Oral Rehydration Therapy

A Revolution in Child Survival

A.I.D. SCIENCE AND TECHNOLOGY IN DEVELOPMENT SERIES

Agency for International Development

Oelgeschlager, Gunn & Hain,
Publishers, Inc.
Weston, Massachusetts

International Standard Book Number: 0-89946-223-5

Library of Congress Catalog Card Number: 88-12621

Printed in the U.S.A.

Library of Congress Cataloging-in-Publication Data

Oral rehydration therapy.

(A.I.D. science and technology in development series)
Bibliography: p. 107
1. Oral rehydration therapy for infants. 2. Oral rehydration therapy for children. I. United States. Agency for International Development. II. Series.
RJ267.5.07 1988 362.1'98923427 88-12621
ISBN 0-89946=223-5

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Foreword

Diarrhea is among the most common health problems in children in the developing world. Each year the dehydration that often results from diarrhea exacts a tremendous toll: the lives of more than five million infants and children.

In a vicious cycle, diarrhea interacts with poor diet. It is a major contributor to malnutrition and interferes with growth and development. And it often coexists with other diseases, such as measles, polio, whooping cough, tetanus, and respiratory infections. The terrible suffering that acute dehydrating diarrhea and diarrhea-related diseases inflict on the young also affects the quality of life of parents and that of all people in the Third World.

Recognizing the connection between such conditions and the constraints they put on economic progress, the international health community has joined in a global strategy to promote high-quality, efficient, and cost-effective health care in the developing world. The simple but effective technology known as ORT (for oral rehydration therapy) is at the heart of this effort.

The safety, efficacy, and low cost of ORT has been demonstrated in more than a hundred countries. Because of the enormous commitment of concerned groups to the problem of diarrheal disease, hundreds of thousands of infants and children have been saved from death by diarrheal dehydration.

In their efforts to achieve health for all, the U.S. Agency for International Development (A.I.D.) and such multinational agencies as the United Nations Children's Fund (UNICEF), the United Nations Development Programme (UNDP), the World Health Organization (WHO), and the World Bank have joined forces to spread

the message of ORT and promote, produce, and distribute oral rehydration salts (ORS), with emphasis on the prepackaged sachets that contain the life-saving glucose and salts.

At the same time, important roles are being played by many nongovernmental organizations such as the League of Red Cross and Red Crescent Societies, numerous private and governmental research institutes and voluntary groups, and thousands of national institutes and scientists cooperating with those responsible for the implementation of diarrheal and other health programs.

ORT has a long history, and I am pleased that the Agency for International Development has supported it throughout, from the original research to country delivery programs. In 1959, A.I.D.'s predecessor organization, the International Cooperation Administration, helped start the Cholera Research Laboratory, which in 1979 was internationalized to become the more broadly based International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). The center's successful work on cholera, the most feared of diarrheal diseases, helped to develop the ORS mixture that is so readily available today. In addition to its own work, most of the leading scientists currently active in research on diarrheal disease around the world have been on staff at the Dhaka center or have been otherwise heavily influenced by its work.

Today, as part of A.I.D.'s overall strategy to reduce child mortality and morbidity, the Agency is supporting a broad range of activities related to control of diarrheal disease. This includes promoting the use of ORT through systematic communications and educational campaigns, strengthening diarrheal disease control components of primary health care programs, supporting research, helping private voluntary organizations mount ORT and immunization programs, collaborating with the Peace Corps to promote the use of ORT at community levels, and promoting private sector production and distribution of ORS packets.

Among the many successful diarrheal control efforts cited in this book is WHO's Control of Diarrhoeal Diseases (CDD) Programme, initiated in 1979, which has as its primary objective the reduction of sickness and death from diarrheal disease. The Programme has collaborated with more than 100 countries in implementing national diarrheal disease control and research activities.

Many of these activities were undertaken in close collaboration with a number of other agencies, including UNICEF, which has made ORT a key component in its Child Survival Revolution

initiative. Because it promises to bring the treatment of diarrheal infection out of the hospitals and clinics and into the homes of every developing nation in the world, ORT represents a true revolution in diarrhea therapy. Reliable data on the impact of ORT on diarrhea mortality support the estimate made by WHO that the technology can prevent two-thirds of deaths due to diarrheal dehydration.

