutrition. ORS is of limited value, and then only as an adjunct to specific therapy.


Rabbani GH see Roy SK

Rahaman MM, Aziz KMS, Munshi MH, Patwari Y, Rahman M. A diarrhea clinic in rural Bangladesh: influence of distance, age and sex on attendance and diarrheal mortality. Am J Public Health 1982 Oct;72(10):1124-8

OR Rahaman MM, Aziz KMS, Patwari Y, Munshi MH. Diarrhoeal mortality in two Bangladesh villages with and without community-based oral rehydration therapy. Lancet 1979 Oct 20;2:809-12

This paper reports the effect of early ORT on diarrhoeal deaths in an isolated rural area of Teknaf, Bangladesh, which has almost no modern health-care facility. To combat diarrhoeal dehydration in Shamlapur village (population 7,021), multiple community-based points were set up by trained volunteers, for distribution of glucose-electrolyte ORS packets. The comparable adjoining village, Bordil (population 3,888), obtained its ORS from Shamlapur. A two-year surveillance showed that, although diarrhoeal attack-rates were equal, the ORS consumption rate after diarrhoea was 80% in Shamlapur and 38% in Bordil. There were 8 diarrhoeal deaths in Shamlapur and 23 in Bordil, showing overall case-fatality rates of 0.5% and 2.4%, respectively ( $p < 0.001$  by  $X^2$  test). The difference in diarrhoeal mortality rates at all ages (0.6/1,000 and 2.9/1,000, respectively, in Shamlapur and Bordil), was highly significant ( $p < 0.001$ ). It was believed that the crucial determinant of the low case fatality rates in Shamlapur was the easy availability of ORS. Thus, although it may not be possible to reduce diarrhoeal attack rates, easy availability of ORS and its early use after village-based training may save many lives, particularly those of children.

Rahaman MM. Rehydration therapy in diarrhea: looking at it from a village (Discussion). In: Holme T, Holmgren J, Merson MH, Mollby R, eds. Acute enteric infections in children: new prospects for treatment and prevention. Elsevier: North-Holland Biomedical, 1981:323-4



## Oral Rehydration Therapy

In the vast majority of cases, oral electrolyte solution as a rehydration therapy, with only occasional use of intravenous rehydration, can virtually eliminate fatalities in acute uncomplicated diarrhoeal illness. A study in Bangladesh showed it is possible to greatly reduce such deaths in developing countries with high diarrhoea endemicity. Another study showed that diarrhoeal patient hospitalization was reduced 30 percent by making ORS available from village-based depots. On the contrary, the limitation of a static treatment centre in reducing diarrhoea-related deaths beyond a distance of four miles was shown in another study, in which dehydration severity and mortality increased significantly with increasing distance from the treatment centre -- especially for patients living more than four miles away. These findings influenced the International Centre for Diarrhoeal Disease Research, Bangladesh to help develop in Bangladesh a national strategy for distribution in rural areas of ORS packets. In 1979, under a National Oral Rehydration Program, ORS was made available in villages, through a responsible unpaid volunteer, trained to correctly formulate the ORS and teach mothers to use it. The volunteers work under the guidance and supervision of existing government health workers. A program evaluation is forthcoming.

Rahaman MM see Islam MS

Rahaman MM see Wahed MA

Rahman ASMM see Cash RA

Rahman ASMM see Taylor PR

Rahman ASMM. Village practitioners of Bangladesh: their characteristics and role in oral rehydration programme. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh, 1981. 72 p. (Thesis and dissertation series, no. 2)

Rahman M see Islam MS

Rahman M see Rahaman MM

Raju VB see Santhanakrishnan BR

Ramayati R see Saragih M

Ransome-Kuti O. Dependence on commercial oral rehydration preparations (letter). Lancet 1980 Nov 15;2(8203):1080

Ratanapanich P see Varavithya W

Rector FC, Jr. see Turnberg LA

Reddy CG see Bai KI

Reddy V see Mathur R

Reiter J see Hyman CJ

Reller B see Cash RA

Reller B see Nalin DR

## Oral Rehydration Therapy

Rennels M see Nalin DR

Rinehart W see Parker RL

Rizvi MH, Qureshi AA, Noomar. K. Oral rehydration therapy in Pakistan. J Pak Med Assoc 1984 Apr;34(4):105-6

ORS therapy has had a definite positive impact on limiting diarrhoea morbidity in Pakistan. This communication discusses ORS use and results in Pakistan. UNICEF, collaborating with the National Institute of Health, has done much to provide WHO-ORS (locally called Nimkol) to hospitals and clinics at negligible cost. The goal is to provide the required quantity, by producing 10 million packets by 1985. ORS use has led to a marked reduction in use of I.V. and in rehydration costs in Pakistani hospitals. ORS is suitable for incorporation into the primary health care system.

Roberts A see Kuberski T

Robins-Browne R see Black RE

Rochat R see Cash RA

Rochat R see Nalin DR

Rodnan J see Hyman CJ

Rodriquez JL see Santosham M

Rohde JE, Hendrata L. Oral rehydration: technology and implementation. In: Jelliffe DB, Jelliffe EFP, eds. Advances in international maternal and child health. Oxford: University Press, 1981:82-97

Rohde JE. Rehydration in the field. Paediatr Indones 1974;14:148-52


Rohde JE. Therapeutic interventions in diarrhoea. Food Nutr Bull 1981 Oct;3(4):34-8

Rohde JE see Hendrata L

Rosenberg A see Santosham M

Rowland MGM, Cole TJ. The effect of early glucose-electrolyte therapy on diarrhoea and growth in rural Gambian village children. J Trop Pediatr 1980 Apr;26(2):54-7

The effect of the home use of an oral glucose-electrolyte mixture administered by mothers to 4½-24-month-old Gambian village children within 24 h of diarrhoea onset was investigated. There was a significant reduction in diarrhoeal prevalence in subjects (10 children) compared with a control group (11 children) who received clinic treatment only. The average height gain in subjects was 34 (range 12-61) mm and in controls it was 21 (range 6-37) mm. This was significant;  $t = 2.55$ ,  $p = 0.02$ . But the difference in age-corrected growth, though still present, no longer was significant;  $t = 1.46$ ,  $p > 0.1$ . There was no difference in weight gain between the two groups. Thus, despite the reduction in diarrhoeal morbidity achieved by early glucose-electrolyte therapy, the severe impact of weanling diarrhoea on growth may not be reduced, unless therapy is accompanied by specific nutritional measures.



