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LIST OF BACKGROUND DOCUMENTS

1.	DEVELOPMENT OF A PROGRAMME FOR DIARRHOEAL DISEASES CONTROL - Report of an Advisory Group - Geneva, 2 - 5 May 1978	WHO/DDC/78.1
2.	TREATMENT AND PREVENTION OF DEHYDRATION IN DIARRHOEAL DISEASES - A Guide for Use at the Primary Level.	WHO Geneva 1976
3.	DIARRHOEAL DISEASES CONTROL PROGRAMME UNICEF-WHO joint Committee on Health Policy - Twenty-Second Session - Geneva, 29 - 31 January 1979	JC22/UNICEF-WHO/79.8
4.	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 filed trial by an international study group	BULL, WHO Vol.55, 1977
5.	ORAL FLUID - A SIMPLE WEAPON AGAINST DEHYDRATION IN DIARRHOEA How it works and how to use it	WHO Chronicle, 31:87-93 (1977)
6.	REPORT OF THE REGIONAL MEETING ON CHOLERA AND DIARRHOEAL DISEASES, Alexandria, 1-5 June 1978	EM/CHOL./21 EM/DIR/DIS/5 EM/MTG/CHL.DHL.DIS/12
7.	CLINICAL MANAGEMENT OF ACUTE DIARRHOEA Report of a Scientific Working Group, New Delhi, 30 October - 2 November 1978	WHO/DDC/79.3
8.	ASSIGNMENT REPORT Seminar on Infantile Diarrhoeal & Rehydration, Karachi, 31 December 1978 - 2 January 1979 Lahore, 4-6 January 1979 by Dr Joh E. Rohde, WHO Consultant	EM/DIARR.DIS/6

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WORLD HEALTH ORGANIZATION
ORGANISATION MONDIALE DE LA SANTE

DEVELOPMENT OF A PROGRAMME FOR DIARRHOEAL DISEASES CONTROL

Report of an Advisory Group
(Geneva, 2–5 May, 1978)

This report contains the collective views of an international group of experts and does not necessarily represent the decisions or the stated policy of the World Health Organization.

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LIST OF PARTICIPANTS

Members:

Dr J.M. Borgoño, Servicio Nacional de Salud, Dirección General, Santiago, Chile

Professor I. Dogramaci, Department of Paediatrics and Institute of Child Health, Hacettepe University, Ankara, Turkey (Vice-Chairman)

Dr N.M. Fakhar, Under-Secretary for Health, Population and Family Planning, Ministry of Health and Welfare, Teheran, Iran

Dr E.J. Gangarosa, Deputy Director, Bacterial Diseases Division, Bureau of Epidemiology, Center for Disease Control, Altanta, GA, USA (Rapporteur)

Dr N. Hirschhorn, Management Sciences for Health, Cambridge, MA, USA

Dr W. Koinange-Karuga, Senior Deputy Director of Medical Services, Ministry of Health, Nairobi, Kenya

Dr J.A.B. Nicholson, Ministry of Overseas Development, London, England

Mr O.O. Oladapo, Chief Sanitary Engineer, Lagos State Development and Property Corporation, Lagos, Nigeria

Professor V.I. Pokrovskyi, Central Institute of Epidemiology, Moscow, USSR

Dr V.N. Rao, Deputy Director-General, Indian Council of Medical Research, New Delhi, India (Chairman)

Dr J.E. Rohde, The Rockefeller Foundation, Yogyakarta, DIY, Indonesia

Representative of the United Nations Children's Fund:

Mr M. Assadi, Deputy Director, Programme Division, United Nations Children's Fund, United Nations, New York, NY, USA

Secretariat:

Headquarters:

Dr D. Barua, Bacterial and Venereal Infections, Division of Communicable Diseases, WHO, Geneva, Switzerland (Co-Secretary)

Dr M. Behar, Chief Medical Officer, Nutrition, Division of Family Health, WHO, Geneva, Switzerland (Co-Secretary)

Dr G. Causse, Chief Medical Officer, Bacterial and Venereal Infections, Division of Communicable Diseases, WHO, Geneva, Switzerland

Mr R. Davies, Environmental Health Technology and Support, Division of Environmental Health, WHO, Geneva, Switzerland

Mrs E. Israel, Appropriate Technology for Health, Division of Strengthening of Health Services, WHO, Geneva, Switzerland

Dr S. Litsios, Chief Scientist, Primary Health Care and Rural Development, Division of Strengthening of Health Services, WHO, Geneva, Switzerland

Mr J.N. Lanoix, Division of Environmental Health, WHO, Geneva, Switzerland

Dr Z. Matyas, Chief Medical Officer, Veterinary Public Health, Division of Communicable Diseases, WHO, Geneva, Switzerland

Dr M.H. Merson, Cholera Research Laboratory, Dacca, Bangladesh (Consultant)

Dr A. Moarefi, Health Education, Division of Family Health, WHO, Geneva, Switzerland

Dr A. Petros-Barvazian, Director, Division of Family Health, WHO, Geneva, Switzerland

Dr L. Reinius, Food Hygienist, Veterinary Public Health, Division of Communicable Diseases, WHO, Geneva, Switzerland

Dr O. Sobeslavsky, Virus Diseases, Division of Communicable Diseases, WHO, Geneva, Switzerland

Dr A. Zahra, Director, Division of Communicable Diseases, WHO, Geneva, Switzerland

Regional Offices:

Dr L.A. Arevshatian, Regional Officer responsible for Bacterial and Virus Diseases, WHO Regional Office for Africa, Brazzaville, Congo

Dr R. Cook, Maternal and Child Health Adviser, WHO Regional Office for the Eastern Mediterranean, Alexandria, Egypt

Dr R. Lindner, Regional Adviser on Communicable Diseases, WHO Regional Office for the Western Pacific, Manila, Philippines

Dr M. Radovanović, Regional Adviser on Communicable Diseases, WHO Regional Office for Europe, Copenhagen, Denmark

Dr J.H. Rust, Department of Communicable Diseases, Disease Control, WHO Regional Office for the Americas/Pan American Sanitary Bureau, Washington, D.C., USA

Dr N.K. Shah, Regional Adviser on Communicable Diseases, WHO Regional Office for South-East Asia, New Delhi, India

1. INTRODUCTION

An Advisory Group on Development of a WHO Programme for Acute Diarrhoeal Diseases Control met in Geneva from 2 to 5 May 1978. Dr H. Mahler, Director-General, opened the meeting and said that the Organization was committed to giving the highest priority to the Diarrhoeal Diseases Control Programme in view of the extent, importance and complexity of the problem of diarrhoeal diseases in developing countries. Member States had urged WHO to help develop the activity as a technical cooperation programme at the national and international level. He counted on the continued partnership of UNICEF and on further bilateral and multilateral collaboration. He asked the Group to be very realistic in assessing the value of different control strategies and looked forward to studying its recommendations for development of the Diarrhoeal Diseases Control Programme.

2. JUSTIFICATION OF THE PROGRAMME

2.1 Diarrhoeal diseases as a major health problem

The acute diarrhoeal diseases constitute one of the greatest social evils - not only do they kill people living in hunger and poverty but they retard the growth of young children and impair the quality of life of those who survive. The problem is overwhelming and complex as it involves deep-rooted cultural and behavioural factors in addition to the more obvious socioeconomic inequalities.

Although there is a lack of reliable information on incidence and associated mortality from diarrhoeal diseases, particularly from countries where the problem is serious, some data are available which allow a fair assessment of the magnitude of the problem:

On a global scale it has been estimated that in 1975 there were about 500 million episodes of diarrhoea in children below five years of age in Asia, Africa and Latin America, resulting in 5 to 18 million deaths[1] which is comparable to the situation seen in the industrialized countries at the end of the last century.

In the South-East Asia Region, the incidence of diarrhoeal diseases in different countries has been shown to vary from 1.5 to 12 per 1 000 population of all ages.[2]

In one report published by PAHO in 1973 describing patterns of childhood mortality in Latin America, diarrhoeal diseases accounted for 28.6% of 35 095 deaths due to all causes in children below five years of age and were by far the major single cause of death in the study areas.[3]

In a study conducted by a WHO Diarrhoeal Diseases team working in 7 developing countries in 1960-65, diarrhoeal disease monthly incidence rates in young children were in some instances as high as 40%.[4]

In addition to the high incidence of diarrhoeal diseases many studies have convincingly demonstrated a close association between diarrhoea and malnutrition. These conditions thrive in the same socioeconomic and cultural surroundings, and by perpetuating each other, contribute to high rates of childhood morbidity and mortality and hinder efforts to regulate fertility. While malnourished children have a higher incidence of diarrhoeas which are often more severe causing a higher rate of diarrhoea-related mortality, diarrhoeal diseases are probably the most important contributors to malnutrition because of food withdrawal, anorexia and malabsorption.

In the developing countries more than one third of the beds in children's hospitals or wards are occupied by cases of diarrhoea receiving expensive antibiotics and intravenous fluid, putting a heavy load on the limited budget for health care in these countries.

Since 1961, cholera has been reported by 80 countries in Asia, Africa and Europe and has caused major outbreaks and become endemic in those areas where the incidence of acute diarrhoeal diseases is high and water supplies and sanitation facilities are inadequate. In cholera-endemic areas, however, cholera accounts for less than 5-10% of all acute diarrhoea cases in non-epidemic seasons; even when it occurs, in more than 90% of instances cholera is clinically indistinguishable and is treated in the same way as other acute diarrhoeas. Although most cases are mild, cholera can spread fast and be fatal even in adults; the economic losses of countries can be great and the sufferings of the people considerable. After a quiescent period in 1975-76, cholera has recrudesced in several countries and has extended most recently to the Gilbert Islands in the South Pacific and the Maldives, illustrating the need for preparedness for epidemic control as the prevailing pandemic shows no sign of ending.

2.2 Recent research developments

Intensive research activities stimulated by the current cholera pandemic have made available abundant new knowledge about diarrhoeal diseases. This includes:

- The discovery that a single modality - oral rehydration fluid - can be used to treat most cases of dehydration from watery diarrhoea, including cholera, in all age-groups;

- The recognition of the role of new viral and bacterial agents which makes it possible to identify etiological agents in more than 80% of diarrhoeas; this is a reversal of the situation prevailing a few years ago when 80% of cases remained undiagnosed and were called "acute undifferentiated diarrhoeas";

- The understanding of the pathogenesis of most of the acute diarrhoeas, opening up other possibilities for improving treatment and prevention, including development of vaccines;

- The demonstration that the provision of safe drinking water supplies alone is not sufficient to prevent acute diarrhoeal diseases;

- The finding that travellers' diarrhoea though caused by a variety of diarrhoeal pathogens is commonly due to enterotoxigenic Escherichia coli, in which case judicious use of antibiotics like doxycycline may have a preventive role;

- The demonstration that aluminium adjuvanted whole-cell cholera vaccines may provide better protection in children and longer protection in adults than the generally available vaccine, justifying their further study.

Among these and many other advances of fundamental and applied importance, the discovery of oral rehydration therapy is considered to be of special significance as it has made it possible to undertake immediately a common programme for reducing deaths from all acute diarrhoeal diseases while efforts continue to attain the long-term objective of their prevention and control.

2.3 Need for a WHO-supported programme

There is a widespread awareness of the problem of diarrhoeal diseases but there has been a lack of definite commitment to deal with it. This is partly due to inadequate dissemination of information to those in the medical profession and other health-related fields about the available technology that can be used. Member States have expressed concern and have pressed the Organization for technical cooperation in this field. It is therefore necessary to make information available to all health workers and those involved in socioeconomic development in order to enlist their participation in and commitment to a concerted, unified, multi-disciplinary, medium-term programme for diarrhoeal diseases control. Such a programme will also lay the foundation for early detection of epidemics, particularly of cholera, and consequently their rapid control. There is also an important need for the transfer of managerial skills to assist in reorienting national activities for the control of acute diarrhoeal diseases including the re-allocation of funds so that the most beneficial use is made of available resources, both financial and human.

3. CURRENT WHO ACTIVITIES

During the last few years the Organization has been working towards the development of a multi-disciplinary programme for acute diarrhoeal diseases control and has established interdisciplinary groups in Headquarters and the Regional Offices. These groups, working in close collaboration with the complementary programmes of the Organization on environmental health, maternal and child care, nutrition, food hygiene, health education and appropriate technology, have taken up the promotion of oral rehydration as one of their main activities. For this purpose they have organized field studies on the feasibility, acceptability and effectiveness of oral rehydration when delivered through the existing health services facilities in countries with different cultures and health service infrastructure. These studies convince local health administrators of the practicability and benefits of the procedure and serve as entry points to a broader control programme. Such studies are in progress or have been completed in Costa Rica, Egypt, El Salvador, Guatemala, India, Iran, Laos, Liberia, Nigeria, Philippines and Turkey. In addition to these field evaluations being carried out at the community level, at least 15 more countries are known to have introduced oral fluid for routine treatment of acute diarrhoeas and also for treatment of cholera during epidemics.

Interregional, regional and national courses to train different levels of health workers have been held in Bangladesh, Brazil, Congo, Dominican Republic, Guatemala, India, Indonesia, Liberia, Panama, Papua New Guinea, Philippines, Singapore, Thailand and Yemen.

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Several manuals and guidelines for workers at different levels have been published and distributed widely.

Regional Advisory Committees on Medical Research of five of the six WHO regions have given priority to diarrhoeal diseases research, determing priority research areas, and identifying institutions and individuals to undertake the work. Some Regional Offices have already made a special budget allocation for this purpose.

Close collaboration exists with UNICEF for the promotion of oral rehydration and the improvement of water supply. The Government of the United Kingdom has made a contribution to the WHO Voluntary Fund for Health Promotion for diarrhoeal diseases control.

These activities represent the beginning of the expanded multi-disciplinary programme for acute diarrhoeal diseases control which is planned to be complementary to and supportive of other WHO activities in primary health care and overall health development.

4. OBJECTIVES OF THE PROGRAMME

After reviewing the nature and extent of the problem and recent scientific advances, the Advisory Group strongly endorses the current WHO policy, as outlined by the Director-General, and urges WHO to establish a global Programme for Diarrhoeal Diseases Control with the following objectives:

(i) The immediate and medium-term objective of the Programme is to increase technical cooperation with Member States (a) in reducing mortality and preventing other ill effects of the acute diarrhoeal diseases, particularly deterioration of nutritional status, through the implementation of oral rehydration programmes and (b) in decreasing morbidity through the improvement of water supply and sanitation. The objective will also include research on various aspects of the problem to develop and improve other possible means of prevention and control.

(ii) The long-term objective is to prevent and control acute diarrhoeal diseases by ensuring adequate water supply and sanitation and other appropriate control measures so that they cease to be a major public health problem.

5. POSSIBLE CONTROL STRATEGIES

This section of the report is a brief factual review of the main strategies that can be and have been used to treat, prevent and control the acute diarrhoeal diseases.

5.1 Management of acute diarrhoeal diseases

There are three aspects of management of acute diarrhoeal disease:

5.1.1 Treatment and prevention of dehydration

The primary cause of mortality from diarrhoeal disease is dehydration. In cholera, the most severe of the diarrhoeal illnesses, fluid losses can reduce body weight by 10% in 4-6 hours. Rapid administration of appropriate intravenous fluid has brought mortality rates from cholera and other diarrhoeal illnesses in hospitalized patients to well under 1%. The disadvantages of this type of therapy are that these fluids are only available in hospitals and treatment centres, they are costly and they need aseptic precautions in their preparation and administration.

The recent development of oral rehydration solution has vastly simplified the procedures of rehydration. The solution contains glucose and essential electrolytes which when administered orally are absorbed in the small intestine even in the presence of copious diarrhoea. Many studies have shown that this solution can be used successfully, both orally and by nasogastric infusion, to treat most cases of dehydration both in the hospital and at home. In the absence of glucose, sucrose can be substituted without compromising the usefulness of the fluid. Delivery of the fluid in most areas at the moment is primarily through a pre-packaged mixture of glucose and salts which is added to an appropriate volume of water. Home-made solutions containing locally available sugar and salt prepared by "pinch and scoop" methods or by spoon measures are under evaluation.

The challenge today is to provide replacement of diarrhoeal losses with oral rehydration fluid as early as possible during illness. At present this cannot be done on the massive scale necessary by depending on the existing health care delivery systems with their limited coverage and outreach. This problem can be overcome only by a more universal dissemination of rehydration services which in the case of diarrhoea in children must include participation of mothers in this health care process.

5.1.2 Dietetic management

Of all the common childhood diseases diarrhoea has the greatest impact on nutrition mainly as a result of:

- withholding of food by mothers because they believe that fasting is important for curing diarrhoea;

- decrease in food intake due to anorexia which is associated with dehydration;

- nutrient losses through malabsorption and protein leakage, particularly during dysentery which is associated with destruction of the intestinal epithelium.

WHO-supported studies in the Philippines and Turkey have shown that oral rehydration coupled with education on proper feeding practices during and after diarrhoea results in better weight gain than when no oral rehydration is used, and thus may reduce the ill effects of diarrhoea on nutritional status and constitute an important step in interrupting the diarrhoea-malnutrition cycle.

Adequate feeding of a child during and after diarrhoea is of definite nutritional importance. In a borderline or malnourished child fasting for any period of time is inappropriate and potentially dangerous. Breast feeding should continue uninterrupted unless severe vomiting makes it difficult; children receiving artificial milk should be given it temporarily in more diluted form. Any foods the child consumes regularly can continue to be offered during diarrhoea. During convalescence all foods should be given in greater than normal quantities by feeding the child more frequently.

5.1.3 Drugs

Antimicrobial agents are beneficial in the treatment of diarrhoeal disease only in a few specific circumstances. These include treatment of Shigella dysentery, severe cholera and typhoid fever. These agents should not play a primary role in diarrhoeal disease control programmes because most diarrhoeas are not due to these diseases; moreover, their use diverts the attention of health workers from the more important tasks of rehydration and dietary management. Spasmolytics are also inappropriate because they do not alter the duration or severity of the disease, may prolong the carriage of organisms in the gut, and are associated with many toxic side effects, particularly in children.

Other time-honoured remedies such as iodo-hydroxy-quinoline, kaolin and charcoal have not been shown in careful studies to offer any reduction in frequency or change in composition of diarrhoeal stools.

5.2 Nutrition of the child and mother

The composition of human milk is uniquely sufficient and ideal for the nourishment of infants. No other product can equal it for this purpose. In addition, breast feeding contributes directly to immunological adaptation to extra-uterine life. In all societies it is free of such potential hazards associated with artificial feeding as allergic disorders and metabolic derangements including tetany, hyper-osmolar dehydration and obesity. In developing countries, however, it is even more important in that it avoids the risks of over-dilution leading to malnutrition and contamination of bottles, rubber teats and milk which so often results in acute diarrhoeal diseases. In one study area milk in feeding bottles has often been found to contain a large number of faecal and non-faecal bacteria. It is not therefore surprising that early weaning in developing countries is associated with a high incidence and greater severity of diarrhoeal diseases and malnutrition in young infants.

To be maximally effective breast-feeding should begin as soon as possible after the moment of birth and, except in unusual circumstances such as illness in the mother, should continue unsupplemented as the child's sole source of fluids and nutrients for a period of between 4 and 6 months. Attempted supplementation by the bottle is often a sad delusion, since in general this causes a decline in breast milk production in the same proportion as the volume of milk given by bottle.

The lactation performance of the mother is affected not only by socio-psychological factors like confidence and satisfactory mother-child relationship, but also by her own health and nutritional status. The nutritional requirements of women increase during pregnancy and lactation and they must be met to prevent delivery of low birth weight infants and to facilitate production of breast milk in sufficient quantity to permit breast feeding to continue for an adequate period of time.

Full lactation by the mother also diminishes fertility, thereby helping to maintain better birth spacing which has significant health benefits for her and her babies. On the other hand, if pregnancy occurs the volume of breast milk greatly diminishes.

5.3 Water supply, sanitation and food hygiene

For the eventual elimination of diarrhoeal diseases as a major health problem interventions in water supply, sanitation and food hygiene, combined with improved personal hygiene, are the most effective. Despite the progress made by Member States in the provision of water supply and sanitation during the period 1970-1975[14], the actual situation expressed in real terms as a percentage of population served was as follows:

	% Population Served	
	Urban	Rural
Water supply	77%	22%
Excreta disposal	75%	15%

Until recently, water supply and sewage disposal facilities have mainly been provided to the privileged urban communities rather than to the deprived and under-served populations of rural and fringe urban areas.

The role of water supply and sanitation as an essential health measure, particularly with respect to rural and urban-fringe populations, was emphasized by the recommendations of HABITAT - the United Nations Conference on Human Settlements, 1976, and the United Nations Water Conference, 1977, which were echoed in Resolution WHA30.33 adopted by the World Health Assembly in May, 1977. Concurrently the Organization has been reinforcing its cooperation with Member States in preparing for the International Drinking Water Supply and Sanitation Decade which aims at providing safe drinking water and sanitation for all by 1990.

Given the limited resources available in developing countries, the best strategy for approaching the problem of diarrhoeal diseases associated with unsanitary conditions from a cost-effective perspective is through primary health care. To this end, and following a decision of the twenty-first session of the UNICEF/WHO Joint Committee on Health Policy on this subject, a study is presently being undertaken on water supply and sanitation as integral parts of primary health care. A key factor in this approach is the enlisting of community participation to reduce the cost of installation and ensure the proper maintenance and utilization of these facilities. In keeping with this approach, over recent years there has been a growing awareness of the need to develop appropriate technologies to facilitate the provision of water supply and sanitation in different situations. Nevertheless, there still remains scope for adaptation of existing technologies that are appropriate to various needs and conditions. There is also a need for coordinated multi-sectoral (health, agriculture, public works) approaches for water supply and sanitation in order to meet the needs of the populations in the urban-fringe and rural areas.

Recent studies, however, have demonstrated that provision of safe drinking water supplies alone is not sufficient to control the acute diarrhoeal diseases. This is because (1) the use of contaminated water for non-drinking purposes (e.g., bathing and cooking) also contributes to transmission of diarrhoeal diseases, and (2) diarrhoeal diseases such as shigellosis and rotavirus infection may be transmitted through non-waterborne routes. Thus, control efforts comprising the supply of safe water must be complemented by a combination of efforts to provide proper means of waste disposal and to educate the public on proper personal and food hygiene practices such as handwashing, avoidance of the use of polluted water for irrigation, and use of only safe water for washing fruits, vegetables and utensils.

5.4 Health education

In the control of acute diarrhoeal diseases health education should not be regarded as a separate strategy in itself but as an integral part of all strategies. As a general principle, to be effective health education activities must take into consideration the beliefs and health practices of people and their communities. Since health education is behaviour-oriented, activities should be based as far as possible on an individual approach. Collaboration with persons who are well respected in the community as opinion leaders is beneficial. The mass media, particularly the radio, are very useful as a tool for reinforcing health education activities. Health education programmes for diarrhoeal disease control must be directed towards those concerned at every level, namely:

- top decision makers, to ensure priority in the allocation of resources;

- health workers, to assure technical guidance;

- mothers, to encourage them to provide care promptly and correctly;

- community members, to obtain their active participation in the use of oral rehydration and in improving water supply, waste disposal, and personal and food hygiene.

5.5 Epidemiological surveillance

In the present context surveillance can be defined as the continuous appraisal of the occurrence of diarrhoeal diseases in a community based on information supplied by persons involved in some way in the delivery of health care. Its primary objective is to provide information on the prevalence or incidence of diarrhoea and to define population groups who are at greatest risk of infection. Other types of surveillance programmes looking at specific indicators of disease (e.g., water and sewage sampling) are also useful, particularly in surveillance of cholera.

Although laboratories are not essential for conducting surveillance, they are very beneficial in that they provide information on the most prevalent pathogens and thus facilitate specific control measures.

In the absence of regular surveillance, studies or ad hoc surveys can provide information on the prevalence of different etiological agents in a particular locality, including their antibiotic-susceptibility pattern. Besides the more traditional enteric bacterial pathogens (Salmonellae, Shigellae, Vibrios, enteropathogenic E. coli) and foodborne pathogens (enterotoxin producing Staphylococcus aureus, Vibrio parahaemolyticus, Bacillus cereus and Clostridium perfringens), a large number of additional pathogens have now been recognized as causing diarrhoea. These include:

- Enterotoxigenic E.coli which cause an illness similar to cholera and are a common cause of diarrhoea in young children and also in adults and travellers to endemic areas;

- Newly recognized bacterial pathogens - Yersinia enterocolitica and Campylobacter jejuni - which have unusual isolation requirements and have not been adequately investigated in many countries;

- Rotaviruses, which in most studies are the most commonly recognized causes of infantile diarrhoea, accounting for 50-60% of diarrhoea cases in children aged 6-24 months;

- Other small viruses, such as parvoviruses, which cause diarrhoea in adults and whose importance is not yet defined.

Laboratories involved in diarrhoeal diseases surveillance need not be elaborate, and with innovation in their design, can function with a minimum of funds and equipment. Developments in recent years which have greatly facilitated laboratory diagnosis include:

- The use of transport media which can sustain bacterial life for long periods for transporting rectal swabs to the laboratory. On an even simpler scale, blotting paper moistened with stool has been shown to be an excellent transport material on which vibrios can survive for weeks;

- For the isolation of vibrios, the development of TCBS medium which does not require autoclaving;

- Most recently, the employment of simplified ELISA[a] assays which, for example, can detect rotavirus antigen in stool within four hours of collection.

A simple surveillance system functioning properly should be able to provide an early warning system for the detection of epidemics, especially of cholera, by reporting changes in the pattern of age and seasonal incidence and severity of cases. When these are observed, prompt laboratory and epidemiological investigations can be set up to take samples for determining the etiology and mode of spread. While these investigations are being conducted, treatment and sanitation facilities can be reinforced with the necessary staff and supplies.

Another benefit of surveillance is that it provides an opportunity to undertake operational and basic research.

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[a] Enzyme-linked immunoadsorbent assay

5.6 Epidemic control

Of the epidemic diarrhoeal diseases, cholera deserves special attention as it can kill very rapidly and spread very fast in receptive areas. The speed and volume of travel and trade is such today that no country is able to prevent the introduction of cholera, but its spread within a country can be controlled by good surveillance and a high standard of sanitation.

WHO has developed an effective mechanism for responding to requests for epidemic assistance from Member States. The need to maintain and strengthen the capability of the Organization to respond promptly to such requests has been underlined by World Health Assembly resolution WHA24.26 (May, 1971) and Executive Board resolution EB47.R31 (January, 1971). Several documents and guidelines have been prepared describing strategies for epidemic control in different situations[7-10,12,13]. (See also Sections 5.7 and 5.8 concerning immunization and mass chemotherapy.)

Countries that have already adopted a medium-term programme for diarrhoeal disease control will be in a better position to detect and control epidemics of enteric infections. Countries confronted with epidemics may find it opportune to develop such a programme using the experience gained and resources mobilized during the epidemic period.

5.7 Role of immunization

In general, the development of enteric bacterial vaccines has been unable to take into account the optimum mechanism for enhancing local immune response in the host because the nature of gut-associated immunity against enteric infections is still very poorly understood. The following is a review of vaccines that may be used in control of some of the diarrhoeal diseases.

Cholera

A number of controlled field trials of bivalent whole-cell cholera vaccines in endemic areas during the last two decades have demonstrated up to 50%-60% protection for 3-6 months in adults receiving one dose.

Efforts to improve the cholera vaccines have continued and in recent years two aluminium adjuvant bivalent whole-cell vaccines have been found to protect children in endemic areas in India and Indonesia to a much greater extent than the generally available vaccines; they also provided about 50% protection for approximately 14 months in adults. However, since the number of cases was small in both areas, these observations need to be confirmed.

During the last decade there has also been considerable interest in a toxoid vaccine prepared from cholera enterotoxin. In a single large field trial one such preparation was found to convey little protection, but another field trial is planned to assess the efficacy of a purified toxoid and a combined toxoid-bacterial vaccine. Because of shared antigenicity between cholera enterotoxin and the heat-labile toxin of enterotoxigenic *E. coli* there is a prospect that a cholera toxoid may protect against both diseases. Since enterotoxigenic *E. coli* are the leading cause of travellers' diarrhoea there is an additional impetus for the development of this vaccine.

Naturally occurring and laboratory mutants of Vibrio cholerae have been tested as oral vaccines and have been found ineffective or unstable. A streptomycin-dependent mutant has been tested with some encouraging results in primates, but the need for multiple oral doses and its potential for reversion preclude its usefulness. Multiple oral doses of toxoid afforded no protection to animals or volunteers. Prolonged protection was achieved in animals by combined subcutaneous and oral administration of cholera toxoid but this has not been tested in volunteers.

Typhoid

Since 1954, controlled field studies have been conducted in areas where typhoid fever was endemic to test the effectiveness of acetone-killed and dried, formalin-killed, heat-killed phenol-preserved, and alcohol-inactivated vaccines. While the acetone-killed and dried vaccine is generally considered to be superior, properly prepared heat-killed phenol-preserved vaccine was only slightly less effective; alcohol-inactivated vaccine (preserving Vi antigen) was less effective than either.

A field trial with a vaccine prepared from a non-motile strain of S. typhi showed lack of effectiveness. A recently developed "unaltered" Vi antigen has attracted interest and may be field tested. Interest in a live streptomycin-dependent typhoid oral vaccine has waned because of the danger of reversion, but an epimerase-less strain has shown some promise in volunteer studies and is presently being field-tested. Killed oral preparations are marketed in several countries, but no protective effect has been observed in three field studies.

Practical application of cholera and typhoid vaccines

Mass immunization programmes for the control of cholera with existing vaccines cannot be justified because (1) although high levels of protection have been observed in some field trials of cholera vaccines, their effectiveness has not been demonstrated in epidemic control; claims that have been made about their usefulness cannot stand scientific scrutiny; (2) even when potency can be ensured, they provide only about 60% protection to adults in endemic areas for about 2-3 months; (3) they do not materially interrupt transmission; (4) they do not affect the carrier state; (5) they do not prevent the introduction of cholera into a country; (6) they give a false sense of security to those who receive them; (7) they give a false sense of accomplishment to those who administer them; (8) there are more effective control measures such as treatment and simple sanitation supported by health education which are also less expensive; and (9) very often mass vaccination is performed using the same needle for several persons which allows transmission of viral hepatitis - a much more serious disease. However, selective vaccination of high-risk population groups using appropriate techniques and potent vaccine may be advisable in circumstances where there is little or no possibility of providing treatment facilities or instituting simple sanitation measures supported by health education.

Carefully selected typhoid vaccine of known potency would probably be useful in known endemic areas if a high-risk group has been determined by surveillance and in selected outbreaks where there is evidence to suggest a continuing common source.

Shigella

Streptomycin-dependent strains of Shigella flexneri and S. sonnei have been developed, extensively studied and field-tested. High levels of type-specific efficacy have been demonstrated in children and members of the armed forces but protection lasted for less than one year. Laboratory reversion of these strains and in one instance reversion in man of a vaccine strain have been reported. These facts and the need for multiple doses seriously limit the possibilities of public health application of these vaccines.

Live oral vaccines prepared from recombinant Shigella and E. coli have been tested but have not been shown to protect.

Rotavirus vaccine

Increasing titres of antibodies against rotavirus with increasing age associated with decreased susceptibility to the disease suggest the possible usefulness of a rotavirus vaccine. Although rotavirus strains appear to be morphologically similar, there may be subtle antigenic differences and this question is being studied as a step towards the development of a vaccine.

5.8 Role of chemoprophylaxis

The term chemoprophylaxis usually implies administration of antimicrobial drugs to a person to prevent disease in that particular individual, but such drugs are now being increasingly used for mass treatment for the prevention and control of epidemics when it may be more appropriate to use the term mass chemotherapy.

Travellers' diarrhoea

This syndrome, which may affect as many as 60% of travellers to the developing countries within a few weeks of arrival is considerably hindering the development of the tourist industry. One tablet of 100 mg of doxycycline daily has recently been found to significantly reduce the incidence of travellers' diarrhoea due to enterotoxigenic E. coli in a field trial among Peace Corps Volunteers in Kenya. It must, however, be recognized that travellers' diarrhoea can be caused by a variety of organisms, some of which are resistant to tetracyclines. Thus, while doxycycline may offer some degree of individual protection to travellers in certain circumstances, hygienic measures remain the best method of prevention.

Cholera

Tetracycline has been shown in clinical field trials in Dacca, Calcutta, and the Philippines to reduce the transmission of V. cholerae among close contacts of cases, although in one endemic area the effect was repeatedly shown to last only a day or two longer than the period of treatment. Tetracycline was administered in most of these trials in multiple doses for 3 to 5 days; one large daily dose given for 5 days was less effective. Recently, however, doxycycline in only one 300-mg dose was found to be almost as effective as multiple doses of tetracycline given over 3 days.

A long-acting sulfa drug - sulfadoxine (Fanasil) - was also found in a field trial in a newly affected area in Africa to shorten the period of vibrio excretion by close contacts but the appearance of new carriers among them - i.e., transmission - was not looked for. In another trial in Calcutta, sulfadoxine was found as effective as tetracycline in reducing transmission but was slower in action, being less effective during the more important first 48 hours.

These findings have led countries to use antimicrobials like tetracycline, chloramphenicol, sulfadoxine, and streptomycin in the control of cholera epidemics but their effectiveness has never been properly evaluated. All these drugs have potentially serious side effects, particularly when administered in an unsupervised manner. Tetracycline may cause liver damage and is contraindicated in pregnant women, young children and persons with renal disease; sulfadoxine may cause blood dyscrasias and hypersensitivity reactions including Stevens-Johnson syndrome; chloramphenicol can cause aplastic anaemia; and all of these drugs can promote the development of multiple drug resistance and alter intestinal flora.

A WHO working group[15] discussing this problem concluded that the evidence for the effectiveness and safety of drugs used for preventive medication against cholera is not such that they could recommend any of them for mass application. It has also been pointed out that, as in a community usually not more than 5% of persons will be infected with V. cholerae at any one time and of them less than 5% may go on to develop cholera, it may be necessary to treat about 400 persons to prevent one case. Thus, the risk-benefit ratio does not justify mass treatment. Multiple symptomatic cases of cholera in a family are very rare. With the system of surveillance available in most areas, by the time an epidemic is recognized the infection is generally too widespread to be controlled by mass chemotherapy or even by treatment of close contacts.

This kind of therapy with the appropriate drug may, however, be effective in controlling outbreaks in small, rather isolated and stable communities, e.g., refugee camps, on board ships, etc. Doxycycline or other tetracyclines given in appropriate dosage may be suitable for that purpose. Clinical experience with other antimicrobials is limited and does not allow a critical assessment though chloramphenicol and trimethoprim-sulfamethoxazole may be considered as alternative drugs.

Other diarrhoeas

Mass chemotherapy may also be effective in controlling outbreaks of shigellosis and other severe bacterial intestinal infections in small, stable communities as described above if the pathogen and sensitivity pattern can be determined and the effective antimicrobial drug obtained quickly.

It is difficult to find a technical justification for the use of chemoprophylaxis or mass chemotherapy in the control of diarrhoeal diseases in circumstances other than those special situations mentioned above.

6. RECOMMENDATIONS

The Group's recommendations are presented in 5 areas: appropriate strategies; implementation; evaluation; training, education and dissemination of information; and research.

6.1 Appropriate strategies

After reviewing the various possible strategies and considering their applicability under the circumstances prevailing in the areas where the programme is needed most, the Group recommends five appropriate strategies for inclusion in the WHO Diarrhoeal Diseases Control Programme: management of acute diarrhoeas; nutrition of the child and mother; water supply, sanitation and food hygiene; epidemiological surveillance; and health education. For reasons discussed in Sections 5.7 and 5.8, the Group does not feel that the strategies of vaccination and chemoprophylaxis should be included in the Programme, except in special epidemiological circumstances, and therefore they are not discussed in this section. The role of WHO in technical cooperation with Member States in the control of epidemics due to cholera and other enteric infections is closely linked with this Programme as described in Section 5.6.

While the Group recognizes the value of an interdisciplinary approach for ultimate control of diarrhoeal diseases and believes that the Programme will need to be flexible so that priorities accorded to different strategies can be adjusted as required in different situations, it wishes to emphasize its strong feeling that the strategy that can be applied now with available means and which will have the greatest immediate impact on a global basis is wide implementation of oral rehydration therapy. The Group also believes that the Diarrhoeal Diseases Control Programme should be complemented by other related WHO programmes in environmental health, maternal and child care, nutrition, food hygiene, health education, bacterial and viral diseases, primary health care, and appropriate technology.

6.1.1 Management of acute diarrhoeas with particular reference to oral rehydration

Because oral rehydration therapy based on administration of oral rehydration fluid along with proper dietary instructions

- provides a balanced fluid and electrolyte replacement at low cost;

- is easily administrable not only in hospitals and treatment centres but also by community-based workers and family members; and

- improves appetite and allows better feeding and thus prevents malnutrition

the Group recommends that programmes be instituted immediately to apply this therapy with the principle objective of reducing mortality and other ill effects from diarrhoea, especially in children. The Group believes that the provision of such services to persons with diarrhoea will also contribute to the promotion and success of other control strategies. While making this recommendation the Group emphasizes that there is a great need for more operational research to determine alternative ways that are suited to the situations prevailing in given

regions and countries for delivering oral fluid therapy along with dietetic education.

The Group believes that oral rehydration programmes will be incomplete without the inclusion of appropriate dietary management of children during and after diarrhoea. The practice of withholding food from children with diarrhoea must be strongly discouraged. Children who are receiving cow or goat milk should be given it in diluted form. Some restrictions, particularly of solid and semi-solid foods, may be needed in cases with severe vomiting but adequate feeding with usual foods must be resumed as soon as possible. Under no circumstances should breast feeding be discontinued; in fact, positive efforts should be made to maintain it. Immediately after the acute stage, efforts should be made to compensate for nutrient losses which are inevitable during diarrhoea by advising mothers to feed the children more than the usual amounts of food during the convalescent period; this may require a change in the intra-family distribution of foods and in the frequency of feeding the child and the mother needs to be convinced of its importance.

It is recognized that primary care or basic health service workers, especially those involved in the delivery of maternal and child health care, will be primarily responsible for providing this basic therapeutic health care service. Most of the cost of provision of oral rehydration at the community level can be met by the savings in reduction of hospitalization and need for expensive intravenous fluids and drugs.

Antimicrobials so often used in the treatment of diarrhoeas should be discouraged except for the management of dysentery, severe cholera or typhoid fever. Antimicrobials should not be used as prophylaxis for diarrhoea except in persons from non-endemic areas travelling in highly endemic areas, when doxycycline or other tetracyclines may be beneficial in certain circumstances. The use of spasmolytics should be discouraged but non-specific diarrhoeal drugs (e.g., kaolin), while not recommended for therapy, may be considered as harmless practice and have been used by some workers as entry points for the introduction of oral fluid therapy.

6.1.2 Nutrition of the child and mother

Because of the protective value of breast feeding and the risk associated with too early introduction of other foods, the Group recommends that efforts be made to ensure that infants are fed exclusively from the breast for their first 4 to 6 months of life. This is particularly important in developing countries and for families living in an insanitary environment without sufficient resources and facilities to ensure safe artificial feeding, although there is now evidence that under any circumstances (including those in the industrialized countries) breast feeding has many advantages over artificial feeding.

Health workers should promote breast feeding by

- educating mothers about the importance of lactation and improving their nutrition;

- facilitating during postnatal care such practices as early mother-child contact and rooming-in, and discouraging bottle-feeding of babies during the first days of life;

- refuting propaganda that advocates artificial feeding.

Breast feeding should be continued even when a child become sick; if he has to be hospitalized he should be admitted together with his mother. To facilitate breast feeding governments should be encouraged to enact legislation and promote social measures to restrict the importation and control the advertising of infant formulas and sale of bottles for artificial feeding, to promote the creation of creches and to grant adequate maternity leave.

The health of the mother is very important for ensuring the provision of adequate amounts of breast milk with sufficient nutrients. Thus, health workers must identify pregnant and lactating mothers who are nutritionally deficient and ensure their rehabilitation by providing food supplements, if necessary.

Special efforts should be made to inform obstetricians, paediatricians, general practitioners, public health personnel, nurses, midwives and all cadres of paramedical personnel of the importance of breast feeding. Particular attention must be directed to medical and other related curricula; these should include lectures on the scientific attributes of breast milk with special emphasis on the possibility of disease transmission by artificial feeding. Every effort must be made to promote breast feeding in the community. Through every medium available - the press, radio, television, word of mouth, etc. - the public must be made aware of the advantages of breast feeding and attention must be given to the enlightenment of men as well as women. The nutritional value of human milk and the advantages of breast feeding should be taught in primary and secondary schools as part of health and nutrition education and of preparation for family life and responsible parenthood. To achieve this there is an urgent need to educate teachers and to provide them with material for inclusion in their syllabus.

Starting from the 4th - 6th month of life infants need other foods in addition to breast milk to satisfy their nutritional requirements. In families living in an insanitary environment and with an inadequate concept of personal hygiene this is a period of great danger (weanling diarrhoea). To help control diarrhoeal diseases in this period the Group believes that health and nutrition education programmes emphasizing proper methods of preparing solid and semi-solid foods from those normally eaten by adults should be carried out. The use of bottles should always be discouraged.