## Oral Rehydration Therapy

Roy B see Chakrabarti GC

Roy SK, Rabbani GH, Black RE. Oral rehydration solution safely used in breast-fed children without additional water. *J Trop Med Hyg* 1984;87:11-3

This study evaluates the recommendation that breast-fed infants can be given ORS with no additional water during diarrhoea therapy, without developing clinical complications of hypernatremia. At a rural Bangladesh treatment centre, 64 children aged 3 months to 2 years were treated for diarrhoea and mild-to-moderate dehydration with ORS (90 mmol/L Na<sup>+</sup>). No plain water was given. All children continued breast feeding after the first 4-h rehydration period. The mean body weight gain after rehydration was 6.2%. All children were successfully rehydrated with the ORS/breast milk regimen. After 24 h of *ad libitum* ORS and breast milk intake, 61 children had serum sodium levels in the range of 128-148 mmol/L. Three children had marginal hypernatremia with sodium levels of 150-151 mmol/L. Two with diarrhoea of unknown etiology had a greater purging rate ( $p < 0.01$ ) than the average for children with this type of diarrhoea. None developed clinical signs and symptoms of hypernatremia. Additional water may be unnecessary during rehydration of breast-fed children.

Russell R see Santosham M

Ryder R see Santosham M

Ryder RW see Santosham M

Sachar DB see Hirschhorn N

Sachdev HPS, Bhargava SK, Gupta BD, Narula S, Daral TS, Mohan M. Oral rehydration of neonates and young infants with dehydrating diarrhea. *Indian Pediatr* 1984 Mar; 21(3):195-9

The acceptance, safety and efficacy of a low sodium ORS (60 mmol/L) was compared with those of standard I.V. therapy in a controlled, randomized study among 36 infants (0-3 months) hospitalized in India with acute non-cholera dehydrating diarrhoea. Patients were divided into 2 equal groups with no significant differences in clinical characteristics between the groups. ORT was successful in all 18 patients including low birth-weight infants and none required I.V. Efficacy of ORT, as documented by: improvement in clinical signs of dehydration; normalization of plasma protein, blood urea and hematocrit values; increase in body weight ( $p < 0.001$  for all changes); and urinary output was similar to that of I.V. ( $p < 0.05$  for all parameters). Electrolyte and acid base abnormalities present on admission were corrected within a few hours without complications. It is concluded that glucose-electrolyte ORS containing 60 mmol/L sodium is as safe and effective as I.V. for the treatment of non-cholera neonatal and early infantile diarrhoea.

Sack DA. Treatment of acute diarrhoea with oral rehydration solution. *Drugs* 1982; 23:150-7

This paper reviews some of the principles of oral rehydration, and outlines practical methods for using ORS. Though based on experiences at the International

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Centre for Diarrhoeal Disease Research, Bangladesh, the principles are generally applicable. By utilizing glucose-facilitated absorption of sodium and water, ORS is capable of rehydrating patients with acute watery diarrhoea of different etiologies. Even during diarrhoea-induced intestinal hypersecretion, this mechanism for absorption remains intact. ORS does not stop the secretion nor slow the purging rate. However, the needed volume, base and potassium are thus replaced, eliminating diarrhoea's metabolic consequences. All etiologies, age groups, and severities of diarrhoeal diseases respond to ORS therapy, unless there exists very severe diarrhoea, shock and dehydration, requiring initial intravenous therapy, followed by ORS. Antibiotics are useful against specific diseases, but neither these nor antimotility drugs should be used routinely. Being a simple, inexpensive, convenient diarrhoea therapy. ORS is particularly relevant to developing countries. However, its use also should be encouraged in developed countries, where ORS can largely replace intravenous hydration in diarrhoeal diseases.

Sack DA, Sack RB, Black RE. Treatment of diarrhea caused by rotavirus (letter). N Engl J Med 1981 May 14;304(20):1239

Commenting on a previous report by other researchers regarding the treatment of patients with rotavirus diarrhoea, the authors of this letter caution that clinicians may come to the wrong conclusion. The authors contend that oral rehydration now should be considered the treatment of choice, both for out-patient and in-patient rotavirus diarrhoea victims; and that parenteral intravenous therapy should be considered an alternative for special cases of severe dehydration -- thus for patients who are in shock, and have very heavy stool losses that prevent them from remaining hydrated, severe vomiting that interferes with oral replacement, depressed mental status, and glucose malabsorption with dehydration. These indications are rare in children with rotavirus. Moreover, studies of the WHO-recommended ORS in rotavirus diarrhoea show success rates from 85 to 100 percent, meaning few patients required intravenous. In developing countries, ORS can save many lives. In the U.S. the issue is one of substituting a simple, comfortable, effective and inexpensive form of therapy for a more expensive form, associated with discomfort and iatrogenic and nosocomial hazards.

Sack DA see Santosham M

Sack RB, Pierce NF, Hirschhorn N. The current status of oral therapy in the treatment of acute diarrheal illness. Am J Clin Nutr 1978 Dec;31(12):2252-7

Sack RB, Cassells J, Mitra R, Merritt C, Butler T, Thomas J, Jacobs B, Chaudhuri A, Mondal A. The use of oral replacement solutions in the treatment of cholera and other severe diarrhoeal disorders. Bull WHO 1970;43(3):351-60

Despite the progress in cholera therapy, mortality rates from the disease remain high in rural areas where I.V. fluids are not readily available. Therefore, the efficacy of a glucose-electrolyte ORS and the therapeutic effect of a non-specific adsorbent, charcoal, were determined in a controlled trial among 51 adult males (36 with cholera and 15 with severe non-cholera diarrhoea) hospitalized in Calcutta, India. The ORS contained electrolytes (in mEq/L) Na 90, Cl 60, and HCO<sub>3</sub> 30 and glucose 120 mmol/L. Cholera patients on ORS without charcoal maintained normal hydration and acid-base balance, comparable to the control group receiving I.V. ORS alone did not increase diarrhoea duration or stool volume. The addition of charcoal to ORS led to a significant increase in stool volume (control vs. ORS-charcoal:  $p < 0.05$ ), prolonged Vibrio excretion, and frequent vomiting; charcoal

## Oral Rehydration Therapy

therefore is not recommended. In this study, ORS reduced the I.V. requirement by almost 50%, to 4 L per patient. Use of ORS is likely to yield improvement among cholera patients in rural areas and reduce the treatment cost as well.

Sack RB see Mahalanabis D

Sack RB see Pierce NF

Sack RB see Sack DA

Sack RB see Santosham M

Salino H see Azis AL

Samadi AR, Islam MR, Aziz KMS. ICDDR,B model for treatment of diarrhoeal diseases. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh, Jul 1982. 12 p. (ICDDR,B special publication no. 19)

Diarrhoeal diseases are a major health problem in developing countries. Another major problem that is still faced in developing countries is lack of resources and properly trained personnel to cope with health problems. This paper presents the model for treatment of diarrhoeal diseases followed at the International Centre for Diarrhoeal Disease Research, Bangladesh, with particular reference to its organization, administration, staffing pattern, procedures for screening patients and methods for treatment. This includes the procedure of practical management of patients which is also outlined in a functional chart. This model provides an example of running a large diarrhoeal disease treatment centre by the trained paramedics and auxiliaries, under supervision of a physician. The model also provides information about the successful use of oral rehydration solution in treating a majority of dehydrated patients. In any developing country where limitations of resources and trained personnel exist, such a model can be easily adopted for the treatment of diarrhoeal illness.

Samadi AR, Islam R, Huq MI. Replacement of intravenous therapy by oral rehydration solution in a large treatment centre for diarrhoea with dehydration. Bull WHO 1983;61(3):471-6

The study's aim was to compare the efficacy of ORS versus IV therapy in treating moderate and some severe diarrhoeal dehydration cases. Over 5 months in 1980, 10,379 hospitalized patients were treated with IV followed by ORS; and during the same period in 1981, 9,897 patients with similar dehydration were treated only with the WHO-recommended ORS. The results: the percentage of referred cases from the treatment centre to the medical ward of a large research hospital, due to complications, was 9.07% in 1980 and 7.52% in 1981 ( $p < 0.01$ ). The mortality rate for the two groups was not statistically significant. In 1980, 93% of all patients were treated with IV-ORS and 7% with ORS alone; while in 1981, these numbers changed to 39% ( $p < 0.001$ ) and 61% ( $p < 0.001$ ). Since the average per patient cost in the treatment centre in 1981 was US \$ 4.40, a saving of 33.3% was achieved. This suggests that, for most moderately dehydrated patients, ORS is as effective as IV-ORS. Use of ORS alone in such cases is important, as it is safe, cheap and does not require skilled personnel. Such a consideration is important to developing countries.

Samadi AR see Islam MR

## Oral Rehydration Therapy

Sanborn WR see Sunoto

Saner G see Aperia A

Sáñez-Quialo S see Ludan AC

Santhanakrishnan BR, Deenadayulu K, Raju VB. The role of oral electrolytes in the management of acute gastroenteritis in non-hospitalised children. *Indian Pediatr* 1974;11:351-4

Santos-Ocampo PD see Ludan AC

Santosham M, Sack RB, Pierce NF, Sack DA. Hyperkalaemia and glucose/electrolyte solution (letter). *Lancet* 1980 Sep 13;2:583-4

This letter reports an experience which contradicts an earlier one reported, which stated that the UNICEF-recommended glucose electrolyte solution (GES), used for more than 24 h, may be hazardous--causing hyperkalemia and hypernatremia--in well-nourished infants aged below 1 year. The letter describes a study, which compared GES with another ORS containing 50 mmol/L Na, versus I.V. hydration in 100 Panamanian and 40 well-nourished U.S. children aged 6 months to 2 years. Twenty-nine well-nourished children in Panama and 10 in the USA, were randomized into the GES group. Neither hyperkalemia nor hypernatremia was experienced at any time in any patient, although oral hydration, supplemented by free water, was continued for a mean period of  $28.9 \pm 10.7$  h in the Panama study and for  $37.6 \pm 12.4$  h in the U.S. study. Optimal GES use involves accurate assessment of dehydration degree, early replacement of deficit, introduction of early feeding (including free water), and continuous fluid loss monitoring. GES needs to be continuous after initial dehydration only if diarrhoea continues. The authors disagree with the earlier observation that serum potassium (or other electrolytes) should be monitored routinely after 24 h in well-nourished young infants on GES. They maintain that output and frequent clinical assessment are the most important items to monitor, both for oral and I.V. rehydration.

Santosham M, Bertrando R, Foster S, Garrett S. Oral electrolyte solutions for infantile diarrhea (letter). *Pediatrics* 1982 Apr;69(4):503-4

Santosham M, Carrera E, Sack RB. Oral rehydration therapy in well-nourished ambulatory children. *Am J Trop Med Hyg* 1983 Jul;32(4):804-8

Few data are available on the use of WHO-ORS in well-nourished ambulatory children with minimal dehydration. In an outpatient clinic in Panama City, a randomized study evaluated the safety of ORS containing 90 mmol/L (WHO formula) or 50 mmol/L of sodium in diarrhoea management among 93 well-nourished ambulatory children aged 3 months to 2 years. Patients were randomized into three groups. Patients in Group A were given WHO-ORS; patients in Group B ORS containing 50 mmol/L sodium, and those in Group C a clear liquid diet, consisting of commonly-available aerated beverages, banana, cereals and apple sauce. All 93 patients were hydrated successfully. Patients in both ORS groups gained significantly ( $p < 0.05$ ) more weight than did those in the control group by the 2-week follow-up visit. There were no complications of either ORS, and no one developed hypernatremia or hyponatremia during therapy. Thus, ORS containing both 90 and 50 mmol/L sodium is effective and safe, and can be recommended for undernourished and well-nourished ambulatory or hospitalized patients with minimal dehydration.

MM

## Oral Rehydration Therapy

Santosham M, Daum RS, Dillman L, Rodriguez JL, Luque S, Russell R, Kourany M, Ryder RW, Bartlett AV, Rosenberg A, Benenson AS, Sack RB. Oral rehydration therapy of infantile diarrhea: a controlled study of well-nourished children hospitalized in the United States and Panama. *N Engl J Med* 1982 May 6;306(18):1070-6

Santosham M, Dillman L, Sack RB, Carrera E, Kourany M, Ryder R, Benenson W. Oral therapy of well-nourished children hospitalized with acute watery diarrhea. In: Johns Hopkins University International Center for Medical Research. *Progress report 1980 (terminal report)*. Baltimore, 1980:17-24

Santosham M see El-Mougi M

Saragih M, Ramayati R, Karo-Karo M, Harahap E, Sutanto AH, Siregar H. The knowledge of parents of children with diarrhea on oralit at the Department of Child Health, Dr Pirngadi General Hospital Medan. *Paediatr Indonesia* 1983 May-Jun;23 (5-6):103-9

Interviewed about their knowledge on Oralit, were 285 parents of children with diarrhoea. Only 53.7 percent of the parents knew of and used Oralit; 12.2 percent knew of it but never used it; 13.7 percent had heard of it; and 20.4 percent never heard of it. The information sources were doctors, 63.9 percent; friends and neighbors, 16.7 percent; radio and television, 7.9 percent; and newspapers and magazines, 1.8 percent. The main supplier or distributor was dispensaries.