6.1.3 Water supply, sanitation and food hygiene

The Group recognizes the need for an all-out effort in improvement of water supply, sanitation and food hygiene for reducing morbidity from diarrhoeal diseases. The best prospects for success lie in mobilizing entire communities to prevent diarrhoeal diseases through measures that are culturally acceptable and feasible. There must, however, be support for the development and transfer of appropriate water supply and sanitation technologies that can be applied at the primary health care level, especially in the underserved rural and fringe urban areas. These technologies should be simple in their design and, especially, in their maintenance. Further innovations in materials, equipment and practice are needed. Improvements in only one of these areas (e.g., water supply) are not sufficient; an attempt must be made to effect these innovations in the 3 areas of water supply, sanitation and food hygiene.

WHO manuals [12,13] can be of general guidance in the planning and implementation of these programmes though it is emphasized that intervention measures will vary greatly between countries and areas with different geography, climate, and sociocultural characteristics.

To be effective in the control of diarrhoeal diseases, water and sanitation programmes must consider the behavioural and sociocultural characteristics of the community and its ability to participate and use alternative technologies so that those concerned become agents for improving their own quality of life.

The approach to the provision of water supply and sanitation should be simple, innovative and acceptable to the community at a cost that they can afford now. There should be encouragement for the utilization of well-known simple techniques for the supply of safe, adequate and accessible water and the control of excreta disposal such as the protection of existing water sources from pollution, the utilization of slow sand filtration, sanitary latrines, low cost sewage collection and treatment methods, etc. These approaches should be reinforced and simplified to reduce cost through the transfer of technologies developed by operational research, particularly at the national level.

Prior to and during the application of these technologies, intensive efforts in health education are needed in order to enhance their impact. This should be carried out by workers at all levels of the health and other social services. For example, programmes on environmental sanitation and personal and food hygiene should be part of school syllabuses; the message in these programmes should inform children of the dangers of insanitary conditions and habits and of the simple measures that must be taken by each individual, which can in turn influence both family and community attitudes and practices. The implication of this is that sanitary habits can be instilled at a very early age and that each individual has a responsibility for his or her own health and the health of the community. Water supply and sanitation facilities should be provided in schools as an important health measure, and at the same time serve as part of the educational programme.

The Group recognizes also the important role that women play in educational programmes both as educators for hygiene and sanitation within the community and the family and as the primary procurers and users of water and preparers of food.

The Group emphasizes that there should be no conflict between activities to promote oral rehydration and activities to improve water supply, sanitation and food hygiene. The former have as their main objective the reduction of mortality and improvement of nutrition and they can be implemented immediately at a relatively small cost. The latter, however, represent the ultimate means of reducing morbidity and controlling diarrhoeal diseases and will require more time, efforts and resources for their realization.

6.1.4 Health education

Factors responsible for diarrhoeal diseases are basically behaviour-related. Therefore, the Group strongly believes individuals and communities should be educated to be more active in practicing healthy behaviour. Moreover, since communities differ in their dynamics of decision-making, efforts must be made to plan educational activities to conform with these patterns and practices as opposed to following stereotyped patterns which may not necessarily meet the needs of the particular situation. Community participation resulting from effective health education can ensure proper utilization of the various services as well as active involvement of the people in preventive and promotive measures.

Health education should be considered as an essential function of every health worker at every stage of health activity, and health education specialists should assist these workers by providing them with guidelines and in-service training. Particular attention should be given to the importance of educating government decision makers on the need for multisectorial commitment to the control of diarrhoeal diseases. Emphasis should be given not only to the health benefits, but also to the value of such a programme in ensuring the success of education, family planning, urban development and other national investments. A broad appreciation of the problem and its importance for the health and economy of the society will ensure that sufficient manpower and fiscal resources are allocated to attain the programme objectives.

6.1.5 Epidemiological surveillance

The Group believes that epidemiological surveillance should play an important role in the Diarrhoeal Diseases Control Programme by providing information on the incidence and etiology of diarrhoea in different population groups and by forming the basis of an early warning system for the detection of epidemics. Surveillance programmes, whenever possible, should be integrated into other national communicable disease surveillance programmes. They should use simple definitions and forms for collecting data on vital events and diarrhoea cases, or at least deaths due to diarrhoeas, and should have a strong feedback component to provide an interpretation of the data for those collecting it. Although it is not absolutely essential, diagnostic laboratories should be involved in surveillance where possible, and analyse specimens on a sampling basis, especially when an epidemic is suspected.

In its simplest form, a surveillance system based on reporting of changes in the pattern of age and seasonal incidence or in the severity of diarrhoeas in a locality as observed by the persons delivering health care (e.g., oral rehydration) can provide an early warning system for prompt detection of an epidemic or recrudescence which would then be confirmed by laboratory and epidemiological investigation. Ancillary personnel who are also involved in some way in health care delivery, like traditional medical practitioners, pharmacists, village leaders, teachers or religious leaders, can also provide useful information about excess deaths due to diarrhoea and draw attention to an epidemic.

6.2 Programme implementation

The Group recognizes that the Diarrhoeal Diseases Control Programme constitutes a part of the overall WHO programme of technical cooperation with Member States. The basic interpretation of "technical cooperation" endorsed by the WHO Executive Board[16] is that:

"Technical cooperation means activities which have a high degree of social relevance for Member States in the sense that they are directed towards defined national health goals and that they will contribute directly and significantly to the improvement of the health status of their populations through methods that they can apply now and at a cost they can afford now, and which conform to the principle and aim of developing national self-reliance in matters of health".

There can be no doubt that the WHO Diarrhoeal Diseases Control Programme satisfies all these criteria and will bring benefit to a very substantial number of people, particularly children, in the developing countries.

The mechanism envisaged for implementation of the Programme is for WHO to work with national authorities as partners in all stages of their programme development. It is anticipated that the basic approach to be adopted by national authorities for implementing the programme will be through their existing infrastructures, particularly primary health care and programmes of maternal and child health care, environmental health, or the basic health services as they are available at the community level, with a focus on the rural and peri-urban areas. A national programme in general usually evolves from pre-existing activities aimed at coping with identified specific problems. The Group believes that the identification of national personnel with the necessary competence, motivation and influence to ensure the implementation of the programme is probably the single most important factor for its success. Unless active national commitment and participation is secured, including that of the communities involved, no long-term impact can be expected.

In applying oral fluid therapy, which is a strategy given high priority, efforts should be made to use and strengthen existing systems. It is most important that the development of systems for oral fluid delivery should be used as an occasion for strengthening community capacity to handle other health problems as the development of diarrhoeal disease control activities should be linked with other health care activities within the community.

National and/or local conditions must be the principal determinant of the nature, scope and elements of the programme. Whatever changes may be found necessary or desirable, they should be the outcome of constructive exchanges of experience gained within or outside the country; in other words, the programme must be adapted to local conditions and gradually integrated into the existing health and social services activities both at the local and national level.

Countries may find it desirable to implement a diarrhoeal diseases control programme on a limited basis in a state, region or a subdivision before embarking on a countrywide programme. With this experience planning for a national programme will be facilitated as regards estimating costs and having an experienced cadre of health workers available.

In its role of promoter of and partner in technical cooperation concerning this Programme, WHO in collaboration with UNICEF can provide critical inputs, depending on circumstances and local needs. Examples of such inputs are:

- technical cooperation in assessment of the nature and extent of the diarrhoeal disease problem and in the formulation, implementation and evaluation of national programmes;

- collection, evaluation and distribution of relevant scientific information (see Section 6.4);

- organization and management of training activities such as seminars, meetings, training courses, including the preparation and provision of educational and teaching aids (see Section 6.4);

- procurement and/or development of local facilities for production of essential supplies (e.g., ingredients for oral rehydration) and equipment through the establishment of national or regional centres as required;

- production, standardization and distribution of essential laboratory reagents;

- support to countries which have identified water supply and sanitation as priority areas for underserved rural and fringe urban areas;

- provision of technical services by staff members or consultants.

The Group, having considered the global magnitude and severity of diarrhoeal diseases and their health and socioeconomic implications, and realizing the urgent need to improve the present unsatisfactory situation on a technical cooperation basis, recommends to the Director-General that:

(a) a suitable mechanism for consultation with representatives from interested organizations within the United Nations system and other national, international and non-governmental organizations be established by WHO Headquarters to ensure coordination and support to this Programme, and

(b) technical advisory groups be set up both at Headquarters and Regional Offices to review periodically the strategies and the overall Programme progress.

Although consideration must be given to the fact that there is a need for improving the currently available methods for the treatment, prevention and control of diarrhoeal diseases, it is clear that many lives can be saved and the quality of life improved by wide application of oral fluid therapy, the effectiveness of which has been proved. It would not be justified to postpone action while waiting for better methods to become available; by pursuing a pragmatic approach, the Programme will be able to incorporate new knowledge as it is generated by basic research and by operational activities in the field.

6.3 Programme evaluation

Evaluation of national diarrhoeal disease control programmes will have to be encouraged and supported by WHO to ensure the progress and effectiveness of the activities that have been selected and undertaken. Two aspects need to be considered: (1) operational evaluation and (2) impact evaluation.

Operational evaluation can be used to assess and measure the progress of programme inputs against pre-established targets; for example, there may be a need to evaluate the programme of procurement or manufacture of oral rehydration supplies and of their distribution, delivery and use. Similar targets will be needed for the development of water and sanitary facilities if not already established. A time schedule for each programme operation will serve as a guide to progress. At periodic intervals (i.e., weekly, monthly), the national programme coordinator can review each of these parameters and determine and rectify the causes of shortcomings. Evaluation can be based on such operational indicators as the following:

- number of packages of ingredients for oral rehydration manufactured, distributed or consumed;

- personnel trained in their administration;

- sanitary facilities provided or improved;

- production of supplies and equipment (e.g., for sanitation).

Impact evaluation is important to assess the benefits of the programme in reducing the ill effects of the diarrhoeal diseases problem. The ultimate objective is to reduce mortality and morbidity. This may be difficult to measure because of unavailability and unreliability of vital statistics, the need for a large population base to reliably measure impact on mortality and the tendency for aberrant increases in incidence to appear as surveillance is improved. Impact indicators may include:

- number of deaths from diarrhoea, with age-specific data, if possible;

- number of diarrhoea cases in hospitals, health centres or outpatient departments;

- awareness of mothers;

- sales of supplies for bottle feeding;

- acceptance of treatment by the population;

- nutritional status surveys;

- nursery school attendance; and

other parameters which remain to be defined.

It may be possible to select several representative areas of a country or region to measure impact by serial collection of data before and after intervention, but it should be stressed that other variables which cannot be easily controlled or recognized often operate and influence findings. It may not be essential to demonstrate impact as certain information derived from other countries can also be accepted and applied.

These evaluation techniques complemented by surveillance information can facilitate early recognition of problems, permitting rapid corrective actions. They may also indicate a need to modify goals and objectives, to obtain additional resources, or to request technical guidance from within the country or from WHO.

6.4 Training and education; dissemination of information

The Group believes that, for the success of this Programme, WHO should give high priority to technical cooperation in the training and education of national health workers. The following specific training needs are recognized:

- intercountry/interregional seminars for the motivation of policy-making senior public health administrators and paediatricians;

- national/intercountry training courses for professional and auxiliary health personnel and community workers on technical aspects of oral rehydration therapy including dietetic management, surveillance, and water supply, sanitation and personal and food hygiene;

- development of educational and training material, communicational technology and manuals for education and training of the public and health personnel on these control strategies; preparation of a handbook of simple measures for community hygiene and sanitation which emphasizes their relationship to diarrhoeal disease control, for use at the community level and in schools;

- organization of training courses to teach laboratory workers well established and newly devised laboratory techniques (e.g., ELISA assays) in enteric bacteriology and virology;

- supporting countries in the training of personnel in the operation, maintenance and surveillance of sanitation facilities. Water supply and sanitation facilities require that personnel (particularly at the local level) be trained in the operation and maintenance of these facilities as frequent breakdowns reduce considerably the health benefits derived from these installations.

The Group also feels that WHO should retrieve all available information and experience and disseminate widely material on:

- the effectiveness of different strategies for delivery of oral fluid;

- the unique advantages of breast feeding and means of promoting it.

Regarding breast feeding, the Group urges WHO to continue to cooperate with countries in their activities to discourage the inappropriate use of milk formulas and unethical advertising practices. In order to encourage countries that have declining trends in breast feeding WHO should disseminate information on countries where such trends have been reversed; the results of the WHO cooperative study on breast feeding in seven developing and two developed countries should be used for this purpose.

6.5 Research needs

The Group recognizes the great importance of continuing research and presents below, under the different strategies, what it considers to be the priority needs that should receive further WHO support.

6.5.1 Management of acute diarrhoeas including feeding practices

- Development of technology for cheaper packaging of oral rehydration salts using the presently recommended formula;

- Research to develop appropriate methodology for implementation of oral rehydration therapy using either packages, the "scoop and pinch" method, or spoon measures by peripheral health workers, community leaders or family members;

- Research to explore the linkage of oral therapy with other health activities (e.g., fertility regulation, nutrition, expanded programme on immunization, etc.);

- Research to determine the most suitable diet for use during and after diarrhoeal episodes, taking into consideration the availability of foods and local practices;

- Search for effective anti-diarrhoeal drugs, particularly antisecretory agents to block the action of enterotoxins at different levels, to be used as an adjunct to rehydration;

- Research to improve or modify for simplification the composition of oral fluid (e.g., need for bicarbonate and potassium, possibility of using sucrose instead of glucose);

- Studies of traditional remedies used in treatment of diarrhoea.

6.5.2 Water supply and sanitation

- Search for and review of existing information on operational studies that further quantify the beneficial effect against diarrhoeal diseases of individual and collective control measures concerning water, food, liquid and solid wastes - i.e., to identify the relative importance of each of these sanitary/hygienic interventions;

- Promotion of the acceptance and utilization of appropriate technologies through strengthening the capabilities of the existing network of collaborating centres for water supply and wastes in the adaptation and testing of appropriate water supply and sanitation technologies for the prevention and control of diarrhoeal diseases - e.g., use of faecal wastes for composting, biogas, etc., slow sand filtration for the treatment of water supplies, etc.

- Research to ascertain the effect of travellers' diarrhoea on the tourist industry with a view to encouraging the intensification of measures for the provision of water and sanitation and improving food safety in touristic areas.

6.5.3 Epidemiology

- Studies to define the etiology and epidemiology of diarrhoeas in different age-groups and populations of varying socioeconomic status and environment (e.g., rural vs urban and dry vs wet areas). Particular emphasis should be placed on rotavirus and enterotoxigenic E. coli which are known important causes of diarrhoea in children. These studies should also look into the relationship between specific agents and malabsorption;

- Studies to define the importance of small viruses as a cause of diarrhoea;

- Development of simplified and rapid techniques for laboratory diagnosis of diarrhoeal diseases;

- Field studies to demonstrate the effectiveness of surveillance based on reporting by community-based health workers;

- Studies on economic aspects of diarrhoeal diseases and their control.

6.5.4 Health education

- Research to determine cultural and societal traits influencing behaviour as it relates to diarrhoeal diseases and to explore methods for effective intervention.

6.5.5 Vaccine development

- Studies on the nature of gut-associated immunity and on optimal ways of enhancing the intestinal immune response;

- Studies of the immunological relationships of enterotoxins produced by different enteric pathogens;

- Development and field testing of oral (live or killed) and improved parenteral vaccines, especially against cholera and typhoid fever;

- Studies on methods of cultivation and antigenic characteristics of rotaviruses and development of rotavirus vaccine;

- Studies on the role of antitoxic immunity in E. coli diarrhoea and on the development of a toxoid for its prevention;

- Studies on the mechanisms of colonization of small intestinal pathogens.

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Treatment and Prevention of Dehydration in Diarrhoeal Diseases

A Guide for Use at the Primary Level

WORLD HEALTH ORGANIZATION
GENEVA

The World Health Organization (WHO) is one of the specialized agencies in relationship with the United Nations. Through this organization, which came into being in 1948 the public health and medical professions of more than 150 countries exchange their knowledge and experience and collaborate in an effort to achieve the highest possible level of health throughout the world. WHO is concerned primarily with problems that individual countries or territories cannot solve with their own resources—for example, the eradication or control of malaria, schistosomiasis, smallpox, and other communicable diseases, as well as some cardiovascular diseases and cancer. Progress towards better health throughout the world also demands international cooperation in many other activities: for example, setting up international standards for biological substances, for pesticides and for pesticide spraying equipment; compiling an international pharmacopoeia; drawing up and administering the International Health Regulations; revising the international lists of diseases and causes of death; assembling and disseminating epidemiological information; recommending nonproprietary names for drugs; and promoting the exchange of scientific knowledge. In many parts of the world there is need for improvement in maternal and child health, nutrition, nursing, mental health, dental health, social and occupational health, environmental health, public health administration, professional education and training, and health education of the public. Thus a large share of the Organization's resources is devoted to giving assistance and advice in these fields and to making available—often through publications—the latest information on these subjects. Since 1958 an extensive international programme of collaborative research and research coordination has added substantially to knowledge in many fields of medicine and public health. This programme is constantly developing and its many facets are reflected in WHO publications.

TREATMENT AND PREVENTION OF DEHYDRATION IN DIARRHOEAL DISEASES

TREATMENT AND PREVENTION OF DEHYDRATION IN DIARRHOEAL DISEASES

A Guide for Use at the Primary Level

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PREFACE

These simple guidelines present well-tried and accepted techniques for the treatment and prevention of dehydration which is due to acute diarrhoeal diseases. They have been prepared to assist those who are concerned with the training of primary health workers in the preparation of their own guidelines adapted to their own local needs and resources.

Primary health care calls for the integration of all elements necessary for health at the community level; this includes the integration of preventive, curative, and promotive services for both the community and the individual. Health interventions should be undertaken at the peripheral and practical levels of the health services by using the most appropriate technology that has been adapted to the abilities of the workers who have been trained for these activities.

In spite of the advances that have been made in the treatment of acute diarrhoeal diseases, including cholera, these diseases still remain a scourge to the populations in developing countries. However, by using the oral rehydration fluid, which is recommended in this guide and which contains ingredients that are inexpensive and readily available, it is possible to treat dehydration at the peripheral and practical level in patients of all ages with diarrhoea and particularly in children. Although cases of severe dehydration and shock will continue to need other methods of rehydration, the number of such cases can be reduced if oral rehydration is employed in the early stages of diarrhoea.

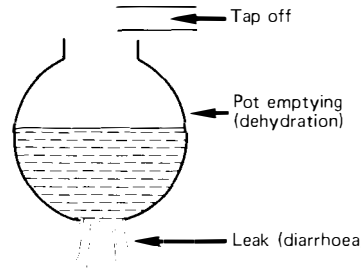
Generally speaking, primary health workers are trained to treat the minor and common ailments. Workers (not necessarily the same ones) may also be trained for direct or indirect involvement in environmental efforts and in immunization, nutrition, and other aspects of the health care of mothers and children. The education and participation of the rural community in health matters is a fundamental part of all such activities.

The publication of this guide is part of WHO's overall effort in the development of simple technical guidelines for use in the promotion and implementation of national primary health care activities.

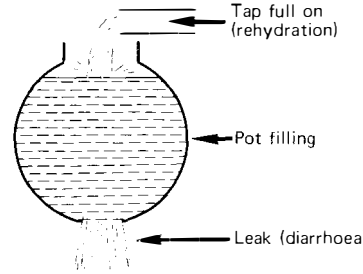
THE FIVE STEPS OF DIARRHOEA AND ITS MANAGEMENT

Step 1. DEHYDRATION

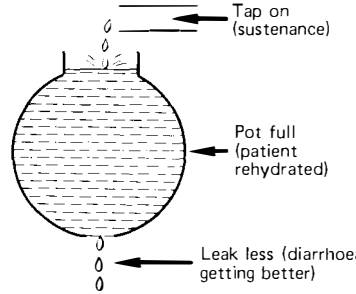
The person with diarrhoea is like a pot of salt water with a hole in its bottom. A dead patient is like an empty pot. It is most important to keep the pot full.



Step 2. REHYDRATION OF THE PATIENT with salt and water is like filling the pot. *It must be done quickly, within six hours or less.*

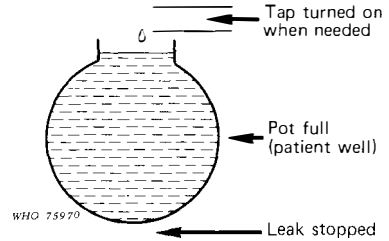


Step 3. SUSTENANCE OF THE PATIENT is like keeping the pot full with salt water while the leak continues, and at the same time making the patient stronger by feeding him with the proper food.



Step 4. CURE OF THE PATIENT is when the leak stops and the pot is full.

Step 5. PREVENTION is trying to stop the beginning of further leaks by keeping people strong and healthy; but if a leak starts again, prevention is by giving salt water and food before the "pot starts to empty" (i.e., before the patient dehydrates).



THE DANGERS OF DIARRHOEA

The cause of death in diarrhoea is DEHYDRATION (Step 1).

Patients with diarrhoea can lose large amounts of water and salts. This is called *dehydration*. Dehydration can develop rapidly within a few hours. The body needs water and salt to live. When the lack of water and salt through diarrhoea is equal to about ten per cent (1/10th) of the body weight, dehydration becomes severe and the person will die within an hour or two.

Diarrhoea is the most common cause of death in children under three years of age because:

(1) A small child's body has not yet learned to defend itself well against infection.

(2) Malnourished children get diarrhoea easily and diarrhoea makes malnutrition worse.

(3) During diarrhoea some children do not get enough food and drink. Many people believe that it is dangerous to feed a child who has diarrhoea. This is wrong because starvation leads to malnutrition. Children are not able to say that they are thirsty and are often not given enough to drink, especially on their journey from home to the health centre or hospital.

(4) Children are more likely than adults to suffer the bad effects of other infections which are often present during diarrhoea.

THE TREATMENT OF DIARRHOEA

What is most important?

(1) Give back the water and salts already lost in the diarrhoea stools. This is called REHYDRATION (Step 2) and this initial replacement should be completed within six hours.

(2) Continue to replace the losses of water and salts as long as the diarrhoea continues so that dehydration does not return, and start feeding the child his usual diet such as breast milk, or cereals and other weaning foods. Treat other infections and complications. Give drugs only when needed. All this is called SUSTENANCE (Step 3) and goes on until the diarrhoea stops with CURE (Step 4).

ASSESSING THE DEGREE OF DEHYDRATION (Step 1)

Every patient with watery diarrhoea has some dehydration and will need fluid. Dehydration may be *mild* or *severe*. Patients with mild dehydration appear almost normal. Yet they may have already lost half of the fluid (50 ml per kilogram body weight) required to produce severe dehydration (100 ml per kilogram body weight). As further small amounts of fluid are lost, signs of dehydration develop rapidly. This is why it is very important to treat dehydration while it is mild and the patient still appears well. Otherwise, dehydration may rapidly get worse and become more difficult to treat. The patient may die.

THIS TABLE HELPS TO DECIDE WHETHER DEHYDRATION IS MILD OR SEVERE

	SIGN	DEHYDRATION	
		Mild	Severe
(1)	Patient's appearance	Alert or restless Thirsty	Limp or unconscious Too weak to drink well or to drink at all Cold skin (shock)
(2)	Skin elasticity	Normal or slightly less than normal	Poor
(3)	Radial pulse	Present	Weak or absent
(4)	Eyes, fontanelle	Normal or slightly sunken	Sunken
(5)	Urine flow (difficult to tell in children)	Usually normal	Little or none
	Amount of fluid lacking when these signs are present:	50 ml for each kilogram of body weight	100 ml or more for each kilogram of body weight

Explanation of the table

(1) *Patient's appearance.* Thirst is the only early sign of dehydration, but remember that infants cannot say that they are thirsty. They show their thirst by crying and being eager to drink fluid that is given to them. At first, when dehydration is mild, patients may appear well, but as dehydration increases they become restless and weak. Finally, patients become dazed and then unconscious; their bodies become limp, their hands and feet become cold, and they are near to death. This condition is called *shock.*

(2) *Skin elasticity.* Pick up a fold of skin from the belly, shoulder, neck, or upper leg between your thumb and first finger; then let it go. Normally the skin springs back like an elastic band and flattens out almost immediately. This is called the elasticity of the skin. As dehydration develops, the skin will flatten out more slowly. With severe dehydration it may take many seconds to flatten.

Nutrition affects the elasticity of the skin. Marasmic babies ("skin and bones") have very poor skin elasticity; in babies with kwashiorkor (oedematous form of protein-energy malnutrition) the test should be done in places where there is no swelling (oedema); in fat babies, even when they are severely dehydrated, the skin elasticity may seem normal where the skin covers a lot of fat. In all these cases the other signs of dehydration are more reliable.

(3) *Radial pulse.* Dehydration causes the pulse rate to increase and the strength of each pulse beat to be weaker. With severe dehydration the pulse at the wrist may become absent altogether and may be felt only in the groin (femoral artery), arm (brachial artery), or neck (carotid artery). These patients are near to death. Learn to recognize a weak pulse by comparing the pulse in normal infants, children, and adults with that in dehydrated patients.

(4) *Eyes and fontanelle.* When the body loses fluid, the tissues behind the eyes shrink and the eyes appear sunken and dry. In infants the soft spot on the top of the head (the fontanelle) sinks.

(5) *Urine flow.* The return of good urine flow is an excellent sign of normal hydration.

Note: While you are looking for the signs of dehydration, look for other important signs which may need special treatment (see pages 17, 18, 21). These are:

(a) Blood in the stool

(b) Fever (check the rectal temperature in young children)

(c) Enlarged spleen

(d) Unconsciousness or convulsions

(e) Difficult, fast, or deep breathing

(f) Marasmus or kwashiorkor.

REHYDRATION
(Step 2)

If possible, severely dehydrated patients should always be referred to the nearest physician or clinic or health centre. If delay is anticipated, rehydration should be started according to the resources available.

Fluids can be given by mouth, nasogastric tube, and intravenous needle, or into the peritoneal cavity. Every health centre should aim to be able to use each of these methods which are described in Annex 1.

THIS TABLE IS A GUIDE TO REHYDRATION

DEHYDRATION	WHAT KIND OF FLUID	HOW MUCH TO GIVE	HOW FAST TO GIVE
Mild:			
(a) Patients who can drink	Glucose-salt solution (continue with breast feeding)	Encourage patients to drink continuously until they refuse	Within 4-6 hours (usually given at home)
(b) Patients who need a nasogastric tube	Glucose-salt solution	120 ml/kg body weight	6 hours
Severe:			
Patients who need intravenous fluid	(a) Ringer's lactate OR 'Diarrhoea Treatment Solution'	100 ml/kg body weight	Within 4–6 hours (or less in adults) (half of the requirement to be given in the first hour)
	OR		
	(b) ½-Darrow's solution with 2.5% glucose (not so good for adults)	150 ml/kg body weight	6 hours (half of the requirement to be given in the first hour)
	OR		
	(c) Normal saline (if nothing else is available)	100 ml/kg body weight	6 hours (divided evenly)

The weight of the patient is helpful in deciding how much fluid to give, although it is not as important as the signs of dehydration. If weighing is not possible, the weight must be guessed. For children a growth chart helps if the age is known (see Annex 3).

Explanation of the table

(1) *Oral or nasogastric rehydration.* Most patients with mild dehydration can be rehydrated by mouth or nasogastric tube. The mother can be shown how to give fluid continuously to the child (about one teaspoonful every minute) and breast feeding should be continued. Giving fluids by nasogastric tube is necessary when there are no attendants available, or when the patient cannot drink enough fluid to keep up with the amount required for rehydration, or when there is severe vomiting. Vomiting less than four times an hour usually does not interfere with drinking and the vomiting almost always ends when the patient is rehydrated.

The most suitable fluid* for oral and nasogastric use is a glucose-salt solution which contains in one litre of water:

Sodium chloride (table salt)	3.5 grams
Sodium bicarbonate (baking soda)	2.5 grams
Potassium chloride	1.5 grams
Glucose (dextrose)	20.0 grams.

The glucose is an important ingredient. It helps the salt and water to be absorbed into the body. The method of preparation of this solution is described in Annex 2.

If the patient cannot be given enough fluid by mouth to replace what is lost in severe diarrhoea or if vomiting and dehydration seem to be getting worse, then intravenous rehydration is necessary.

(2) *Intravenous rehydration.* Patients with severe dehydration and those who do not respond well with oral rehydration need intravenous fluids. The routes for giving intravenous fluid are described in Annex 1.

Patients on intravenous fluids need to be treated in a clinic or hospital because it is important to keep the right amount of fluid flowing into the vein.

* If this solution is not available, a 'home salt-and-water solution' can be made by adding a 'thumb-and-two-finger pinch' of table salt into each pint (or half litre) of water, orange juice, or tea. Remember, however, that this solution should only be used when there is no other solution available.

What intravenous fluids to use: The fluids should be sterile and contain no impurities which can cause fever and chills when given intravenously. The fluid must contain proper amounts of the salts, such as sodium, chloride, potassium, and bicarbonate, which are being lost in the diarrhoea stool. The following solutions can be used:

(a) Ringer's lactate solution (Hartmann's solution for injection) is the best commercially available solution. It can be used for children and adults.

(b) A specially prepared 'Diarrhoea Treatment Solution' is best, if available; it contains in one litre:

Sodium chloride	4.0 grams
Sodium acetate	6.5 grams
Potassium chloride	1.0 gram
Glucose	10.0 grams

(c) Half-strength Darrow's solution with 2.5 per cent glucose may be used for rehydration, but about twice as much will be needed as the two solutions above. This is less suitable for adults with severe diarrhoea because it does not contain enough sodium chloride.

(d) Normal saline is the poorest fluid. If the solutions above are not available, it is better than nothing. Particularly in infants, the glucose-salt solution by mouth or nasogastric tube should replace normal saline as early as possible during the rehydration period.

Five per cent dextrose solution must *not* be used as an intravenous fluid for treating diarrhoea.

(3) *Intraperitoneal rehydration.* This method is used in some clinics but is not recommended unless the health worker has been appropriately trained and has the facilities for its safe use. It is effective only in children, and only when they are not in shock. It is best given as a single, large dose of fluid (70 ml/kg) before sending the child, depending on his/her condition, home or to the hospital. Glucose-salt solutions by mouth or nasogastric tube can accomplish as much in such instances. The fluids used for intraperitoneal drips are the same as those used for intravenous rehydration, and sterility is very important. The method is described in Annex 1.

IS REHYDRATION COMPLETE?
(end of Step 2)

The patient must be examined at intervals during rehydration. After 4–6 hours of satisfactory treatment, all signs of dehydration should have disappeared except that the urine flow may not yet have started. It is most helpful to examine skin elasticity and pulse strength, both of which should be normal (see pages 11, 12). The patient should feel and appear much better and often may go to sleep. Children who are dazed or unconscious when rehydration is started may not become fully awake for 12–24 hours. Rehydration must continue until all signs of dehydration have disappeared. Patients with severe continuing diarrhoea will not be fully rehydrated after 6 hours of treatment. Sometimes too much rehydration fluid is given, especially in young children, and the eyelids become puffy. If this occurs, intravenous fluid should be stopped.

During rehydration after severe dehydration, see if the patient can drink the glucose-salt solutions in order to prepare for a change from the intravenous to the oral route during sustenance (Step 3).

SUSTENANCE
(Step 3)

Sustenance takes care of:

(a) the serious problems that cause or complicate the dehydration;

(b) the replacement of further fluid loss as fast as it occurs—thus maintaining rehydration;

(c) nutritional rehabilitation.

Overcoming the serious problems that cause or complicate the dehydration

When rehydration is well under way, it is important to look for any conditions that might be causing or complicating the diarrhoea. The following situations may call for urgent treatment and, if possible, should be referred to higher levels unless the primary health worker has been specially trained and equipped to deal with them:

(1) *Severe diarrhoea* (for example, more than one watery stool every two hours or diarrhoea which has produced severe dehydration) may be due to cholera. If cholera is suspected,* give tetracycline as soon as it can be given by mouth. Adults are given two capsules (500 milligrams) every six hours for three days; children are given one capsule every 12 hours for 3 days. Continue with the drug even after the diarrhoea has stopped.

(2) *Blood and mucus in the stool* (from dysentery**), with or without high fever, is treated with tetracycline for *five days.* Adults get two capsules every six hours and children get one capsule every six hours.

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* If on clinical and epidemiological grounds cholera is suspected, *inform* the health authorities and collect a stool specimen (see page 9 of *Guidelines for the laboratory diagnosis of cholera*, Geneva, World Health Organisation, 1974), if possible before commencing treatment with the antibiotic.

** In endemic areas, the possibility of amoebic dysentery should be remembered

(3) *Pneumonia, otitis media, tonsillitis, and skin infection* should be treated with an antibiotic, usually a long-acting penicillin intramuscularly.

(4) *Deep, sighing breathing.* Sometimes the patient's blood composition alters in dehydration and this makes the breathing faster as well as deep and sighing; this deep, sighing breathing gets better when the patient is rehydrated and the blood returns to normal. Pneumonia also makes the breathing fast, short, and difficult.

If you are in doubt as to why the patient is breathing faster than normal and if you can get no advice, then it is better to treat the patient as if he has pneumonia and to continue the rehydration. If the breathing remains fast or becomes faster in spite of the antibiotics and rehydration, then you need urgent help from a physician.

(5) *Malaria.* Where malaria is very common, every child with diarrhoea—certainly those with fever and an enlarged spleen—should receive chloroquine for three days as follows: for children under a year—a first dose of 50 mg followed by 25 mg after 6 hours, and then single doses of 25 mg each on the second and third days; for a child 1–4 years old—start with doses of 100 mg and 50 mg (after 6 hours), and then single doses of 75 mg each on the second and third days.

(6) *Convulsions or unconsciousness.* There are a number of reasons why children with diarrhoea become unconscious or have convulsions. The convulsions must be checked by giving paraldehyde, and aspirin is given if there is high fever. The child should be seen urgently by a physician because a lumbar puncture may be necessary to rule out meningitis.

(7) *High fever.* Whatever the cause, the patient's fever must be lowered by sponging and by giving aspirin. Aspirin should not be given to children under one year of age.

Replacement of further fluid loss as fast as it occurs

Diarrhoea usually lasts for one or two days, but may go on longer. If the fluids do not fully replace what is lost, dehydration will remain and the patient may become worse again (back to Step 1).

THIS TABLE IS A GUIDE TO FLUID SUSTENANCE

SITUATION	FLUID	HOW TO BE GIVEN	HOW MUCH TO GIVE
(a) If the patient can drink well and has one stool every two hours or longer	Glucose-salt solution or 'Home salt & water solution' (continue with breast feeding)	By mouth; at home	Provide 2–3 litres and give at the rate of 100–200 ml/kg body weight per day until the diarrhoea stops
(b) If severe diarrhoea continues (more than one stool every two hours)	Glucose-salt solution (continue with breast feeding, if the child does not require a nasogastric tube)	By mouth or nasogastric tube; in the clinic or hospital, if possible	15 ml/kg body weight per hour
(c) If the severe diarrhoea persists	(i) Ringer's lactate or 'Diarrhoea Treatment Solution'	Intravenously; in clinic or hospital	10 ml/kg body weight per hour and oral fluid
	(ii) ½-Darrow's solution with 2.5% glucose (commence breast feeding as soon as possible)	Intravenously; in clinic or hospital	20 ml/kg body weight per hour. Give less after oral fluid has been started successfully

Explanation of the table

Nearly all patients during sustenance can be given all the fluid they require by mouth or nasogastric tube. Patients with mild diarrhoea can be sent home but must return for nutrition education or if the diarrhoea gets worse again.

Patients with severe diarrhoea must remain at the clinic or hospital where they can be observed frequently while the oral or intravenous fluids are being given.

Assess and record the following every two to four hours:

(a) Signs of dehydration; these should disappear during rehydration (Step 2). Rehydration must be continued until the signs have disappeared.

(b) The volume or the number and size of stools. In children the mother's observations help; as long as diarrhoea continues, the fluid that is lost must be replaced, otherwise dehydration will remain or get worse. The diarrhoea of young children usually stops in 6 to 12 hours but may increase a little when milk or food is started.

(c) The volume of fluid that has been given; this helps to know whether the right amount of fluid has been given. If signs of dehydration do not disappear, it may be because the required amount of fluid has not been given to the child.

The weight of the patient should be recorded, when possible, *daily*. The weight should increase rapidly in the first day during Step 2 (while the "pot is filling"). When the patient is rehydrated (the "pot is full"), the weight of the patient is his true weight and shows whether there is any malnutrition and a need for nutritional rehabilitation.

These procedures are summarized in Annex 4.

Nutritional rehabilitation (Steps 3 and 4)

(1) *What to do during the diarrhoea*

Starvation is harmful, especially to children and especially during an illness such as diarrhoea. Breast feeding should be continued if the child is on breast milk. Food should not be given if the child refuses to eat or is not fully conscious. When he is able to eat, the child should be started on the energy and protein foods which can be obtained and used in his home, such as cereals, bananas, well cooked legumes, and root vegetables, e.g., potatoes.

If the child had been given cow's milk during or after weaning or as a substitute for breast milk, cow's milk can be started again during the stage of rehydration or sustenance. However, some children with diarrhoea will get more diarrhoea when fed cow's milk (especially dried skimmed milk) and this can sometimes become severe each time such milk is given. In these children, if the other energy and protein foods are available, cow's milk should be avoided. If cow's milk must be given to these children, it should be limited to about 150 ml, every four hours, diluted with water or glucose-salt solution. Adults may resume their normal diet in stages, starting with foods with low residue or roughage (e.g., cereals, roots and tubers like potatoes and carrots, legumes, and non-fibrous fruits).

In some countries eye damage in children, which is due to Vitamin A deficiency, is a threat during any acute illness. If this is a problem in your area, then a massive oral dose of 200 000 International Units of Vitamin A should be given which would afford protection for six months. Alternatively, if a Vitamin A preparation suitable for intramuscular injection is available, this can be administered in a dose of 100 000 International Units for immediate protection.

(2) *Why it is important to detect malnutrition*

It is important to make sure that malnourished children who have recovered from an acute attack of diarrhoea are followed up. As long as they are malnourished, they are at risk of more diarrhoea, infection, further malnutrition, and death. These 'at-risk' children will need close supervision and nutritional rehabilitation. A weight chart should be kept and the mother taught how to improve her child's nutrition using the protein and energy foods available to her.

(3) *How to detect malnutrition*

(a) By physical appearance. The child who looks like all 'skin and bones' has marasmus. If there is oedema (swelling), especially in the face, arms, and legs or back, this is called 'kwashiorkor'. These children often have dry, coarse hair (with a change in colour) and cracked skin (again with a change in colour). These changes represent extreme degrees of malnutrition and require special medical attention.

(b) By measurement. It may be that the previous weights of the child were recorded on a growth chart kept in the clinic or with the mother. Look at this chart and see if the child's weight was increasing along the normal path. Any weight drop before the attack of diarrhoea will mean that the child was becoming malnourished.

In cases where no previous weights are available, if the child's weight after rehydration (provided that there is no oedema) is below the bottom line of the growth chart in Annex 3, then this child may well be malnourished.

Advice on nutrition, as described above, must always be given even if the patient's body weight cannot be measured.

MEDICINES WHICH SHOULD NOT BE USED IN THE TREATMENT OF DIARRHOEA

A number of medicines, which are of no value and are even dangerous, are often given to treat diarrhoea. Money and time are wasted in their use. These medicines are:

(1) Neomycin and streptomycin (harmful to the intestine)

(2) Purgatives (diarrhoea and dehydration worsen)

(3) Tincture of opium, paregoric, or atropine (dangerous to children, and to patients with dysentery)

(4) Cardiotonics such as epinephrine or coramine (nikethamide); shock must be corrected by intravenous fluids and not by these drugs

(5) Steroids (expensive, dangerous)

(6) Oxygen (expensive, unnecessary)

(7) Charcoal and kaolin (of no value and they interfere with antibiotics)

(8) Pectin and bismuth (no value)

(9) Lomotil (no value)

PREVENTION
(Step 5)

Education of the mother

The treatment of a child with diarrhoea gives an opportunity to teach the mother how dehydration may be prevented and how her child's nutrition may be improved so that another attack becomes less likely and less dangerous. The best way to teach the mother is to *involve her* in the treatment of her child from the start.

Every mother has *five important lessons* to learn. These are:

(a) If the child gets diarrhoea, give him as much as he will drink. The ideal fluid is the glucose-salt solution which can be prepared from a packet by following the instructions on its use.

The mother can be helped to understand this lesson during the period of sustenance by involving her both at the clinic and at home (after the patient's discharge); she should therefore help in preparing and giving the fluids herself to the child during rehydration until the diarrhoea has stopped.

(b) The child's nutrition must be improved if it is poor, and kept up if it is good by telling the mother that diarrhoea should not stop her feeding her child. She must be encouraged to continue breast feeding and not to resort to any breast-milk substitutes.

(c) The mother should be encouraged to attend the health centre for immunization and nutrition education.

(d) Health education—the mother should also be educated in hygienic practices in child care, particularly in feeding.

(e) Finally, it is important to learn from the mother her beliefs about diarrhoea and feeding, and to distinguish between those that are helpful and those that are harmful.

Success in influencing a mother in these practical matters depends largely on her seeing the way the treatment of her child was carried out and on the attitudes and behaviour of the primary health worker.

Other preventive measures

(a) The primary health worker can prevent death by treating and preventing dehydration, as has been described.

(b) In children, malnutrition can be prevented by rapid treatment of dehydration with early feeding and by following up the underweight children.