Sarder AM see Chen LC

Sarker SA see Wahed MA

Sedgwick JR see Cutting WA

Segall M see Melamed A

Sengupta PG see Deb BC

Shields DS, Nations-Shields M, Hook EW, Araujo JG, de Souza MA, Guerrant RL. Electrolyte/glucose concentration and bacterial contamination in home-prepared oral rehydration solution: a field experience in northeastern Brazil. *J Pediatr* 1981 May;98(5):839-41

Electrolyte concentrations and bacterial contamination in ORS prepared by traditional healers, village health volunteers and parents of children in rural, northeastern Brazil were investigated. No participants prepared a hypernatremic solution. Traditional healers prepared ORS with the smallest standard deviation and the narrowest range in sodium concentration (mean  $75 \pm 11$ , range 61-94 mEq/L), while the other groups also prepared ORS with safe sodium concentrations (village health practitioners: mean  $97 \pm 15$ , range 80-125 mEq/L; and parents: mean  $78 \pm 22$ , range 25-100 mEq/L). River water consistently was more contaminated with fecal coliform (FC) bacteria than was well water, by approximately four logs. However, ORS prepared from either source, when incubated at 37°C, supported growth to  $>10^7$  FC/dl within 16 h. Participants lacking running water in their homes prepared more contaminated ORS samples ( $p < 0.05$ ). The authors suggest that consideration should be given to modifying the WHO ORS formula, to inhibit bacterial growth when ORS is used at the village level.



## Oral Rehydration Therapy

Shyamsunder P. Oral rehydration therapy in the management of cholera and other diarrhoeal diseases. *Antiseptic* 1977;74(10):633-8

Sil J see De S

Simhon A see Nalin DR

[Simple methods of treatment of cholera and diarrhoea]. Dhaka: Directorate-General of Health Services, Government of Bangladesh, (1976?). 8 p.

This manual describes simple treatment methods particularly applicable during diarrhoea and cholera epidemics in the remote rural areas of Bangladesh. Criteria for determining the dehydration severity, and methods of rehydration and maintenance using ORS are discussed. Procedures for maintaining proper hygienic conditions within treatment centres are also outlined.

Simpson TW see Mahalanabis D

Sircar BK see De S

Sircar BK see Deb BC

Siregar H see Purba MD

Siregar H see Saragih M

Snyder JD. From pedalyte to popsicles: a look at oral rehydration therapy used in the United States and Canada. *Am J Clin Nutr* 1982 Jan;35(1):157-61

Attitudes and practices concerning ORT in the United States and Canada were evaluated through a questionnaire sent to the chairmen of pediatric departments of 142 medical colleges. Ninety percent (128/142) responded. All reported using some form of oral fluid therapy for diarrhoeal dehydration. Commercial sugar-electrolyte solutions were most commonly used (89%), followed by clear liquids (78%) and fruit juices (58%). These solutions have very different compositions and ingredient concentrations. About half (56%) the institutions were using some form of ORT to treat children of all ages hospitalized for diarrhoeal dehydration, and 26% specified one particular fluid. The solutions' composition varied greatly in nature, concentration of sugars and electrolytes, and resulting osmolarity. ORT was based on a specific written protocol at 30% of the institutions, and was used most frequently to treat outpatients with mild dehydration. ORT use decreased with increasing dehydration. To determine a uniform, optimal approach to ORT for diarrhoea, comparative clinical trials are needed, to assess which fluid compositions and concentrations are most effective in treating and preventing dehydration.

Snyder JD, Yunus M, Wahed MA, Chakraborty J. Home-administered oral therapy for diarrhoea: a laboratory study of safety and efficacy. *Trans R Soc Trop Med Hyg* 1982;76(3):329-33

From January 1979 through December 1980, an oral therapy field trial was carried out by the International Centre for Diarrhoeal Disease Research, Bangladesh, at its rural field station at Matlab. Serum electrolytes were measured for persons treated for diarrhoea at home with pre-packaged or locally available sugar and salt ORT solution, versus for diarrhoea victims who received no ORT, but were treated according to local customs. No detrimental effect was found for persons

## Oral Rehydration Therapy

treated with ORT at home. The frequency of hypernatremia in the groups showed no significant difference. Five persons (6%) treated with ORT packets and three (4%) treated with labon-gur ORT had electrolyte abnormalities. Incidences of hyponatremia and hypokalemia were significantly lower for persons who took estimated appropriate volumes, than for those who took less than appropriate volumes or who were treated with local customs without ORT. There was no indication of differences in electrolyte abnormality rates by season or by pathogen. The results indicate that ORT can be made and administered safely and effectively by rural Bangladesh villagers, under close supervision; and that home-administered ORT may have a beneficial effect on preventing hyponatremia and hypokalemia. Moreover, ORT use at home by persons with mild or no dehydration did not increase the risk of hypernatremia. While the numbers were small, if a major detrimental effect were associated with taking ORT, the study would have been expected to have shown it.

Soeparto P see Azis AL

Sokucu S see Aperia A

Solanke EO see Coker AO

Sood S. Treatment of acute diarrhoea, starvation versus early oral feeding. *Indian J Child Health* 1963;12:771-7

Sosulski R see Baumgart S

Sotman S see Nalin DR

Spira WM see Rabbani GH

Spivey GH see Hirschhorn N

Srinivasa DK, Afonso E. Community perception and practices in childhood diarrhoea. *Indian Pediatr* 1983 Nov;20(11):859-64

Knowledge and beliefs about diarrhoeal causes in children, as well as feeding practices and treatment during diarrhoea, were studied in 100 families having a child under age five, selected randomly in an urban community in Goa. It was believed that consumption of certain foods by a child or its mother was responsible for diarrhoea. Feeding during diarrhoea was halted by 83%, since it was believed that eating increases diarrhoea. Initial treatment consisted of certain home-made remedies. There was a lack of knowledge about the roles of fluid loss, rehydration and oral rehydration.