(c) If cholera or severe dysentery is suspected, the auxiliary should notify the health authorities in the hope of preventing a major epidemic. If many adults get severe painless diarrhoea with clear watery stools and vomiting, this is likely to be due to a cholera outbreak.

(d) There are many other dangers in the patient's environment which make diarrhoea more likely to happen. They vary from place to place. Obvious problems like sanitation and water supply are difficult to solve. The primary health worker should learn in his own community what some of the dangers are and he should follow up more carefully those families that are more at risk from these dangers. Unfortunately, these families are often the very ones that do not attend the clinic regularly. Other categories of risks and times of danger we know about include: a child being taken off breast feeding; a child who is bottle-fed; a child being separated from its mother; malnutrition or prematurity; a dirty water supply; and a poor and overcrowded family.

ANNEX 1

HOW TO GIVE FLUIDS

It is important to note that routes (2), (3), and (4) described below must only be attempted after proper training of the worker.

(1) *How to give glucose-salt solution by mouth*

Put the fluid into a container from which the patient can drink comfortably. Infants may be given fluids with a cup and spoon or may drink directly from a cup, and older children and adults may drink from a cup or glass. Assess how much fluid the cup or glass holds so that you can easily tell how much the patient has drunk from the number of cupfuls or glassfuls given. Most cups contain from 180 to 240 ml. When large amounts of fluid must be given, e.g., to adults with cholera, it is helpful to put the fluid in a larger container (holding about one litre) at the bedside. The patient can then be instructed to drink the entire litre within one to three hours, depending on the degree of dehydration and the rate of diarrhoea.

It is helpful to have a family member at the bedside to assist in giving the fluids and to keep a record of how many cupfuls have been given. When a mother is allowed to give rehydrating fluids to her infant, she learns how she may use the same fluid at home. In general, for rehydration, patients may simply be given as much fluid as they are willing to drink. During severe diarrhoea, adults and older children may have to be urged to drink the required amount of fluid.

(2) *How to give glucose-salt solution by nasogastric tube*

A plastic or rubber nasogastric tube* is used, and can be used again after cleaning. The length of tube needed to reach the inside of the stomach is approximately the length needed to pass from the tip of the nose, over one ear and down to the lower edge of the sternum. An additional 20 centimetres (8 inches) or so is needed outside the nose so that the tube may be fixed to the face with adhesive plaster. In babies some gentle method of preventing them from pulling out the tube should be used.

* Tubes with internal diameters of 2 mm (French gauge 6) or 2.7 mm (FG 8) are suitable.

The moistened tube is passed through the nose, down the back of the throat, and into the oesophagus. Passage into the oesophagus is easiest while the patient is swallowing. Be certain that the tube is in the stomach and not in the lungs or coiled in the mouth. As the patient is conscious, he will certainly cough if the tube tries to enter the lungs. Examine the mouth with a torch and tongue depressor to be certain the tube is not coiled there, and place a stethoscope or your ear over the stomach and push 10–20 ml of air through the tube with a syringe. If the tube is in the stomach, the air can be easily heard entering the stomach. The required amount of fluid can be introduced by a 20 or 50 ml syringe at the start, and later on a plastic or rubber drip set may be attached to the tube. Fluids may be contained in any type of clean bottle or flask of known volume, which can be easily attached to the drip set. Old intravenous fluid bottles are suitable.

(3) *How to give intravenous fluids*

Fluids may be given into any vein. The needles and tubing used should be sterile. The most useful veins are where the arms fold in front of the elbow, on the back of the hands, on the front of the inside of the ankle, in the side of the neck, and on the side of the scalp (for infants). It is extremely important to learn, practise, and become skilled in starting infusions into these veins. Cutting down on a vein should not be necessary. In some cases of severe dehydration it may be necessary to start infusions in two veins at once so that the life-saving fluid goes in quickly. Once the danger is over, one infusion is then removed.

(4) *How to give intraperitoneal fluids*

Examine the child's abdomen carefully so as to avoid putting the needle into a large liver, spleen, or bladder. It is very important that everything used is sterile, including the fluid.

The bottle of sterile fluid is attached to a sterile set just as for giving an intravenous infusion. Warm the fluid to body temperature. Clean the skin with iodine or alcohol. Push an 18-gauge needle through the skin just below the umbilicus. Then open the clamp on the tubing of the set and push the needle straight (vertically) into the peritoneal cavity. You can tell when the needle is in the cavity because the fluid will flow in a steady stream rather than drop by drop. Fluid should be allowed to flow as fast as possible. The full amount (70 ml/kilogram body weight) can usually be given in 10–20 minutes. The needle can either be held by an assistant during this time or fixed carefully in position with adhesive plaster. When the infusion is completed, the needle is removed and a small gauze bandage placed over the hole.

ANNEX 2

HOW TO MAKE THE ORAL FLUID

One litre of the *glucose-salt solution* should contain the following chemicals: *

Sodium chloride	3.5 grams
Sodium bicarbonate	2.5 grams
Potassium chloride	1.5 grams
Glucose	20.0 grams

These ingredients, which need not be of chemically pure grade, can be measured and pre-packaged in aluminium foil or polythene bags and sealed to keep out moisture; they may be distributed through the usual health-service networks or commercially. The amounts of salts and glucose shown above are for dissolving in one litre of *drinking water,* which is a suitable size for home use. For clinics or hospitals, bags or bottles containing ten times this amount for dissolving in ten litres of water are more practical.

Alternatively, standard measures or teaspoons and suitable containers (plastic bags) could be supplied to dispensaries so that the solution could be made up without the need for weighing the powder.

A fresh solution should be made up every 12–24 hours and it must not be boiled.

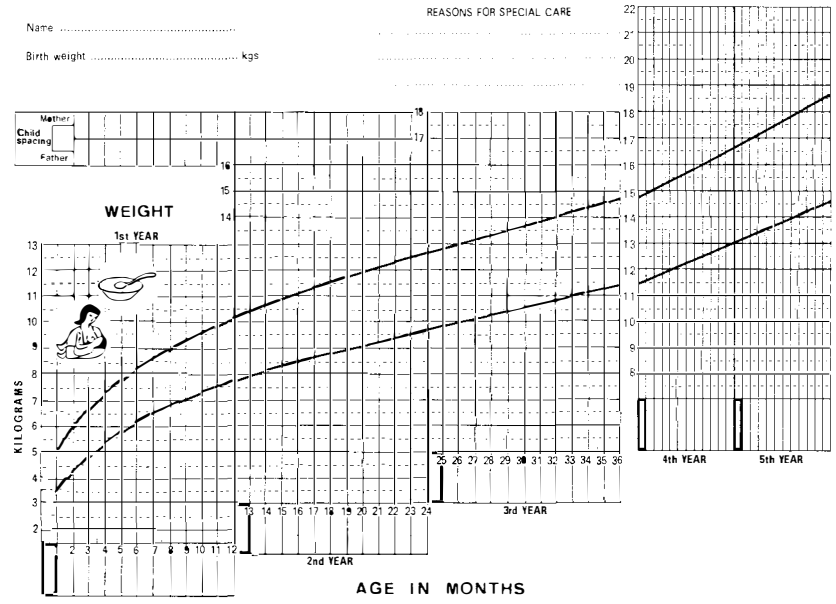
---

* While solutions of different composition have been used for oral rehydration in the past, the formula recommended here has been tested in the field and found to be satisfactory for all diarrhoeas and for patients of all ages.

ANNEX 3

THE GROWTH CHART *

The two reference lines on this chart provide a guide for the *direction* which the weight curve of a child should follow from the age of 1 month to 5 years. In most populations the child's weight will be recorded in the space between these two lines. A child whose weight falls below the lower curve may be considered to be malnourished.



* WHO model. Further details on the use of this chart may be obtained, on request, from the Maternal and Child Health Unit, World Health Organization, 1211 Geneva 27, Switzerland.

ANNEX 4

FLOW-CHARTS ON THE MANAGEMENT OF DEHYDRATION IN DIARRHOEA

The 3 charts in this annex summarize the procedures of management described in this guide. After primary health workers have studied the text and become familiar with the procedures described, they could prepare their own flow-charts according to their local conditions (i.e., depending on the treatment facilities, transport, and access to physicians that are available to them), using these charts *as an example.*

Although these charts refer to the treatment of children with dehydration, the principles of management described in them are applicable to patients of all ages.

Chart 1. Assessment of dehydration

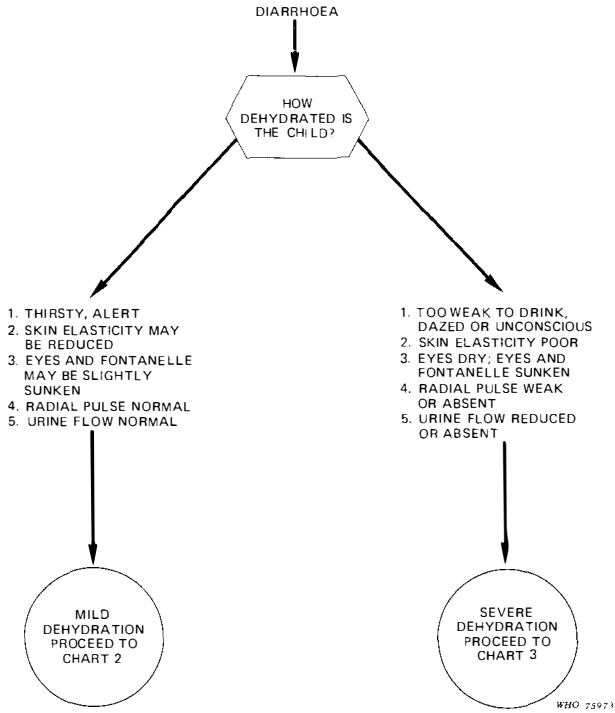
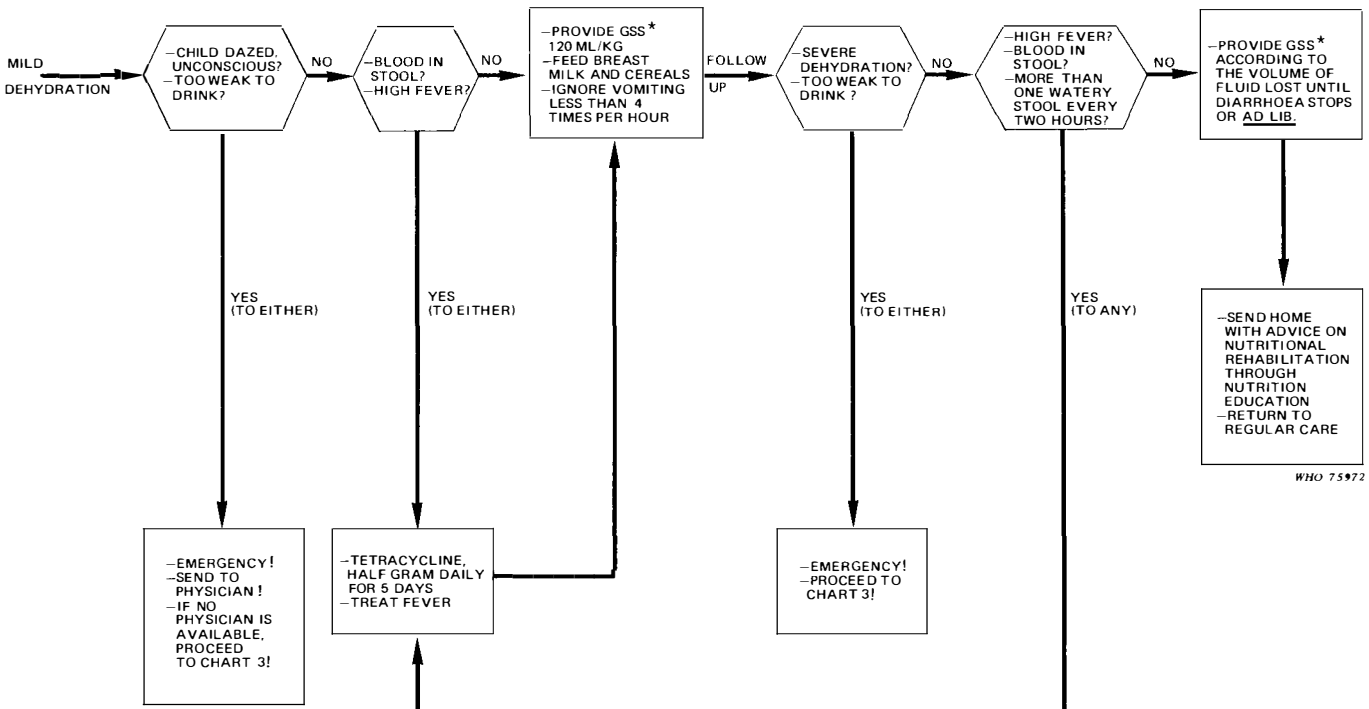
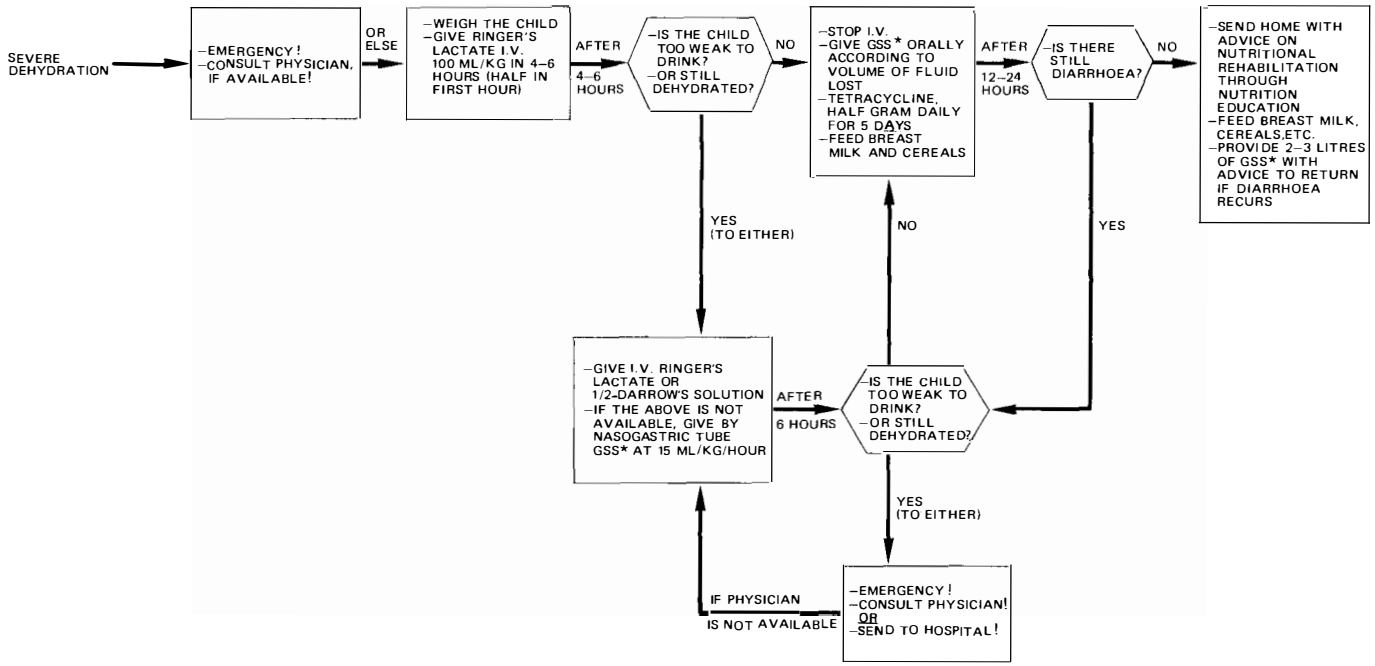


Chart 2. Mild dehydration



* GSS= glucose-salt solution

Chart 3. Severe dehydration



* GSS= glucose-salt solution

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DIARRHOEAL DISEASES CONTROL PROGRAMME

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1. EXTENT OF THE PROBLEM

In identifying the problems, constraints and factors impeding the development of integrated actions in health and health-related fields, it is evident that those attributable to the communicable diseases remain serious and are closely interlinked with existing socio-economic conditions, in particular those related to malnutrition, insanitary environments and unregulated fertility. The investigations carried out, for example, in the Americas on patterns of childhod mortality[1] clearly showed that the inter-relationship of these factors is responsible for the inordinately high levels of mortality in the developing countries, where 30% to 50% of children die before reaching the age of 5 years. Of the total deaths under 5 years, 58% were associated with infectious diseases, and of these, diarrhoea, often accompanied by malnutrition, was the leading cause; 80% of the diarrhoea deaths occurred in

[1] Puffer, R.R. and Serrano, C.V., Patterns of Mortality in Childhood, Washington DC, PAHO, Scientific Publications No.262 (1973)

children between six months and three years of age and were particularly in families with high fertility and closely spaced children. Data from other studies show that when overall infant mortality is greater than 60 to 80 per 1000 live births, more than 30% of the deaths are usually due to diarrhoeal diseases. As diarrhoea-related mortality declines, overall infant mortality decreases proportionately.[1]

The percentage of life experienced with diarrhoeal disease has recently been estimated in one country to be almost 10% in the last half of the first year of life and over 15% during the second year and first half of the third year; this means that in this critical period of life children experience diarrhoea one full month out of every six.[1] These repeated attacks of diarrhoea lead to deterioration of nutritional status of children because of associated food withdrawal, anorexia and malabsorption; the malnutrition per se in turn increases the susceptibility to and severity of diarrhoeal disease so that a vicious diarrhoeal-malnutrition cycle is established.

From an economic perspective it has also been estimated that more than one-third of beds in children's hospitals or wards are occupied by cases of diarrhoea receiving expensive antibiotics and intravenous fluids; these costs place a heavy load on the limited budget for health care in these countries.

In short, acute diarrhoeas not only are a leading cause of childhood mortality in the developing countries, especially during the weaning period, but they also retard the growth and impair the quality of life of those who survive. The problem is overwhelming and complex as it involves deep-rooted cultural and behavioural factors in addition to the more obvious social and economic inequalities. It is in the spirit and context of the Alma Ata Conference that such a large and complex problem should become an essential concern of the strong and continuing commitment which each nation is now making to primary health care at all levels of government and society.

CONTROL STRATEGIES

The magnitude and severity of the diarrhoeal diseases problem is certainly not a new observation but there has been in the past a lack of definite commitment to deal with it. What is new, are the several recent advances in knowledge obtained by intensive research activities which now give us better approaches and strategies for the treatment and prevention of acute diarrhoeal diseases. In addition, these advances now have greater potential for application as part of countries' commitments to strengthening their health delivery system and community involvement through primary health care.

The following strategies can form the basis of a programme for the control of acute diarrhoeal diseases:

2.1 Oral rehydration therapy and the diarrhoea-malnutrition cycle

The most important of the research advances has been the discovery that cases of acute diarrhoea of any etiology in all age-groups can be treated with oral rehydration therapy using a single fluid. This fluid is usually delivered as a pre-packaged mixture of sodium chloride, sodium bicarbonate, potassium chloride and glucose, which, when added to an appropriate volume of water, gives concentrations that are ideal for the intestinal absorption of glucose, electrolytes and water in amounts sufficient to replace acute diarrhoeal losses.[2] Although

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[1] Mata, L., Simhon, A., Mohs, E., Hernandez, F., Villegas, H. and Urrutia, J.J., Modern views on diarrhoeal disease and their relation to nutrition. Paper presented at Gastroenterology Seminar, PAHO/WHO Caribbean Epidemiology Centre, Port of Spain, Trinidad, 16-19 October 1978.

[2] Pierce, N.F. and Hirschhorn, N., Oral fluid - a single weapon against dehydration in diarrhoea, WHO Chronicle, 31: 87-93, 1977

adminstered orally, this solution is absorbed in the small intestine even in the presence of copious diarrhoea of any etiology.

Oral replacement therapy has several important advantages. It can be made widely available so that it can be given by health auxiliaries and by mothers early in the course of diarrhoea, thus avoiding the risk of death from severe dehydration. It can be used in health centres and hospitals by itself successfully to treat dehydration in all but the most severely dehydrated patients without any intravenous therapy; this leads to a dramatic reduction in the need for intravenous fluids which are costly, require aseptic precautions in their preparation and skilled personnel for their administration. In addition, UNICEF/WHO supported studies in the Philippines, Turkey, Iran, Egypt and Liberia have shown that when oral rehydration fluid is adminstered along with education on proper dietary practices that should be followed during and after diarrhoea, there is earlier improvement in appetite and thus better weight gain over time; this is an important step for interrupting the diarrhoea-malnutrition cycle. These proper feeding practices include the promotion of uninterrupted breast-feeding, feeding of usual foods during diarrhoea as tolerated, and feeding of increased amounts of food in convalescence.

Except in the case of severe cholera and shigella dysentery, antibiotics and other diarrhoeal medications should not play a primary role in diarrhoeal disease control programmes; in fact, their use can divert the attention of health workers from the more important tasks of rehydration and dietary management. Much of the cost of the provision of oral rehydration fluid can be met in most countries by savings in reduction of hospitalization costs and use of expensive drugs.