Steiger E see Levine MM

Steiner JF see Swedberg J

Steinhoff MC see Lionel J

Stinzing G see Deorari AK

Subijanto MS see Azis AL

Sugijanto, Abbas N. Edema in oral rehydration. *Paediatr Indones* 1981 Nov-Dec; 21(11-12):229-34

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The study was performed from February to September 1978 in Indonesia, to determine the relationship between edema and oral rehydration. Studied were 160 diarrhoeal patients, aged 5 days-to-12 years with moderate dehydration, who were hospitalized at the General Hospital, Ujung Pandang. The patients (67 females and 93 males) were grouped by age: 14 (8.8%) were 0-to-1-month old, 126 (78.7%) were 1 month-to-2 years, and 20 (12.5%) were more than 2 years old. The patients' nutritional status also was studied. Fifty-eight (36.2%) patients were well-nourished, 95 (59.4%) were undernourished, and 7 (4.4%) suffered from severe malnutrition. All patients received "Oralit", the ORS recommended by the first National Rehydration Seminar, held in Jakarta in 1974. Oralit was said to benefit both cholera and non-cholera diarrhoea patients. The patients were given ORS orally ad-libitum or by gastric drips. Seven (4.4%) patients (5 females and 2 males), aged 2-16 months with body weights ranging from 3.4-9.5 kg, showed periorbital edema with or without pretibial edema. Of these seven patients, three had good nutritional status, three were undernourished and one was severely malnourished. Patients received 200-4400 ml of ORS, and the edema disappeared within 9½-48 hours after ORS withdrawal. The role of nutritional status in predisposing to edema was undetermined, because edema was observed in patients of all the nutritional categories. The relationship between edema on the one hand, and age, sex, nutritional status and total amount of ORS/Na<sup>+</sup> received was not understood. However, edema appeared more frequently in cases receiving excessive ORS/Na<sup>+</sup>-- which confirmed an earlier report that edema is a side effect of oral rehydration solution.

Suharjono see Hernawan

Suharyono, Adnan SW, Sutejo R. Rehydration Centre (R.C.) in the OPD, Department of Child Health, University of Indonesia, during a short cholera outbreak. *Pediatr Indones* 1977 Jul-Aug;17(7-8):218-22

Suharyono see Sunoto

Sumarso see Sunoto

Summary of clinic and community studies of oral (or nasogastric) diarrhea treatment with sugar-electrolyte solutions (Tables). In: Baumslag N, et al. *Diarrhoeal disease and oral hydration: an annotated bibliography*. Washington: USAID, 1979: 91-102

Sunakorn P. Oral electrolyte therapy for acute diarrhea in infants. *J Med Assoc Thai* 1981 Aug;64(8):401-4

Three studies of ORS for acute diarrhoea in infants, were undertaken in the Children's Hospital of Bangkok, Thailand. In the first two studies ORS was given ad libitum. In the first study of 30 patients with moderate dehydration with a mean age of 9.5-4.5 months, uniformly effective hydration was achieved; 3 cases developed edema. In the second study of 16 patients under 6 months of age there was one failure. Edema occurred in 7 and was related to large amounts of fluid intake more than the sodium concentration of the ORS. In the third study in 18 patients under 6 months of age, ORS was given only in amounts to replace previous losses. Five patients required intravenous fluids, but edema was prevented. The authors concluded that 50-100 ml/kg of ORS in the first 6 h is appropriate to correct the previous losses due to acute diarrhoea in very young infants.

Sunoto, Pih H, Wiharta AS, Suharyono. An oral electrolyte solution (Pedialyte) in the treatment of acute infantile gastroenteritis. *Paediatr Indones* 1978 Aug; 18:199-208

## Oral Rehydration Therapy

The efficacy of a sterile, pre-mixed ORS was assessed in 35 infants (17 male) aged 5.5-20 months, hospitalized in Indonesia with acute gastroenteritis. The ORS contained (in mEq/L), Na<sup>+</sup> (30), K<sup>+</sup> (20), Ca<sup>++</sup> (4), Mg<sup>++</sup> (4), Cl<sup>-</sup> (30) and lactate (28). On admission, dehydration was mild in 13 patients (37%) and moderate in 16 (46%). Six (17%) had normal hydration. Twenty-nine (83%) had isotonic and 6 (17%) had hypotonic dehydration. Only 6 infants were undernourished. All were hospitalized for 3 days, and, on discharge, all were in good condition. No one developed severe dehydration or needed I.V. The mean weight gain during hospitalization was 147 g (range: 100-400 g). Pathogenic bacteria were isolated from stools of 24 (68.7%) patients (*Salmonella* spp. in 16, *Shigella* spp. in 4, *Vibrio* spp. in 1). All recovered very well with only ORS and without any antibiotic. No ORS associated complication was observed. Clinical, chemical and other observations showed that acute infantile gastroenteritis, with or without mild and moderate dehydration, can be safely, effectively treated with this ready-to-feed ORS.

Sunoto. Oral rehydration salts: a simple and appropriate tool against dehydration due to diarrhoea. *Paediatr Indones* 1981 Mar-Apr;21(3-4):90-100

Diarrhoeal disease was identified as one of the major public health problems with high morbidity and mortality particularly in children aged under 5, although recent advances in diagnosis, pathogenesis and pathophysiology of this disease were significant. ORT known since the 1950's and used extensively in hospitals and treatment centers in the 1960's has become a world-wide program since the 1970's. This paper communicates these facts and suggests a mass campaign in favor of ORT. Nowadays more than 70 countries have used ORT as a major treatment of dehydration due to diarrhoea. Sodium concentration in ORS is one of the problems still in dispute. Extension of ORT to the use of sucrose-electrolyte solution and sugar-salt solution by using pinch or scoops has enjoyed some popularity. It has been proven that ORT has a beneficial impact in improving nutrition, saving money, and dramatically decreasing mortality. For Indonesia, it was suggested that national efforts to implement ORT must be part of the general program for delivery of basic health services. Integration of ORT with primary health care modalities such as family planning, nutritional programs, maternal and child health, immunization, environmental sanitation, health education, etc. was also suggested. A public campaign using all communication media might have a great contribution in delivering the message to the people wherever they live, thereby ensuring that treatment of diarrhoea begins at home with ORS.

Sunoto, Suharyono, Wibowo S, Sumarso. Oral rehydration solution: an appropriate formula for acute infantile diarrhoea. *Paediatr Indones* 1980;20:205-15

Sunoto, Suharyono, Budiarto AD, Wiharta AS. Sugar salt solution (SSS) using standard plastic scoops ("blue spoon") in the treatment of acute diarrhoea. *Paediatr Indones* 1983 Nov-Dec;23(11-12):217-28

WHO-ORS for diarrhoea therapy has been accepted throughout the world but is available only in big cities and the price is often beyond the reach of the affected community. The efficacy of a simple sugar-salt solution (SSS) measured by a specially designed standard plastic scoop ('blue spoon') therefore was examined. Twenty-eight infants (1 month-2 years) with acute diarrhoea and mild dehydration was treated with SSS (NaCl 3.5 g and sucrose 25 g per liter) while 28 age-matched controls received WHO-ORS (NaCl 3.5 g, NaHCO<sub>3</sub> 2.5 g, KCl 1.5 g and glucose 20 g per liter). Clinical and laboratory data showed that ORS is superior to SSS in

## Oral Rehydration Therapy

increasing body weight and correcting base deficit ( $p < 0.05$ ). Since almost 80% of the diarrhoea patients in the community have very mild or no dehydration, the sugar salt solution could be given early as a home fluid to prevent dehydration. For moderate dehydration, particularly if acidosis and hypoglycemia are already present, the WHO-ORS could be more useful.