In short, oral rehydration therapy makes it possible to undertake immediately a common programme for reducing deaths from acute diarrhoeal diseases while other efforts are continued to attain the long-term objective of their prevention and control. It also serves as an effective entry point for the broadening of child care and other educational activities within the context of primary health care. In diarrhoeal disease control, the principle "Health Care by the People" can be applied; it is people, the mother in particular, who can help in immediate treatment of diarrhoea in her own home.

2.2 Proper maternal and child care practices

There are at least four maternal and child care practices which, if promoted, can do much to prevent diarrhoea - breast feeding, proper weaning practices, appropriate nutritional support and other care to pregnant and lactating mothers, and hygenic handling of the child and good personal hygiene in the family.

The composition of human milk is uniquely sufficient and ideal for the nourishment of infants and provides direct immunologic protection against enteric infection. In developing countries, breast feeding is particularly important in that it avoids the risks of metabolic derangements and over-dilution associated with artificial feeding and also the contamination of bottles, rubber teats and artifical formulas which often causes acute diarrhoeal diseases. To be maximally effective, breast feeding should begin as soon as possible after the moment of birth and, except in unusual circumstances such as illness in the mother, should continue unsupplemented as the child's sole source of fluids and nutrients for a period of between four and six months. The nutritional value of human milk and the advantages of breast-feeding should be taught in primary and secondary schools as part of health and nutrition education programmes.

Starting usually from the fourth to sixth month of life, infants need other foods in addition to breast milk to satisfy their nutritional requirements. For families living in an insanitary environment and with an inadequate concept of personal hygiene this begins the period when the risk of diarrhoea is greatest. To help prevent diarrhoeal diseases in this period, health and nutrition education programmes should also emphasize proper methods for preparing foods that are locally available, culturally acceptable, and affordable, and at the same time nutritionally adequate.

The child's capacity to suck and the volume of milk produced by the mother are affected by the psychological and physical health and the nutritional status of the mother. The large increase in nutritional requirements of women during pregnancy and lactation must be met to prevent delivery of low birth weight babies and to facilitate production of a sufficient quantity of breast milk. One of the tasks of health workers is to detect mothers at risk of nutritional deficiencies and give relevant advice.

These issues are discussed in further detail in Document JC22/UNICEF-WHO/79.4 on Training in Maternal and Child Health.

2.3 Improvement of water supply, sanitation and food hygiene

In the long term, the provision of and correct use of safe water supplies, proper excreta disposal facilities and other environmental sanitation measures will be required for the control of diarrhoeal diseases. Much remains to be done in this direction. All-out efforts must continue, which include involving the community and the developing of technologies that are acceptable and feasible. The approach to the provision of water supply and sanitation should be simple and acceptable to the community at a cost it can afford. The necessary materials and equipment should, where possible, be manufactured in the country to help ensure proper and rapid maintenance. Intensive efforts in health education must be carried out to enhance the impact of these technologies.

Recent studies have demonstrated that provision of safe drinking water supplies alone is not sufficient to control the acute diarrhoeal diseases. This is due to a variety of factors including the use of contaminated water for non-drinking purposes (e.g., bathing and cooking), which contribute to transmission of diarrhoeal diseases. Also, diseases such as shigellosis and rotavirus infection may be transmitted through non-waterborne routes. Thus, control efforts comprising the supply of safe water must be complemented not only by efforts to provide proper means of waste disposal but also those which educate the public on proper personal and food hygiene practices.

Given the limited resources available in the developing countries, the best strategy for approaching the problem of diarrhoeal diseases associated with insanitary conditions from a cost-effective perspective is through primary health care on the lines of the UNICEF/WHO Joint Study on Water Supply and Sanitation Components of Primary Health Care, which will be reviewed at the 22nd Session of the UNICEF/WHO JCHP. Document JC22/UNICEF-WHO/79.3.

2.4 Health education

In the control and prevention of diarrhoeal diseases health education is an integral part of all strategies. Health education must be cognizant of practices and habits of people within their environments in order to effectively bring about the adoption of healthful practices that are continuing and involve active participation of the community. While health education activities for diarrhoeal disease control must be directed towards the entire population, the most important groups are mothers and other family members giving care to infants and young children. Other groups of considerable importance to which activities should be directed are:

- top decision makers, to ensure priority in the allocation of resources;
- health workers, to assure technical guidance;
- school teachers, in order to ensure their proper education of students on health practices;
- community members, to obtain their active participation in the use of oral dehydration and in improving child care practices, water supplies, waste disposal facilities and personal and food hygiene.

2.5 Epidemiologic surveillance and epidemic control

The continuous appraisal of the occurrence of diarrhoeal diseases in a community, based on information supplied by persons involved in the delivery of health care, can provide

information on the prevalence or incidence of diarrhoea, including cholera, and can define population groups who are at greatest risk. Although laboratories are not essential for conducting surveillance, they can provide useful information on the most prevalent pathogens and thus facilitate specific control measures.

A simple properly functioning surveillance system should also provide an early warning system for the detection of epidemics, especially of cholera, by reporting changes in the pattern of age, seasonal incidence and severity of cases. When these are observed, prompt laboratory and epidemiological investigations can be made to determine the etiology and means of spread. While these investigations are being conducted, treatment and sanitation facilities can be reinforced with the necessary staff and supplies, and other appropriate control measures instituted.

3. PROGRAMME OBJECTIVES

Against the background of the magnitude and nature of the problem (section 1) and of the strategies for control (section 2), the Sixth General Programme of Work for WHO for the period 1978-1983 has given high priority to programmes for the control of diarrhoeal diseases. The Global and Regional Advisory Committees on Medical Research have also urged that research on diarrhoeal diseases be intensified.

National health administrators have, in various regional committees, expressed the need for a global WHO Programme on Diarrhoeal Diseases Control, and when the subject was deliberated at the Thirty-first World Health Assembly, adopted a resolution (WHA31.44), urging governments, WHO and UNICEF to intensify efforts to promote national programmes for control of these diseases, to intensify training of health workers, and to develop a global collaborative research programme for their prevention and control.

The long-term objective of this programme is to prevent and control acute diarrhoeal diseases by improvement of water supply and sanitation, education and other appropriate control measures, so that they cease to constitute a major public health problem.

The immediate and medium-term objectives of the programme are: (i) to substantially reduce mortality from acute diarrhoeal diseases as well as their associated ill effects, particularly malnutrition, in children, by treatment of diarrhoea by oral rehydration therapy, which includes the adoption of proper feeding practices during and after diarrhoea; and (ii) to substantially reduce the morbidity from acute diarrhoeal diseases, especially in children, by promotion of proper related child care practices, improvement of water supply and sanitation, health education, epidemiologic surveillance, and development of other measures to interrupt transmission and prevent infection. In 1979, the first year of operation, the programme aims at a coverage of about 50 million people and it is estimated that it will extend to a further 20 million in each subsequent year.

Country programmes in diarrhoeal disease control should be conceived and carried out within the context of ongoing national health programmes and primary health care. The problem of diarrhoeal diseases and specific measures for their control should be identified and national plans of operation formulated and integrated with programmes in maternal and child health, nutrition, health education and environmental health.

4. PROGRAMME DEVELOPMENT

4.1 Global and regional programme development

A WHO Advisory Group on Programme Development for Diarrhoeal Disease Control was convened in May 1978 to review new knowledge and current WHO activities and to recommend strategies for country, regional and global programmes. The group established the priority strategies for programme development described in section 2, recommended approaches for development, formulation, and evaluation of country programmes, and suggested areas for epidemiological, operational and basic research directed toward further improvement of measures for prevention and control. Plans are being made to establish on a continuing basis a Global Technical Advisory Committee to review the progress of the programme and advise on its further development.

In WHO Headquarters and in each of the six Regional Offices, interdisciplinary groups or task forces on diarrhoeal diseases control have been established. They comprise staff members from programmes in communicable diseases, family health (maternal and child health, nutrition, health education), environmental health and appropriate technology. These groups are primarily engaged, as their immediate task, in promoting oral rehydration therapy, in view of its practicability and immediate benefit. Similarly they are coordinating other activities and programmes on breast-feeding and other aspects of child care, health education, nutrition and environmental health with those of the Diarrhoeal Diseases Control Programme.

4.2 Country programme development

About 35 countries are presently using oral rehydration for treatment of diarrhoea cases, in collaboration with UNICEF and WHO. In all these and other interested countries WHO and UNICEF will, subject to availability of funds, collaborate in country programme formulation, implementation and evaluation, in line with the recommendations of the Advisory Group on Development of a Programme for Diarrhoeal ~~Diseases Control~~ and the regional committees' deliberations. Plans of action will vary according to the type of activities required at the country, regional and global levels.

Programme evaluation will be an essential component of country programmes. This will include operational evaluation to assess and measure the progress of programme inputs against pre-established targets. Operational indicators that could be used include the number of packages of oral rehydration salts manufactured, distributed and consumed, the size of population or number of districts receiving oral rehydration fluid, the number of personnel trained in use of oral rehydration therapy and the number of sanitation facilities provided or improved.

Impact evaluation to assess the benefits of programmes will also be encouraged. Impact indicators may include the number of diarrhoea deaths, the number of diarrhoea cases requiring hospital treatment and nutritional status surveys.

For promoting country programme development, regional planning meetings will be held by the WHO Regional Offices by June 1979 to discuss details of all appropriate strategies and mechanisms for development of country programmes. The first such meeting was held in the South-East Asian Region in December 1978 jointly with UNICEF.

Seminars and training courses for health workers of different levels will be organized to meet the needs of the national programmes as they develop and progress. Training manuals, guidelines and various teaching aids are being developed. Visits and fellowships will also be arranged for advanced training and for promoting technical cooperation among the developing countries (TCDC).

4.3 Research activities

An overall research programme has been formulated. This programme has been stimulated by the discovery of the applicability of oral rehydration fluid (see 2.1) and by the recent recognition of newly identified viruses and bacteria as causes of diarrhoea, so that it is now possible, under good laboratory conditions, to identify the cause of up to 80% of acute diarrhoeas. It is anticipated that such new knowledge will lead to a greater understanding of the pathogenesis and epidemiology of the diarrhoea agents which in turn will result in the development of new approaches to their treatment and prevention.

Scientific working groups (SWG) have been established in the areas of clinical management (especially oral rehydration), child care, water supply and sanitation, etiology and epidemiology, and immunity and vaccine development, to help develop the details of a goal-oriented research programme on a global basis. These SWGs, composed of experts from outside the Organization, will review current knowledge, establish research priorities, and propose and review research proposals.

The Regional Advisory Committees on Medical Research in Africa, Sout-East Asia, the Western Pacific and the Eastern Meditterranean have given priority to diarrhoeal diseases, and programmes of research on topics of regional and local importance are being formulated. Regional Offices are identifying regional research priorities and national institutions and scientists to undertake research and receive support to strengthen their research capability.

Some priority areas for research include:

- operational studies to determine the most appropriate methodology for implementation of oral rehydration therapy programmes;

- nutritional studies to determine the most suitable diet during and after diarrhoea;

- clinical studies to find effective anti-diarrhoeal agents, particularly anti-secretory agents, to be used as an adjunct to rehydration;

- epidemiological studies to determine the etiology of diarrhoea in different age groups in different areas;

  laboratory studies to better define the nature of gut-associated immunity and optimal ways of enhancing the intestinal immune response to the major enteric pathogens, leading, for example, to the development and field testing of improved vaccines for cholera and new vaccines for rotavirus and enterotoxigenic Escherichia coli.

PROPOSALS FOR FURTHER UNICEF/WHO ACTION

5. Oral rehydration therapy

UNICEF and WHO have discussed and agreed on an effective mechanism of collaboration at the country level on how best to meet needs for the supply and distribution of oral rehydration salts. A joint meeting in January 1979 will convene persons experienced in local production of oral rehydration salts to review the state of the art and prepare guidelines for UNICEF, WHO and governments. This meeting is of particular importance as the most important constraint that has been identified to date in implementation of national oral rehydration programmes has been the difficulty in ensuring an adequate supply of pre-packaged oral rehydration salts. This has led in a few instances to the use of oral rehydration fluid without all the recommended ingredients and which is not of proven value. It is anticipated that country programmes will need to lean heavily on UNICEF for: cooperation in setting up facilities for local production of packages of oral rehydration salts on a regional or a national basis; provision of packages from its warehouse until local production is sufficient to support national programmes; and promotion and assistance in widespread distribution of these packages with the objective of putting them within the reach of every family. The importance of having a sufficient quantity of packets to support country programme development cannot be overemphasized.

5.2 Country programmes development

In their roles of promoters of and partners in technical cooperation concerning this Programme, UNICEF and WHO can provide other critical inputs to country programme development depending on circumstances and local needs. Examples of such inputs, which are in the context of present efforts to strengthen national health delivery systems, are:

- technical cooperation in assessment of the nature and extent of the diarrhoeal disease problem and in the formulation, implementation and evaluation of national programmes;

- production, standardization and distribution of essential laboratory reagents;

- support to countries which have identified water supply and sanitation as priority areas for underserved rural and fringe urban areas;

- provision of technical services by staff members or consultants;

- support of operational research activities.

5.3 Training, education and dissemination of information

For the success of this Programme, UNICEF and WHO should also give high priority to technical cooperation in the training of national health workers. The following specific training needs are recognized:

- intercountry/interregional planning seminars for policy-making senior public health administrators and paediatricians;

- national/intercountry training courses for professional and auxiliary health personnel and community workers on the technical aspects of oral rehydration therapy including dietetic management, as well as of other control measures like surveillance, and improvement of water supplies, sanitation and personal and food hygiene;

- development of education and training material, communicational technology and manuals on control strategies for education of the public and training of health personnel;

- organization of training courses to teach laboratory workers well established and newly devised laboratory techniques (e.g., ELISA assays) in enteric bacteriology and virology;

- supporting countries in the training of personnel in the operation, maintenance and surveillance of sanitation facilities.

UNICEF and WHO should continue to collect all available information and experience and widely disseminate material on:

- the effectiveness of different strategies for delivery of oral fluid and better dietary management in diarrhoeal diseases;

- the unique advantages of breast feeding and means of promoting it;

- new developments in methods for treatment, prevention and control of diarrhoeal diseases.

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 *

An oral glucose–electrolyte solution administered at home to Philippine children with diarrhoea was associated with a greater average weight gain both during an attack of diarrhoea and over a 7-month period compared with a control group. The longer-term effect on weight, relative to a standard, was more pronounced in children who had more than one attack of diarrhoea in the period of observation than in those who had only one attack. The size of the longer-term weight gain was 3–5 percentage points towards the standard weight. It is suggested that the vigorous compensation of salt and fluid losses improved children's appetites following diarrhoea attacks.

Diarrhoea is a major cause of undernutrition in children, especially when attacks are repeated (*1*), and is associated with catabolism, malabsorption, anorexia, and imposed fasting (*2*). It has been suggested that a rapid and complete repair of water and electrolyte losses during acute diarrhoea will provide some protection from undernutrition, at least by improving the appetite. Such an effect seems to occur in hospitalized children (*2*). Our study, carried out in the Philippines, examined this hypothesis in children treated in an outpatient clinic and at home with an oral glucose–electrolyte solution.

SUBJECTS AND METHODS

Many variables affect body weight in children. To demonstrate with certainty the effect of a single intervention requires the random assignment of subjects to study and control groups, preferably preclassified in respect of important variables. If a placebo can be suitably prepared, a " double-blind " study should be conducted. This classic design neutralizes biased assignment and observation, balances known and unknown prognostic variables, and guarantees the validity of statistical tests of significance (*3*). Unfortunately, our study could not be so designed for several reasons: a placebo for glucose–electrolyte mixtures or solutions cannot be prepared; in our setting, it was not possible to make a random assignment of children to two groups since many people knew each other well and shared information and even medicines; and the random assignment of a number of whole, separate communities would have required resources beyond our means. The study was therefore carried out in two separate communities designated " study " and " control ". Pre-existing variables likely to affect body weight were examined for comparability and the study was designed so as to reduce bias.

Communities *B* (study) and *M* (control) lie on the shore of Guimaras Strait at opposite ends of Bacolod City, the capital of the Philippine province of Negros Occidental. Both are crowded with thatched houses, many on stilts over the water, and sanitation is poor. The heads of these households are fishermen, labourers, or unemployed squatters. El Tor

* The international study group comprised: J. C. Azurin, J. J. Dizon, E. Sullesta, J. S. Sumpaico, and C. V. Uylangco of the Philippine Cholera Committee; A. M. Angara, R. Azucena, and L. Zamora of the Philippine Department of Health; D. C. Arisola, C. De La Rama, I. Henares, L. S. Maestral, and R. Suplido of the Regional Health Office and City of Bacolod Health Department, Philippines; H. H. L. Burgess, H. Dhillon, M. Kacic-Dimitri, T. Okuno, and A. C. Reyes of the WHO Regional Office for the Western Pacific, Manila, Philippines; N. Hirschhorn, P. J. Rousselle, and T. N. Warner of Management Sciences for Health, Cambridge, MA, USA; and an interdivisional group on diarrhoeal diseases, World Health Organization, Geneva, Switzerland.

Requests for reprints should be addressed to: N. Hirschhorn, Management Sciences for Health, One Broadway, Cambridge, MA 02142, USA.

cholera and infant diarrhoeas are endemic and are more prevalent in the rainy season. A health clinic is situated in each community and is readily accessible. Both communities have participated in previous epidemiological studies of cholera.

Between 1 July 1975 and 31 January 1976, all children up to the age of 5 years reporting to the clinics with diarrhoea were included in the study. In both communities, a physician or attending nurse examined the children and followed the common routine of prescribing a nonspecific antidiarrhoeal, together with a specific antimicrobial for parenteral infections or dysentery. Stool cultures were not done routinely; prior experience in this area has shown that diarrhoea in most children is not associated with cholera or with *Shigella* or *Salmonella* infection. Epidemiological assistants weighed the children, told the mothers the reason for and benefits of continued feeding during diarrhoea, stressed the necessity of giving fluids by mouth, and discussed the sanitary preparation of food and fluids. Foods used included breast milk, bread, fish, bananas, and rice; the fluids used were tea, soft drinks, water, diluted cow's milk, rice water, and fish broth to which some salt had been added. All children were examined daily at home while ill and the educational messages were repeated and assistance offered. Clinical data were systematically recorded and guidelines for referral back to the physician followed. Body weight was recorded the day after diarrhoea ceased. There was almost complete follow-up.

Only in community *B* was a glucose–electrolyte mixture used. This mixture, which we called Oresol, was produced for the study by the Philippines Department of Health in foil packets, each containing sufficient to make 0.5 litre of solution. The composition of the fluid, in mmol/litre, was:

Na^+	90
K^+	20
HCO_3^-	30
Cl^-	80
glucose	111

which is that recommended by the World Health Organization (*4*).[a] The instructions for the use of Oresol stated that it should be given *ad libitum* in addition to (or mixed with) other fluids and food, with a target of about 1–2 litres of Oresol per day while diarrhoea continued. The epidemiological assistants were rotated between the two communities monthly; it was made clear to them that this was a study of nutrition and that children with diarrhoea needed fluid *and* food.

Pre- and post-study weights were measured in June and February by the mass weighing (using a portable beam balance) of nearly all children under 5 years of age. Results were expressed as a percentage of the Philippine median developed by the National Nutrition Survey, "Operation Timbang";[b] this value is referred to as "relative weight". The personnel who weighed the children after the study were unaware of the initial weight and in general did not know whether a child had attended the clinic. All weights were read twice. Of those who had been weighed before the study and who subsequently used the clinic, 83% were also weighed after the study.

Interviews were conducted before and after the study on a one-third random sample of all families. The enquiries were especially concerned with the care and feeding of children with diarrhoea.

Data analysis

Standard tests for significance of difference of means were applied. For the comparison of the change in pre- and post-study weights, analysis of covariance was used since the second weight is highly dependent on the first. This is due both to a statistical "regression upon the mean" and to the large relative weight loss incurred by disadvantaged Philippine children in their first year of life and the slight relative weight gain in older children.[c] The net effect is for those above the median to tend to lose relative weight and for those below the median to tend to gain relative weight in time.

For the purposes of classifying age groups (under 1 year and 1–5 years of age), age on 15 September was used.

Comparability of study and control communities

Table 1 compares the two communities as regards some social, sanitary, and health characteristics. The level of education was high. Community *B* had a higher prevalence of breast feeding than commu-

[a] The composition in g/litre is: sodium chloride, 3.5; sodium bicarbonate, 2.5; potassium chloride, 1.5; and glucose, 20.

[b] "Timbang" means weight; this was a national project to weigh all preschool-age children in each community in order to increase the communities' awareness of the nutrition problem and to identify children needing immediate assistance.