Sunoto, Puspongoro TS, Surachmad S, Sanborn WR. Treatment of acute infantile gastroenteritis. Paediatr Indones 1977 Nov-Dec;17(11-12):351-60

Sunoto see Hernawan

Sunoto see Tumbelaka WAFJ

Surachmad S see Sunoto

Sutanto AH see Purba MD

Sutanto AH see Saragih M

Sutejo R see Suharyono

Swedberg J, Steiner JF. Oral rehydration therapy in diarrhea. Postgrad Med 1983 Nov;74(5):335-7

A treatment regimen for diarrhoeic infants and children has been outlined after examining the composition of available rehydration fluids. ORT is an effective, practical, and economical means of treatment for dehydration secondary to diarrhoea. The regimen can be used on an out-patient basis with a substantial reduction in cost. Fluids containing large amounts of carbohydrates (especially lactose) may lead to hypernatremic dehydration because of free water loss due to increased stool output with low Na concentrations. Clinically, hypernatremia has not been a significant problem with proper use of WHO-ORS or similar solutions. It is not necessary to discontinue breast feeding in infants with diarrhoea, and early feeding does not prolong the diarrhoeal illness. In infants who are dehydrated and not breast fed, a diluted (one-half strength), lactose-free formula is generally well tolerated.

Taitz LS, Byers HD. High calorie/osmolar feeding and hypertonic dehydration. Arch Dis Child 1972 Apr;47(252):257-60

The possible role of high osmol/calorie feeding in the pathogenesis of hypertonic dehydration in infantile gastroenteritis was investigated. Analysis of the sodium content of milk in bottles brought by mothers to feed their babies while waiting in a post-natal clinic in Sheffield, UK, indicates a widespread tendency to use excessive milk powder in feeds. The sodium contents of samples ranged from 22-66 mEq/L (mean 32.5 mEq/L), while those of control samples were 25-26.8 mEq/L (mean 26 mEq/L). This difference was significant ( $p < 0.01$ ). In 3 cases of hypertonic dehydration, feeds given infants contained excess calories and solute, because heaped scoops of milk powder instead of the recommended level measures had been used to prepare the formula. High solute loads may become dangerous in states of water depletion, partly due to the osmolar intake and partly because renal function already has been stretched by the osmolar load, thus reducing its reserve

## Oral Rehydration Therapy

capacity. Careless feed preparation therefore must be considered a potential health hazard.

Taubenslag L, Casellas JM. [Diarrhoea in the malnourished: bacterial causes and treatment]. *Pediatr Panamer* 1973;2(1):31-77

Taylor JO see Hirschhorn N

Taylor PR, Merson MH, Black RE, Rahman ASMM, Yunus MD, Alim ARMA, Yolken RH. Oral rehydration therapy for treatment of rotavirus diarrhoea in a rural treatment centre in Bangladesh. *Arch Dis Child* 1980;55:376-9

In November 1977, an enzyme-linked immunosorbent assay detecting rotavirus antigen was introduced in the laboratory of the ICDDR,B's rural treatment center in Bangladesh. During the next 40 days, rotavirus without other pathogens was found in the stools of 216 (45%) of 480 children aged below 5, who visited the center with a gastrointestinal illness. Most rotavirus patients had slight dehydration or none; only 9% had moderate or severe dehydration. Of the rotavirus patients, 188 (87%) were treated with ORS (WHO formula) alone, while 28 (13%) also required some I.V. There was no death. ORS was successful in 205 (95%) of the rotavirus patients, and was not associated with any serious side-effects. Vomiting occurred during oral treatment in 9 (82%) failures and 65 (32%) oral treatment successes ( $p < 0.001$ ). Oral therapy with this ORS has been used extensively and successfully to treat enterotoxin-mediated diarrhoea and also can be used safely to treat rotavirus diarrhoea in infants and young children.

Teburæ M see Kuberski T

Tekce B. Oral rehydration therapy: an assessment of mortality effects in rural Egypt. *Stud Fam Plann* 1982 Nov;13:315-27

Thane-Toe, Khin-Maung U, Tin-Aye, Mar-Mar-Nyein, Ye-Htut. Oral rehydration therapy in the home by village mothers in Burma. *Trans R Soc Trop Med Hyg* 1984;78:581-9

Acceptability and effectiveness of ORT when given by mothers in the home under village conditions was investigated in 6 (2 control and 4 test) communities near Rangoon, Burma. The control and test village communities, respectively, had populations of 2085 and 4278, of which 218 and 623, respectively were children under-5. Each household in the test villages were provided with one packet of ORS, which was replenished whenever a used packet was returned to the field workers during their daily surveillance rounds. ORS was not given to the control village households. In test villages, 327 children (52%) developed acute diarrhoea, with a total of 639 episodes with an incidence of 1.3 episodes per child per year. Sixty-seven children had 3 or more diarrhoea episodes each, contributing to 314 episodes (49%). ORS was readily accepted and administered by mothers in 96% episodes. The impact of ORS on mortality and morbidity could not be shown, as there was no death, nor necessity for hospitalization in either test or control village populations. Weight changes during diarrhoea was negligible -- during the whole year no significant difference was observed in the growth patterns of boys and girls between test and control villages. Among children under 2, who had 3 or more diarrhoea episodes in 1 year, and those receiving ORT during diarrhoea, were protected from a loss of body weight compared with those not provided with ORT. Those given ORS also had better weight gain in the 3-month period following the diarrhoea episodes.

## Oral Rehydration Therapy

Thanomsingh P see Varavithya W

Thapa R see Poudyal L

Thapalyal L see Barua D

Thavisri U see Chavalittamrong B

Thomas J see Mahalanabis D

Thomas J see Sack RB

Thomas K, Chithralekha S, Narayanan KN, Philip E. Oral rehydration therapy in childhood diarrhoea: a comparative study. *Indian Pediatr* 1978 Oct;15(10):791-6

This study compares conventional I.V. therapy with use of a glucose-electrolyte ORS. A total of 3,000 children with diarrhoea and dehydration hospitalized in India were divided into two groups: 1,800 consecutive cases admitted from January 1970 to August 1975 (treated with I.V.) and the next 1,200 consecutive cases admitted from September 1972 (treated with ORS). ORS therapy was safer, cheaper and more convenient; and overall mortality in the I.V. group was 3% compared to 0.7% in the ORS group. Complications, such as thrombophlebitis and septicemia, also were significantly less in the ORS group. I.V. requirements were reduced significantly when ORS was used, especially for severe dehydration. ORS was recommended for rural areas and peripheral hospitals, particularly during epidemics.

Thomas MK see Price HV

Tin-Aye see Thane-Toe

Tomkins A see Conteh S

Tontisirin K see Varavithya W

Tumbelaka WAFJ, Sunoto. Death due to diarrhea: before and after national rehydration programme. *Paediatr Indones* 1978;18:319-27

Turnberg LA, Fordtran JS, Carter NW, Rector FC, Jr. Mechanism of bicarbonate absorption and its relationship to sodium transport in the human jejunum. *J Clin Invest* 1970 Mar;49(3):548-56

Sodium and bicarbonate absorption was studied in human subjects, using a constant perfusion technique. The rate of sodium absorption from the saline solution was markedly influenced by bulk water flow. When the chloride concentration gradient between lumen and blood was eliminated by partial substitution of sulfate for chloride in luminal fluid, sodium movement was approximately zero when water flow was zero. The potential difference between abraded skin and jejunal lumen was near zero when saline was perfused, and did not change with partial substitution of sulfate or bicarbonate for chloride. It thus was concluded that sodium absorption from saline is entirely passive in the human jejunum. On the other hand, in the presence of bicarbonate, sodium is absorbed actively against electrochemical gradients.

The study's second purpose was to explore the link between bicarbonate transport and the active component of sodium absorption, and to determine whether bicarbo-

## Oral Rehydration Therapy

nate absorption is mediated by hydrogen secretion. The absorption mechanism was studied in normal subjects and in 11 patients with pernicious anemia; the latter were chosen because they do not secrete gastric HCl, which can react with bicarbonate in the jejunal lumen. It was observed that bicarbonate absorption (a) occurs against steep electrochemical gradients; (b) does not generate a potential difference between abraded skin and jejunal lumen; (c) is inhibited by acetazolamide; and (d) generates a high Cl<sub>2</sub> tension in jejunal fluid. These observations suggest that bicarbonate absorption is mediated by active hydrogen secretion, rather than by bicarbonate ion transport per se; and that the link between sodium and bicarbonate transport is best-explained by a sodium-hydrogen exchange process.

Van Blerk J see Nalin DR

Varavithya W, Chernchit L, Wongsaroj P. Comparison of oral rehydration with electrolytes solution and soy milk in acute diarrhea. *J Med Assoc Thai* 1980 Nov;63(11):593-7

The usefulness of soymilk in the treatment of acute diarrhoea was compared with conventional oral electrolyte rehydration, followed by diluted breast milk or humanized milk formula. Moderately well nourished patients hospitalized in Thailand with mild to moderate diarrhoea were divided into group I (23 patients aged 3.5-22 mo.) and group II (23 patients aged 2-18 mo.). Group I received 200 mL/kg/24 h of diluted soymilk: 100 mL soymilk + 100 mL ORS containing Na<sup>+</sup> and Cl<sup>-</sup> (60 mEq/L each) and 5% sucrose. Group II received 200 mL/kg of ORS only in the first 24 h. Diluted humanized milk and breast milk were given orally on the second and full-strength milk on the third day in group II. In this group, recovery period was significantly shortened (p=0.05) in the breast fed infants as compared to those on humanized milk formula. But there was no statistically significant difference between soymilk and breast milk or soymilk and humanized milk. Sugar malabsorption was found in 27-30%. Only 5 patients had first degree malnutrition. Stool culture revealed 2 cases of Salmonella in group I and 3 cases of Shigella in group II. Serum electrolytes were within normal limits except total CO<sub>2</sub> content which was persistently low despite the patients' clinical improvement. Sampling error was the most likely explanation. Sucrose electrolyte ORS followed by breast milk would be the most appropriate treatment of diarrhoea in infants and children. Soymilk, given early, was well tolerated, but had no obvious advantage over others. It indicates that soymilk may not be necessary in acute diarrhoea.

Varavithya W, Posayanond P, Tontisirin K, Chernjitra L, Kashemsant C. Oral hydration in infantile diarrhoea. *Southeast Asian J Trop Med Public Health* 1978 Sep; 9(3):414-9

This study compares clinical responses and biochemical changes in moderately dehydrated infants receiving nasogastric and IV infusion. Twenty-two infants aged under 2 hospitalized in Thailand with acute diarrhoea were studied. Eleven infants (mean age: 7 mo.) on nasogastric infusion had adequate tissue perfusion similar to another 11 (mean age 7.8 mo.) who received IV. Amount of stool loss, weight gain, reduction of serum specific gravity and urea nitrogen showed that the nasogastric infusion fluid was absorbed remarkably. Biochemical data showed a high incidence of hypernatremia which could be explained by the limited fluid intake in these infants during diarrhoea. Nasogastric infusion fluid which contained only table



## Oral Rehydration Therapy

salt and cane sugar could provide effective volume. Electrolyte imbalance and metabolic acidosis were gradually corrected at a rate similar to bicarbonate containing solution as reported in other studies. Diluted breast milk given to infants 24 h after therapy was well tolerated. Balance study indicated that nasogastric infusion retained less nitrogen and sodium during the treatment course as compared to IV. Stool culture revealed no significant pathogen in any study patient and all recovered without complications from diarrhoea once dehydration was corrected.

Varavithya W, Pavabutara P, Pichaipat V, Thanomsingh P, Putthipongsiriporn S, Mahothorn K, Ratanapanich P. The role of parents and medical auxiliaries in oral rehydration in Thailand. *Southeast Asian J Trop Med Public Health* 1982 Sep;13(3): 451-4

Mortality from acute diarrhoeal disease can be reduced significantly, if parents and medical auxiliaries are taught proper participation in oral rehydration programs. In Thailand, the role of such diverse people involved in health care delivery related to the promotion and use of ORS was evaluated. Parents and medical auxiliaries (including practical nurses, midwives and volunteer health workers) were trained at all levels. Etiology, epidemiology, physiopathology and control of diarrhoeal disease, with emphasis on ORT, was taught. The results of a study in northeast Thailand showed reduction of diarrhoeal disease mortality, because local health center nurses were trained to administer ORS to diarrhoeal patients. As a result, only 0.6% of diarrhoeal cases had to be referred to a local hospital. The authors concluded that the role of parents and medical auxiliaries relating to the practice and promotion of ORS is the key to success in controlling diarrhoeal diseases, in the context of primary health care.