[c] CAEDO, M. M. ET AL. *Progress report, Integrated Nutrition Family Planning Program.* Manila, US Agency for International Development/Philippine Commission on Population, 1972.

Table 1. Comparison of the two communities

Item [a]	Community *B* (study)	Community *M* (control)
1. No. of households/No. of families	1398/1730	712/801
2. Population	9479	4490
3. Persons/house	6.8	6.3
4. Families poor or destitute	71 %	77 %
5. Families with outside well	98 %	99 %
6. Families with toilets	36 %	30 %
7. Mothers with 6th grade education or higher	81 %	77 %
8. Infants breast fed at time of survey	50 %	34 %
	$P < 0.01$	
9. Families enrolling children in official nutrition programmes	34 %	75 %
	$P < 0.001$	
10. Mean pre-season weight (% of median) of children < 5 years old	77 %	80 %
	$P = 0.06$	
11. Children who weigh less than 75 % of median	35 %	31 %
12. Source of first care for diarrhoea (% responding):		
Family/friends	55 %	46 %
Allopathic	32 %	39 %
Traditional	10 %	12 %
None	4 %	2 %

[a] Items 4–9 and 12 are based on a random sample survey of one third of all families.

nity *M* at the time of the pre-study survey, yet participation in other official nutrition programmes was significantly greater in *M* and the pre-study weight in *M* was marginally higher than in *B*. Undernutrition was common in both communities: a third of the children weighed less than 75% of the Philippine median. About half of those who were breast-fed were weaned before the age of 6 months. The manner of seeking care for diarrhoea was the same in the two communities: half of the population first consulted friends or members of the family and shared proprietary medicines.

RESULTS

Diarrhoea among children attending clinic

During 7 months of observation, 519 children had 710 separate bouts of diarrhoea (Table 2). The approximate ratio of 2 : 1 between communities *B* and *M* reflects the proportions of the population at risk. The average attack was clinically similar in both communities. In general, illnesses were acute and mild to moderate in severity, with dehydration

Table 2. Diarrhoea attacks in the two communities, July 1975–January 1976

Item	Community *B* (study)	Community *M* (control)
1. Attacks	464	246
2. Children	341	178
3. Children with 2 or more attacks	85	52
4. Deaths	0	1
	Pooled data: differences of means not significant	
5. Boy: girl ratio	1 : 1	
6. Children aged < 1 year	24 %	
7. Mean duration of attack	4.4 days	
8. Mean duration from initial visit	2.2 days	
9. Children with watery/frequent/dysenteric stools	76 %/62 %/13 %	
10. Children with other (nonenteric) illness	19 %	
11. Children referred back to physician	10 %	
12. Children with visible dehydration	22 %	
13. Children hospitalized	1.8 %	
14. Children with consistently good appetite	56 %	
15. Days during attack when food taken	3.0	
	Differences of means significant, $P < 0.05$	
16. Duration of vomiting	0.4 days	0.2 days
17. Duration of antidiarrhoeal medicines	2.3 days	2.6 days
18. Volume of oral fluids [a]	3.5 litres	2.5 litres
19. Weight change during attack	+ 129 g	+ 74 g
(a) with other (nonenteric) illness	+ 60 g (NS) [b]	+ 50 g
(b) with enteritis only	+ 140 g	+ 80 g
(c) children < 1 year of age	+ 61 g (NS)	+ 62 g
(d) children ⩾ 1 year of age	+ 149 g	+ 77 g

[a] Includes Oresol in community *B*; breast milk not included.
[b] NS = not significant.

(usually mild) in 22% of cases. Diagnoses of additional, nonenteric illness (chiefly infectious) were made during one-fifth of the diarrhoea attacks. Hospital treatment was required for 13 of the attacks (7 from *B*, 6 from *M*), nearly all for dehydration or persistent diarrhoea. Of the 7 hospitalized patients from community *B*, 6 had taken less than 500 ml per day of Oresol; 1 may have had glucose intolerance (large intake, voluminous diarrhoea, and continued volume depletion). The duration of vomiting was slightly greater in community *B*. The appetites of the patients and the number of days on which food was taken were the same in the two communities.

The average weight gain in community *B* (129 g) was nearly twice that in *M* (74 g). However, when children under 1 year of age and those with other, nonenteric illnesses (two independent populations) were compared, no differences were found between *B* and *M* even though the Oresol intakes on a weight basis were, in these two subgroups, higher than the mean (Table 3).

Table 3. Average consumption of Oresol (ml/kg body weight) in community *B*

Amount consumed:	
per attack	151 (range 0–1630)
per No. of attack [a]	
1st	129
2nd	193
3rd	195
4th	342
5th–6th	401
by age (years) [b]	
< 1	204
1	230
2	198
3	146
4	117
5	80
with other (nonenteric) illness	172
with enteritis only	146

[a] Consumption during the first attack differed significantly from the average consumption during attacks 2–6 ($P < 0.001$).

[b] Average consumption at ages < 1–2 years differed significantly from the average consumption at ages 3–5 years ($P < 0.02$).

Characteristics of Oresol consumption

Table 3 shows the intake of Oresol during an average diarrhoea attack. An intake of 151 ml per kg of body weight averaged 1.3 litres per attack. The range of intake was wide, 0–11 litres. Intake increased with successive attacks, both on a weight basis and in absolute terms, so that during the third to the sixth attacks the intake was 2–3 litres per attack. Intake on a weight basis varied inversely with age. Oresol did not replace other fluids; on the contrary, the correlation between Oresol intake and the consumption of other fluids in community *B* was positive ($r = 0.43$; $P<0.01$).

Weight change from the beginning to the end of the study

Table 4 presents the prestudy and final relative weights and the difference in children from both the study and the control communities. The data are presented by age (children under 1 year and those 1–5 years of age) and by number of diarrhoeal attacks (children with one attack and those with two or more).

The children under 1 year of age showed considerable relative weight loss, a pattern reported previously for disadvantaged Philippine children.[a] Analysis of covariance indicated that Oresol (study community *B*) accounted for a gain of 3 percentage points towards the median; this was statistically significant, however, only in those 1 year of age and over.[b]

The effect on final relative weight of attending clinic *B* for two or more attacks was over twice as great as for a single episode, amounting to a gain of 5 percentage points towards the median.

In those children with paired weights, there was no correlation between relative weight change during the season and weight change during individual attacks of diarrhoea.

[a] CAEDO, M. M. ET AL. *Progress report, Integrated Nutrition Family Planning Program.* Manila, US Agency for International Development/Philippine Commission on Population, 1972.

[b] One would have preferred to include as an additional covariate the pre- and post-study relative weights of children *not* using the clinic to allow for additional, unknown variables that might differentially affect weight in the two communities. To include such data as a single covariate, however, requires the clinic non-users to be identical in other respects to the clinic users within each community. Unfortunately, this was not the case: only 44% of the non-users had paired weights, the children initially being bigger, older, and better cared-for as a group than the users. Diarrhoeal disease was usually treated at home and was likely to have been milder, and some children in community *B* were likely to have received Oresol from neighbours.

Table 4. Pre- and post-study body weights as a percentage of the Philippine median

	Community *B* (study)	Community *M* (control)
1. By age		
< 1 year	(N = 38)	(N = 25)
pre-study (P) [a]	87.7	93.9
final (F) [a]	81.0	80.7
difference [a]	—6.7	—13.2
AC: [b] $\hat{F}$ = 41.5 + 0.4P + 2.9 COMVAR [c] (NS) [d]	r = 0.69	
1–5 years	(N = 173)	(N = 100)
pre-study (P)	75.1	76.3
final (F)	80.1	77.7
difference	+5.0	+ 1.4
AC: $\hat{F}$ = 32.5 + 0.6P + 3.1 COMVAR (P< 0.001)	r = 0.68	
2. By attack, children with:		
one attack	(N = 162)	(N = 92)
pre-study (P)	77.2	79.9
final (F)	80.3	79.1
difference	+ 3.1	—0.8
AC: $\hat{F}$ = 44.4 + 0.4 P + 2.3 COMVAR (P< 0.025)	r = 0.65	
two or more attacks	(N = 49)	(N = 33)
pre-study (P)	78.1	79.6
final (F)	80.4	76.0
difference	+ 2.3	—3.6
AC: $\hat{F}$ = 33.1 + 0.5 P + 5.2 COMVAR (P< 0.01)	r = 0.62	
For community B: $\hat{F}$ = 45.2 + 0.5 P —0.3 EPVAR [e] (NS)	r = 0.62	
For community M: $\hat{F}$ = 43.2 + 0.5 P —3.0 EPVAR (P< 0.05)	r = 0.70	

[a] Pre-study weight (P) = weight in June–July 1975; final weight (F) = weight in February 1976; difference = F—P.

[b] AC = analysis of covariance.

[c] COMVAR = Community Dummy Variable = 1 if study, 0 if control.

[d] NS = not significant.

[e] EPVAR = Episode (attack) Dummy Variable = 1 if two or more attacks, 0 if one attack.

Effect of diarrhoea on weight 1–2 months later

If diarrhoea affects growth, the effect should be seen soon after an attack. We were able to analyse 80 attacks that occurred in the 2 months prior to the post-study mass weighing. Table 5 shows that 1–2 months after a bout of diarrhoea, children in the control community *M* had lost relative weight whereas those in the study community *B* had gained relative weight; the difference, 4 percentage points towards the median, is marginally significant.

Table 5. Effect of an attack of diarrhoea on body weight (percentage of the Philippine median) in the following 1–2 months

	Community *B* (study)	Community M (control)
	(N = 45)	(N = 35)
Weight at start of attack (December 1975 or January 1976), WT_1	79.8	77.9
Weight 1-2 months later (February 1976), WT_2	82.7	76.8
Difference	+ 2.9	—1.1
	P< 0.05	
Analysis of covariance:		
$\hat{WT}_2$ = 1.48 + 0.97 WT_1 + 3.9 COMVAR [a] (P< 0.06)		

[a] COMVAR = Community Dummy Variable = 1 if study, 0 if control.

Feeding practices during diarrhoea

Feeding practices were assessed by interview. In both communities taken together, the proportion of those who replied "never" to the question: "Do you stop feeding during diarrhoea?" increased significantly from one fifth to about half of the respondents. However, a significantly larger proportion of respondents in community *M* (54%) gave this reply at the post-study survey than in the study community (40%, P<0.05). A slightly lower percentage of mothers of children who did not use the clinic gave this reply than mothers of clinic users (P<0.05). In a sample of 140 families in the control community *M*, only 2% knew of Oresol and children from 42% of these families, with a history of diarrhoea, attended the health centre. In a sample of 292 families in study community *B*, 50% knew of Oresol but children from only 37% of these families, with a history of diarrhoea, attended the health centre.

DISCUSSION

This study was designed to test the hypothesis that an oral glucose–electrolyte solution (Oresol), used

freely for outpatient children with diarrhoea, would improve nutrition. Both the study and the control communities were given nutrition education and stress was placed on feeding and the provision of fluids during attacks of diarrhoea. This strategy could be expected to obscure any additional effect Oresol might have; nevertheless, the data support the following conclusions:

1. Oresol was associated with a relative weight gain over a 7-month period in relation to the Philippine median. The increase over the control group due to Oresol averaged 3%, which was statistically significant in the 1–5-year-old group but not in those under 1 year of age. An increase in relative weight of 5% was seen in the study children with two or more bouts of diarrhoea. The effect on relative weight was apparent 1–2 months after an attack of diarrhoea; again, children in the control community lost relative weight while those in the study community gained.

These findings are consistent with Martorell's observation in Guatemala that children who were ill more than 5% of the time with diarrhoea lost weight; incremental growth was unaffected by less frequent disease, by respiratory illness, or by fever (*1*). Binns (*5*) also showed, in Papua New Guinea, that diarrhoeal episodes resulted in either a loss of weight or lack of growth in 44% and 39% of children, respectively, in the month of illness. Martorell compared the weights of children who had diarrhoea frequently with those who did not. When the differences between each 6-month age-cohort (up to the age of 84 months) were summed they amounted to 11%, which is about the same cumulative value that we calculated for our 1-year age-cohort groups from ages 1 to 5. Other studies (*6*, *7*) have shown that nutritional rehabilitation centres dealing with seriously malnourished children produce an average gain of about 4–6% towards the median over 3–6 months. However, these values were uncorrected for regression effects and may therefore be inflated.

2. Children given Oresol gained nearly twice as much weight during an attack of diarrhoea as those not given Oresol. That this was not simply due to salt and water retention is suggested by the failure of Oresol to produce a greater weight gain in children under 1 year of age or in those with additional nonenteric infections, in spite of a larger than average ingestion of Oresol in both subgroups. These children are said to be especially susceptible to salt and water retention (*8*, *9*). The increased weight gain with Oresol may reflect better hydration, lower catabolism, or both. The relationship between weight gain during an attack and long-term relative weight gain is unclear.

The possibility that the effects on weight gain—especially long-term gain—were due to a "Hawthorne effect" (i.e., the effect of intervention alone) must be considered. That possibility is less likely than some effect of Oresol itself for the following reasons: the actual contact time was brief and limited to diarrhoea attacks; feeding and fluid administration during diarrhoea were emphasized to both groups; no differences between the groups as to appetite during attacks were detected; and the clinical events of the average attack were nearly identical in both groups except for Oresol intake and weight gain. Oresol is likely to have improved the children's appetites and food intake following the attack by early treatment of volume, sodium, and potassium deficits, each of which is a cause of anorexia or catabolism (*10–12*). The failure of Oresol to affect relative weight significantly in those aged less than 1 year may have been due to the fact that diarrhoea is a less important cause of relative weight loss than early weaning and insufficient feeding.

3. This study presents the results of considerable field experience with an oral glucose–electrolyte mixture used freely for mild or moderate diarrhoea in infants and children. Except for one child, who may have had glucose intolerance, no adverse effects were found. Evidence was found for the dissemination of knowledge of Oresol but within the study community only.

4. Hospitalization was not significantly reduced by Oresol administration, largely due to the design of the study. However, six out of the seven children from community *B* who were hospitalized actually failed to take adequate amounts of Oresol. Where the ingredients for an oral glucose–electrolyte solution are not available or prescribed, the introduction of packaged powders like Oresol could reduce the incidence of serious dehydration.

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RÉSUMÉ

EFFET POSITIF SUR LA NUTRITION D'ENFANTS PHILIPPINS D'UNE SOLUTION ÉLECTROLYTIQUE GLUCOSÉE ORALE ADMINISTRÉE À DOMICILE POUR LE TRAITEMENT DE LA DIARRHÉE

La diarrhée est chez les enfants une importante cause de dénutrition, les mécanismes qui interviennent étant le catabolisme, la malabsorption, l'anorexie et le jeûne imposé. Des observations faites antérieurement sur des enfants hospitalisés pour diarrhée avaient montré qu'en comblant rapidement le déficit hydro-électrolytique, on améliorait l'appétit et on prévenait les pertes de poids. Il ressort de la présente étude que l'état nutritionnel d'enfants en traitement ambulatoire progresse après une réhydratation maintenue grâce à une solution électrolytique glucosée administrée par voie orale. Les populations étudiées sont celles de deux communautés péri-urbaines déshéritées habitant au bord du détroit de Guimaras (Negros occidentale) aux Philippines. La communauté *M* a servi de groupe témoin, la communauté *B* de sujet d'étude. Quoique de dimensions différentes, ces deux communautés sont comparables du point de vue de la situation socio-économique et sanitaire ainsi que de l'état nutritionnel; toutefois, dans la communauté *M*, l'allaitement au sein est relativement moins pratiqué mais le taux de fréquentation des centres officiels de nutrition est beaucoup plus élevé. Pendant une période de sept mois, tous les enfants de moins de cinq ans souffrant de diarrhée qui ont été amenés au dispensaire ont reçu des médicaments antidiarrhéiques ordinaires, cependant qu'on indiquait aux mères la nécessité de ne pas interrompre l'alimentation et de faire prendre des liquides, des visites journalières de contrôle à domicile étant organisées. Dans la communauté *B*, on a en outre administré de l'Oresol, solution électrolytique glucosée orale, tant que durait la diarrhée. Presque tous les enfants exposés ont été pesés au début et à la fin de l'étude; les malades l'ont été le jour de la première visite au dispensaire et le jour suivant la fin de la diarrhée. Les données cliniques ne font apparaître aucune différence significative entre les deux communautés, y compris pour le regain d'appétit et l'hospitalisation. Les enfants de la communauté *B* ont pris environ deux fois plus de poids que ceux de la communauté *M* au cours d'un épisode moyen (129 grammes contre 74), phénomène associé à l'absorption d'une quantité de liquide nettement plus élevée. La dose d'Oresol reçue a été en corrélation positive avec les doses d'autres liquides et avec le nombre d'épisodes par enfant mais en corrélation inverse avec l'âge. Les enfants de un à cinq ans de la communauté *B* ont aussi pris notablement plus de poids en sept mois que ceux de la communauté *M* (environ 3% de plus vers la médiane). Chez les enfants ayant subi deux épisodes ou davantage, la différence d'évolution du poids attribuable à l'Oresol a été d'à peu près 5%. Un à deux mois après une diarrhée, les enfants de *B* avaient progressé en moyenne de 3% vers la médiane, tandis que ceux de *M* avaient perdu environ 1%. Les effets à long terme sur le poids sont semblables ou légèrement supérieurs à ceux indiqués par les centres de récupération nutritionnelle.

On estime qu'une action énergique de rééquilibration hydro-électrolytique chez les enfants en traitement ambulatoire pour une diarrhée, même bénigne, a un effet immédiat et à long terme positif sur le poids, probablement en commençant par rétablir l'équilibre hydro-électrolytique puis en influant favorablement sur l'appétit à l'issue de l'épisode.

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Oral fluid — a simple weapon against dehydration in diarrhoea

How it works and how to use it

N. F. Pierce [1] & N. Hirschhorn [2]

Oral rehydration therapy provides an effective weapon in the fight against acute diarrhoeal diseases, including cholera. Recently, this method of treatment has been used in various situations and remarkable results in terms of controlling the severity of diarrhoea and mortality due to acute diarrhoea were obtained. WHO has already published a guide on the subject for the use of medical assistants and other primary health workers.[3] The article below discusses why acute diarrhoea is a problem, explains the physiological basis of oral therapy, and describes the treatment and its limitations.

The aim of oral therapy is to prevent and treat dehydration, which is the main complication in any diarrhoeal illness. The treatment involves prompt replacement of faecal losses of water and electrolytes by an oral glucose-electrolyte solution. However, to understand the importance of oral therapy one must have a comprehensive view of the problem presented by diarrhoea.

Why is diarrhoea a problem?

Acute watery diarrhoea due to infections is second only in incidence to infections of the respiratory tract. In some developing nations diarrhoeal attacks may occur as frequently as once every month during a child's second year of life.[4] In these countries acute diarrhoea is probably the most common cause of death; it is certainly the major cause of mortality in small children. Cumulative mortalities of 25–40% among children up to the age of 5 years are common in developing nations; 40% or more of these deaths, which are caused by dehydration or chronic malnutrition, are associated with acute diarrhoea. Malnutrition is often initiated by acute diarrhoea and is aggravated by each subsequent attack of diarrhoea.

Thus in most developing countries, owing to the frequency of diarrhoeal illness (especially in young children) and the resulting morbidity and mortality, acute diarrhoea is a considerable health problem and every effort is needed to bring it under control and to prevent serious consequences.

What causes diarrhoea and the ensuing dehydration?

Acute watery diarrhoea is caused by a variety of infectious agents (see Table 1), whose actions alter intestinal function by different mechanisms. For example, viruses replicate within mucosal cells, produce patchy but transient mucosal damage, and cause water and electrolyte secretion which is greatest during the healing phase.[5] In contrast,

[1] Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD 21224, USA.

[2] Management Sciences for Health, Cambridge, MA 02142, USA.

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Table 1. Infectious agents that commonly cause acute watery diarrhoea

Bacteria	Viruses
Salmonella species	Reo-like virus
Shigella species [a]	Norwalk agent
Enterotoxigenic *Escherichia coli*	
Vibrio cholerae	
Non-cholera vibrios	
Vibrio parahaemolyticus	

[a] May also cause dysentery without watery diarrhoea.

bacteria like *Vibrio cholerae* and enterotoxigenic strains of *Escherichia coli* are not invasive but colonize the mucosal surface and secrete an enterotoxin, which causes mucosal secretion without any apparent damage to mucosal cells.[6] Although these mechanisms differ, the clinical and biochemical effects produced are similar in several important aspects:

(1) Normally the small bowel secretes, rather than absorbs, water and electrolytes. In severe diarrhoeal diseases, the volume secreted is large and cannot be fully absorbed by the colon, so that watery diarrhoea continues even if oral intake stops. In mild disease, diarrhoea may occur only when there is food and liquid intake, since the volume of intestinally secreted fluid is small.