Varavithya W see Kasemsarn P

Vargas W see Nalin DR

Vis HL see Kahn A

Wahed MA, Molla AM, Sarker SA, Rahaman MM, Greenough WB, III. Hyponatremia: a complication in the diarrhoea in children not receiving oral replacement therapy. In: *Proceedings of the 7th Annual Conference of the Bangladesh Medical Association, Dacca, 9-11 May 1980.*

Wahed MA, Zimicki S, Rahaman MM. Sodium content in home-made oral rehydration solution collected from different projects in Bangladesh. *Southeast Asian J Trop Med Public Health* 1982 Sep;13(3):499

ORS prepared at home has been advocated for prevention and treatment of dehydration due to watery diarrhoea. One continuing concern, however, is the variation in concentrations of glucose and electrolytes, especially sodium which may cause hypo- or hyponatremia in infants and children. Since 1978, the biochemistry laboratory of the ICDDR,B tested the sodium content of ORS collected from 6 projects located in various parts of Bangladesh. These projects had different standards for the electrolyte content of ORS, different training, and different sources for obtaining the ingredients. Solutions for testing were obtained from 2

## Oral Rehydration Therapy

weeks to up to 2 years after training. Of them 1.4% to 20% had high sodium content and the coefficient of variation ranged from 24% to 40%. While no single factor could be identified as the principal determinant of solution safety, important considerations were accuracy and replicability of water measurement and the quality of training imparted.

Wahed MA see Ali MA

Wahed MA see Snyder JD

Walker SH. Oral solutions for rehydration of patients with diarrhea (letter). *J Pediatr* 1983 May;102(5):802-4

Walker SH. Race associated differences in drinking behaviour. *Aust Paediatr J* 1983 Sep;19(3):165-7

Walker-Smith JA see Hutchins P

Wallace CK. Oral therapy for acute dehydration diarrhoeas. *Ethiop Med J* 1975; 13:181-4

Wallace CK see Phillips RA

Waterman D see Nalin DR

Watkinson AM see Watkinson M

Watkinson M, Watkinson AM. The impact of domiciliary glucose electrolyte solution on diarrhoeal prevalence and growth in children under five years of age in a rural West African village. *Ann Trop Paediatr* 1982 Mar;2(1):13-6

Watkinson M. Oral rehydration: too high a price to pay? *Br Med J* 1983 Aug 27; 287(6392):618

Watkinson M, Lloyd-Evans N, Watkinson AM. The use of oral glucose electrolyte solution prepared with untreated well water in acute non-specific childhood diarrhoea. *Trans R Soc Trop Med Hyg* 1980;74(5):657-62

This study describes the degree of bacterial contamination in a glucose-electrolyte solution (GES) prepared from local well water in a rural Gambian village, and its ability to support bacterial growth. Addition of solutes greatly enhanced the water's ability to support bacterial multiplication, the differences becoming significant ( $p < 0.01$  for any pair of results) by 12 h. A controlled prospective trial in the village compared this solution with one prepared from clean drinking water. Forty-eight village children aged 3 months to 4 years were split into 2 groups matched for age and nutritional status. One group received clean water GES and the other well water GES, whenever diarrhoea was reported. There were no significant differences in the effects of the solutions when they were given to children with acute diarrhoea. The intake of potentially pathogenic organisms from the well water solution was small compared to that from local weaning foods. In remote areas of developing countries, where general and food hygiene is poor, it may prove possible to use such untreated water in preparing therapeutic GES.

Westley TA see Hirschhorn N

Oral Rehydration Therapy

Wibowo S see Sunoto

Wiese HF see Darrow DC

Wiharta AS see Sunoto

Wongsaroj P see Varavithya W

Woodward WE see Hirschhorn N

World Health Organization. Diarrhoeal Diseases Control Programme. Guidelines for the production of oral rehydration salts. Geneva, 1980. 58 p.

World Health Organization. The management of diarrhoea and use of oral rehydration therapy. Geneva, 1983. 25 p.

Woman-to-woman sharing of knowledge, skill and confidence: an exercise in crisis management - the 'BRAC' story from Bangladesh. Future 1983;(6):12-7

Yadav SP see Jain A

Yankauer A. Oral rehydration and social change: the control of diarrhoeal diseases in the Third World (editorial). Am J Public Health 1982;72(10):1105-6

Ye-Htut see Thane-Toe

Yolken RH see Taylor PR

Yunus M, Chakraborty J. [Matlab oral therapy field trial training manual for treatment and prevention of diarrhoea]. Dhaka: Cholera Research Laboratory, 1978. 20 p.

Yunus M see Chakraborty J

Yunus M see Chen LC

Yunus M see Snyder JD

Yunus M see Taylor PR

Zetterström R see Aperia A

Zimicki S see Chakraborty J

Zimicki S see Wahed MA

Zingde KD see Mazumdar H

Zinno R see Levine MM

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List of participants

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## INTERNATIONAL DIARRHOEAL DISEASE INFORMATION SERVICE AND DOCUMENTATION CENTRE

The International Diarrhoeal Disease Information Service and Documentation Centre (DISC) was set up in May 1982 by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). DISC is based at the Library and Publication Branch of the ICDDR,B. For an initial three years, DISC operations are being supported by a grant from the International Development Research Centre (IDRC), Canada.

Policies for DISC are guided by an international Advisory Board, consisting of 25 members, the majority of whom are from developing countries. Current members of the Board are the following: Mr Zakiuddin Ahmed, Bangladesh; Dr K M S Aziz, ICDDR,B; Dr J Azurin, Philippines; Dr D T Aye, Burma; Dr D J Bradley, UK; Dr T C Butler, ICDDR,B; Dr W Chaicumpa, Thailand; Dr W B Greenough III, ICDDR,B; Dr J Holmgren, Sweden; Dr Farida Huq, Bangladesh (Member-Secretary); Dr M Jegathesan, Malaysia; Dr A K Azad Khan, Bangladesh; Dr S Lam, Singapore; Dr M H Merson, WHO, Geneva; Dr M O Ojo, Nigeria; Dr S C Pal, India; Dr C Palasuntheram, Sri Lanka; Dr Fu-xi Qiu, China; Dr M M Rahaman, ICDDR,B (Chairman); Dr S C Sanyal, India; Dr J S Saroso, Indonesia; Dr C-T Soh, Korea; Dr Y Takeda, Japan; Dr M A Waheed, Pakistan; Mr J E Woolston, IDRC, Canada.

DISC has initially been concentrating on publications that are produced in or about Asia. The subject scope covers information on diarrhoeal diseases which emerge from, or are useful to: bio-medical research; development of control and treatment procedures; establishment of programs for introducing control and treatment procedures. The aims of DISC are: to collect, organize and disseminate information; to encourage free flow of information; to help avoid duplication of research efforts; and to speed the application of improved practices.

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