(2) Diarrhoeal stool is usually isotonic with plasma but may differ greatly from plasma in electrolyte content (Table 2). Potassium and bicarbonate concentrations are usually higher than plasma; sodium concentration may be similar to plasma or lower. In general, sodium content approaches that in plasma when stool is watery and the rate of loss exceeds 50 ml per kg of body weight in 24 hours. Sodium content is lower when the rate of loss is less than this, and when faecal matter is present and food intake is continued.

(3) Disaccharidase enzymes of the bowel mucosa (especially lactase) are often damaged so that the ingestion of lactose in cow's milk by infants with lactase deficiency makes the diarrhoea worse. The lactose is not absorbed in the small bowel but passes into the colon along with the additional water required to maintain isotonicity. In the colon the lactose is fermented into smaller fragments, including organic acids, which apparently further increase the stool volume by their osmotic activity.[7]

(4) Acute diarrhoea usually lasts 1 to 7 days and ends when the infection is controlled by the host's defences. In some cases (e.g., cholera and shigellosis), the duration may be shortened by antibiotics. Chronic or recurrent diarrhoea usually indicates intestinal abnormalities due to malnutrition, disaccharidase deficiency, or parasitism.

Dehydration is the result of fluid loss from the body. With diarrhoea this loss occurs almost entirely from the extracellular fluid compartment and leads to a progressive diminution of blood volume. When this fluid loss is less than 5% of the body weight, thirst is the only sign of dehydration (apart from the diarrhoea). When the deficit exceeds 5% of the body weight, the following symptoms and signs develop rapidly: tachycardia, decreased skin turgor, postural hypotension, irritability, oliguria or anuria, severe thirst, hypotension, and stupor or coma. *Shock occurs when the deficit equals about 10% of the body weight; greater losses cause death.* It is important to note that half of this lethal deficit can develop before the usually recognized signs of dehydration appear. Vomiting occurs but may not necessarily be due to fluid deficit. Some children develop serious hypoglycaemia, partly owing to fasting; this may cause coma, convulsions, and even death.

Hypertonic dehydration, which is due to relatively greater losses of water than salt, may occur in a few infants and, when serious, may cause coma or convulsions and death. This problem may occur when infants with diarrhoea are fed large amounts of cow's milk; larger volumes of stool with lower sodium content are then produced and a greater deficit of water than salt results. Hypertonic dehydration is relatively uncommon in developing countries, probably because more children are breast-fed (breast milk has a lower solute load than cow's milk and the feeding volumes are smaller) and because cow's milk, when used, is very much diluted, thus providing extra water to replace the stool losses.

Hypotonic dehydration (serum sodium concentration less than 130 mmol/l) may occur when stool loss is replaced orally by plain water. Hypotonic dehydration causes few specific symptoms and is usually much less dangerous than hypertonic dehydration.

Long-term effects of repeated diarrhoea

The long-term effects of repeated diarrhoeal attacks are largely nutritional, children under the

[6] Gangarosa, E. J. et al. The nature of the gastrointestinal lesion in Asiatic cholera and its relation to pathogenesis: a biopsy study. *Am. J. trop. Med.*, 9: 125 (1960).

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While intravenous fluid therapy (*left*) is necessary for severe cases of dehydration, it might have been avoided if oral rehydration (*right*) had been started early enough.

age of 3 years being the most frequent victims. Watery diarrhoea causes a negative nitrogen balance, which reflects protein catabolism due to the infection and to fasting. When the quality and quantity of a patient's food intake is marginal, the protein losses during diarrhoeal attacks (and during other infections) are only slowly regained and the weight lost is only gradually recovered. The cumulative result is restricted growth and increasing protein deficiency. If this process is repeated, it is eventually complicated and accelerated by chronic diarrhoea and dietary malabsorption associated with atrophy of the small bowel mucosa. The final outcome, if not death from an intercurrent infection, is death with the clinical picture of protein-energy malnutrition.

Major objectives in treatment

The two major objectives in treating acute diarrhoea are:

very early replacement of water and electrolyte losses to prevent or treat dehydration

– maintenance of adequate nutrition to prevent malnutrition.

Early replacement therapy should begin *promptly* after diarrhoea starts. Early treatment has three important advantages. First, it avoids the risk of death from severe dehydration. Second, it minimizes the symptoms associated with increasing water and electrolyte deficit, e.g., vomiting, anorexia, lethargy, or coma, which interfere with continued feeding. And third, the treatment needed is simpler because it is given while two important homeostatic mechanisms (thirst and renal function) are still intact. When an oral glucose-electrolyte solution is taken under these conditions, thirst is one important guide to the amount required,[8] and normal renal function permits the excretion of any excess of water or salt.

Maintaining nutrition during acute diarrhoea is essential to prevent the adverse effects of fasting. Moreover, nutrition *can* be maintained because the

[8] HIRSCHHORN, N. ET AL. *Ad libitum* oral glucose-electrolyte therapy for acute diarrhoea in Apache children. *J. Pediatrics*, 83: 562-571 (1973).

gut remains able to absorb a variety of nutrients, lactose being the most common exception. Apart from lactose, usually no other dietary restriction is needed. In fact, there is no physiological basis to the common belief that the bowel should be " rested " during acute diarrhoea.

The primary goal of treatment is not the immediate termination of diarrhoea. Although shortening the duration of diarrhoea would be desirable, most attempts are either ineffective (such as " routine " antibiotics or " antidiarrhoeal mixtures ") or they interfere with goals of higher priority. For example, fasting may diminish stool loss but obviously prevents maintenance of nutrition. Moreover, treatment aimed at stopping diarrhoea often diverts attention from the major objective—fluid and electrolyte replacement—until a serious deficit has developed.

Early treatment of acute diarrhoea

If diarrhoea is to be treated early, common barriers to treatment must be removed. This means that treatment must be easily available and inexpensive, and it must be *effective*. In practical terms, this requires delivery of treatment by health workers in a network of neighbourhood or rural primary health centres, rather than through a small number of distant hospitals by highly trained but overworked physicians. Oral rehydration techniques are well suited for this purpose and have the additional advantage that family members can participate in giving the solution and, after instruction, can usually continue treatment at home with daily follow-up and reinstruction at the health centre until the patient recovers. This approach presents an absolute minimum of barriers to early treatment. It holds the possibility that family members may learn to initiate treatment at home as soon as diarrhoea starts on a subsequent occasion, thus providing the ultimate in early treatment.

In contrast, parenteral fluid therapy has serious limitations as a means of early replacement: it is expensive (a single bottle may cost more than a day's wages), it can be administered only by trained personnel, and ideal formulations are often not available. For these reasons it is almost never used until a serious deficit has developed. Parenteral fluid therapy is of great value in treating severe dehydration and some other complex problems associated with diarrhoea (see below). It should be available in all major hospitals, but it should be emphasized that the need for parenteral fluid therapy could have been avoided in many of these patients and they could have been treated more easily and economically with oral fluid if this had been given early in the course of their illness.

Oral rehydration therapy

Oral therapy is based on the observation that glucose is actively absorbed by the normal small bowel and that sodium is carried with it in about an equimolar ratio. Thus, in the normal intestine there is considerably greater net absorption of an isotonic salt solution with glucose than of one without glucose (Fig. 1-A). During acute diarrhoea the absorption of sodium (without glucose) is impaired. An isotonic salt solution taken by mouth simply augments stool volume by passing through the gut unabsorbed; glucose absorption by the small bowel, however, remains largely intact and the net absorption of water and electrolytes (including potassium and bicarbonate) from isotonic glucose-salt solutions can equal or exceed simultaneous stool losses even when the loss is rapid, as in cholera (Fig. 1-B).

Other sugars, especially those that yield glucose when broken down in the gut, may be useful for enhancing salt and water absorption when glucose is not available. If their breakdown were incomplete, however, their effect would be reduced. A sucrose-salt solution containing 40 g sucrose per

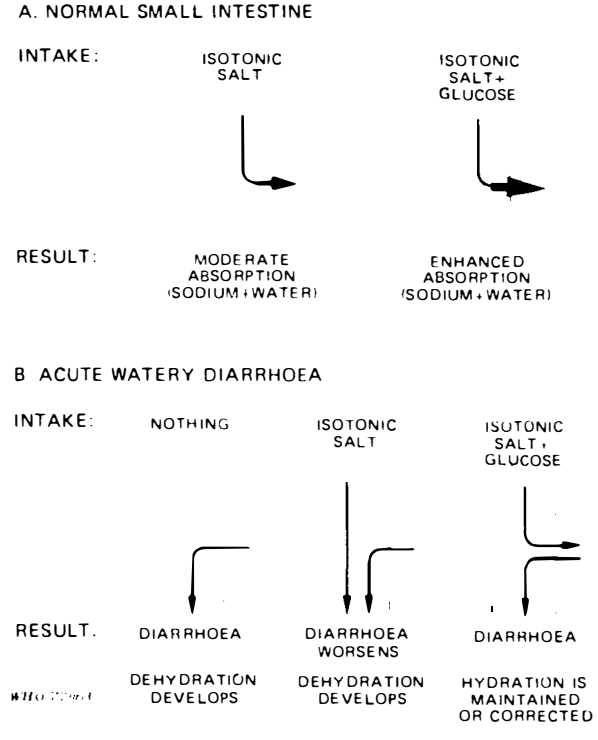

Fig. 1. Effect of glucose on intestinal absorption of salt and water (A) in the normal small intestine and (B) during acute watery diarrhoea. See text for details.

litre, for example, has been almost as effective as the glucose-salt solution for treating patients above the age of 5 years with severe cholera and other diarrhoeal diseases (D. L. Palmer et al., unpublished observations).

For the successful implementation of oral therapy in local health centres and even in homes, the method employed must be uniform and simple. The use of an oral solution based on a single formula is essential in such an approach, the advantages outweighing any possible value of solutions of varying composition for use in different age groups or phases of treatment. Moreover, it should be emphasized that the water and electrolyte requirements are reasonably constant (and can thus be met by a single solution) in those clinical situations in which large amounts have to be given.

Table 2 and the accompanying box show the composition of a widely tested and effective glucose-electrolyte solution, which is approximately isotonic with plasma; it contains sodium and glucose in an approximately equimolar ratio and sufficient potassium and bicarbonate to replace a major portion of stool losses. The sodium concentration is sufficient to correct an initial isotonic deficit and to replace continuing stool losses when the rate of loss is moderate or severe. Normal renal function is essential so that any excess of salt or water may be excreted. In children with mild diarrhoea the stool sodium concentration is often lower than that in the oral solution;[9] the water requirements of such patients are also met by the water provided in continued oral feedings.

[9] MAHALANABIS, D. ET AL. Water and electrolyte losses due to cholera in infants and small children: a recovery balance study. *Pediatrics*, 45: 374-385 (1970).

Table 2. Electrolyte content of stool in acute watery diarrhoea compared with that of normal plasma,[a] and the electrolyte and glucose content of oral fluid.

	Na^+	K^+	Cl^-	HCO_3^-	
Cholera stool					
adults	140	13	104	44	
children (< 5 years)	101	27	92	32	
Enteritis stool					
children (< 5 years)	56	25	55	14	
Normal plasma	142	4.5	105	25	
Oral fluid[b]	90	20	80	30	Glucose 111

[a] Values, which are averages from several studies, are expressed in mmol/l. Widest variations are seen in Na and Cl content of enteritis stool in children. Sodium content drops rapidly from mean values above 90 mmol/l to a mean of about 60 mmol/l when the rate of stool loss falls below 50 ml/24 h per kg of body weight.

[b] Values are expressed in mmol/l. The composition of oral fluid in grams per litre is given in the accompanying box.

The ORAL REHYDRATION FLUID
consists of

sodium chloride (table salt) 3.5 g
sodium bicarbonate (baking soda) 2.5 g
potassium chloride 1.5 g and
glucose 20.0 g

dissolved in one litre
of potable water

The oral glucose-salt mixture may be obtained in packets, the contents of which are easily dissolved in a litre (or other recommended volume) of potable water. The made-up solution should not be boiled.

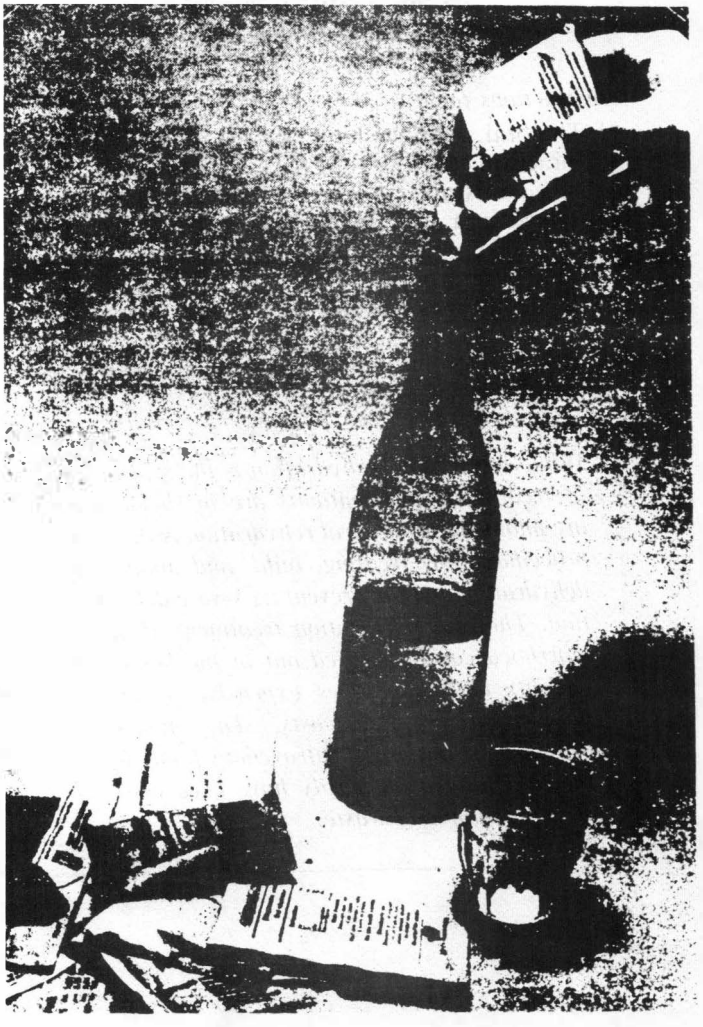

Table 3. Guidelines for oral fluid therapy

	Amount given	Time required
1. Rehydration		
A. For *mild dehydration* (on examination, normal or diminished skin turgor or sunken fontanelle; patient able to drink)	50–120 ml/kg, the larger amount when turgor is diminished. Encourage patients to drink until they refuse. Adults may need up to 1000 ml per hour. If patients tire of drinking, use a continuous nasogastric infusion	Usually 4–6 hours
B. For *severe dehydration* (hypotension, shock, stupor or coma, absent radial pulse)	100 ml/kg *intravenous* polyelectrolyte solution (e.g., Ringer's lactate [a]), or normal saline if nothing else is available. Do not use oral therapy until shock is corrected	Give half rapidly (30–60 minutes), the remainder in 3–6 hours
2. Maintenance		
A. For *mild* continuing diarrhoea (less than 1 stool every 2 hours)	100–200 ml/kg oral solution	Every 24 hours, until diarrhoea stops
B. For *severe* continuing diarrhoea	15 ml/kg oral solution, sometimes more. Observe carefully to confirm adequate maintenance of hydration	Every hour, until diarrhoea becomes mild or stops

[a] An ideal polyelectrolyte solution is DTS (diarrhoea treatment solution), which is recommended by WHO. If half-strength Darrow's solution with 2.5% glucose is used, give 150 ml/kg.

Instructions for use

The oral solution should be made fresh daily. It is practical to use foil packets containing preweighed mixtures of glucose and the salts to be dissolved in a specified volume of drinking water. These packets can be safely stored as long as they are moisture proof.

The guidelines for the use of oral therapy are simple (Table 3). The limits of its usefulness will be described below. It may be used as the sole therapy to rehydrate patients with mild or moderate dehydration (up to 7% loss of body weight) and to maintain hydration in almost all patients, after rehydration, until the diarrhoea stops. In general, most patients who are awake and able to drink well can be treated by the oral route.

While intravenous rehydration is the best form of treatment when patients are in shock and are unable to drink, oral rehydration is the best procedure for treating mild and moderate dehydration and for preventing severe dehydration. The oral rehydration treatment of acute diarrhoea can be carried out in the homes of patients and thus saves expensive injectable fluids and hospital costs. The numerous instances of the use of intravenous fluids when the oral fluid could easily have been justified are an example of waste.

Thirst is a very useful guide to the amount of oral solution required. Rehydration is often achieved by allowing the patient to drink as much fluid as desired, but patients with very rapid stool loss may have to be encouraged to drink sufficient fluid. Excess fluid intake may cause puffy eyelids (this is harmless), in which case the oral solution should be stopped until this finding disappears. If patients tire of drinking, the fluid can easily be given by continuous nasogastric infusion. If the initial dehydration is severe, rehydration must be performed intravenously with an isotonic polyelectrolyte solution (or normal saline if only that is available), after which the oral solution may be used for maintenance.

The maintenance requirements of oral fluid, after rehydration, should equal the rate of continuing stool loss. For adults with severe diarrhoea (e.g., in cholera), measurement of stool losses, separate from urine, by the use of a cholera cot helps to determine the maintenance requirements. Since

accurate stool collections are not possible with infants, the stool losses should be carefully estimated by frequent observation of diapers. Stool losses are usually greatest in the first 24 hours of treatment and decrease steadily thereafter. Patients with mild diarrhoea may be given oral fluid for home use, returning each day for reexamination and more fluid, if needed. Those with frequent diarrhoea should be observed every 3–6 hours to determine whether oral intake is sufficient and hydration appears satisfactory. Valuable signs of adequate hydration include normal skin turgor, normal urine flow, normal pulse rate and volume, and a sense of well-being. If signs of dehydration reappear despite vigorous oral replacement, parenteral fluid therapy should be started.

Patients given the oral solution may vomit. This occurs most commonly when oral therapy is first begun. Unless vomiting is severe and repeated, oral therapy should be continued, small amounts being given frequently. The volume of fluid lost by vomiting is usually a very small portion of that taken and retained by the patient.

If possible, patients with diarrhoea should continue to eat and drink to maintain their nutrition. Drinking of the oral solution can be alternated with food intake. Breast-fed children should continue to be nursed; those given cow's milk should take reduced amounts limited to 150 ml every 4 hours. If the diarrhoea worsens markedly, cow's milk should be stopped and other protein foods used. Staple foods such as cereals, bananas, cooked legumes (lentils, chick peas, etc.), and potatoes can be continued during the diarrhoea. Adults should resume a normal diet of well-cooked food as soon as their appetite returns. When the required amounts of oral fluid have been taken, patients may be given additional water if they desire it.

Antibiotics should not be given routinely. Oral tetracycline shortens the duration of diarrhoea in cholera. Antibiotics are also effective in severe shigellosis, but the appropriate choice can be made only by testing the sensitivity of the organism *in vitro*.

There are no other adjuncts to the treatment of diarrhoea that are of proven value.

Limitations

There are some circumstances in which oral therapy is not successful or has not been fully tested and therefore cannot be recommended. In these situations, water and electrolyte replacement should be given parenterally:

- Patients with severe dehydration, often with signs of shock. Such patients need very rapid water and salt replacement intravenously. Oral therapy is too slow.

- Patients who cannot drink because of fatigue, stupor, or coma. The oral solution can be given to such patients by nasogastric tube.

- Patients with prolonged oliguria or anuria, but not those with brief oliguria or anuria which often accompanies dehydration. The former require precise administration of water and electrolytes, usually parenterally.

- Patients with severe and sustained vomiting.

- About 3% of patients with acute diarrhoea have serious glucose malabsorption. In these patients oral therapy causes a marked increase in stool volume, the stool containing large amounts of glucose, and the dehydration worsens.

- Patients with very severe diarrhoea (e.g., adults losing more than 800 ml of stool per hour) may be unable to drink enough fluid to replace the continuing losses.

- Oral therapy has not been evaluated in premature infants or in babies less than one month old.

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Oral therapy has been used with success to treat thousands of attacks of mild and moderate acute diarrhoea in children and adults in many parts of the world, and its usefulness has been carefully documented in a number of reported studies. When cholera and infantile diarrhoea were treated by this method by experienced workers, there was almost no mortality and the need for intravenous fluids was reduced by 70–90%. When oral therapy was used under the worst possible conditions to treat cholera among refugees from Bangladesh, most of the treatment being given by untrained family members, mortality was only 3% and half of these deaths occurred before the treatment could be given.[10]

These observations and the rationale on which this approach to treatment is based argue strongly in favour of oral therapy as the single most effective therapeutic tool in the treatment of acute diarrhoeal disease.

[10] MARTINSEN, D. H. ET AL. Oral fluid therapy of cholera among Bangladesh refugees. *Johns Hopkins med. J.*, 132: 197-205 (1973).