In 1983, in order to help accelerate ORT programs, A.I.D. sponsored the first International Conference on Oral Rehydration Therapy (ICORT I), held in Washington in cooperation with ICCDR,B, UNICEF and WHO. That meeting was a testimony to the international health community's recognition of the seriousness of diarrheal disease, and it demonstrated the value of ORT. Following the meeting, A.I.D. nearly doubled its commitment to the new therapy. Between 1983 and 1985, while strengthening many existing ORT programs and launching new ones, A.I.D. provided more than $67 million to assist ORT activities around the world.

In 1985, recognizing the importance of ORT and other child survival interventions, the United States Congress appropriated $85 million to A.I.D. for a Child Survival Action Program to promote ORT and immunization.

That same year, in cooperation with the sponsors of ICORT I, as well as the World Bank and UNDP, A.I.D. sponsored a second International Conference on Oral Rehydration Therapy (ICORT II), which further focused worldwide attention on the problem of diarrheal dehydration and the implementation of ORT programs.

Since that time, we have seen continued progress; families in developing countries have better access to ORT, and they increasingly rely on ORT when their children are attacked by diarrhea. Health programs, too, are increasingly able to teach families how to prevent dehydration and to integrate ORT with other child survival interventions. It is satisfying indeed that, in cooperation with other international organizations, A.I.D. is helping to make ORT a basic pillar in the worldwise struggle to save the lives of children and to improve their overall health.

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Preface

To date, more than 1,000 scientific and medical publications have been published on the subject of oral rehydration therapy. As part of A.I.D.'s Science and Technology in Development series, this volume draws on that large body of work. At the same time, new scientific knowledge and practical experience are being acquired at a rapid rate. Therefore, the book also uses the latest statistics, developments, conclusions, and plans for the future as presented in numerous current newsletters, monographs, pamphlets, brochures, speeches, conference proceedings, and unpublished news releases, as well as other materials.

Ample documentation exists to support the conclusion, so often cited in discussions of this remarkable therapy, that it is one of the great discoveries of the 20th century—the most technically advanced, safe, and cost-effective way of dealing with acute dehydrating diarrhea.

Moreover, the book shares the knowledge and experience of many of the 1,200 participants who gathered in Washington in December 1985 to attend the successful ICORT II. During the four days of that meeting, I heard public health administrators, health workers, doctors, volunteers, and government representatives talk about the many ways ORT is changing the face of health care delivery. The participants discussed the diarrheal disease process itself and the interventions being used to control it, but they also stressed the pivotal role of communciations and marketing techniques, the need for reliable supplies of oral rehydration salts (ORS), and the importance of political and community organization.

In addition to the sources mentioned above, material for this book was provided by numerous individuals associated with key groups active in carrying the ORT banner. These organizations include, in addition to the U.S. Agency for International Development, UNICEF, UNDP, and WHO.

The book was prepared for publication by Metrotec, Inc., Washington, D.C., under contract number DAN-1406-1-00-5096-00 with the Agency for International Development.

For reviewing its contents before publication, I am especially indebted to:

Robert Clay, M.P.H.
George Curlin, M.D.
Katherine Elliott, M.D.
William B. Greenough III, M.D.
Norbert Hirschhorn, M.D.
Anthony Meyer, Ph.D.
Clifford A. Pease, Jr., M.D.
William Smith, Ph.D.

These persons bear no responsibility for judgments or errors of fact in this document.

Gerald S. Snyder

List of Acronyms and Abbreviations

ADRA	Adventist Development and Relief Agency
AHRTAG	Appropriate Health Resources and Technologies Action Group (London)
A.I.D.	Agency for International Development
CARE	Cooperatives for American Relief Everywhere
CCCD	Combatting Childhood Communicable Diseases project
CDD	Diarrhoeal Diseases Control Programme (WHO)
CRS	Catholic Relief Services
CSAP	Child Survival Action Program
DDRC	Diarrheal Diseases Research and Rehydration Center (Cairo)
FAO	Food and Agriculture Organization (UN)
HealthCom	Communication for Child Survival Project (A.I.D.)
ICA	International Cooperative Administration (forerunner of A.I.D.)
ICC	International Child Care
ICDDR,B	International Centre for Diarrhoeal Disease Research (Bangladesh)
ICMRT	International Center on Oral Rehydration Therapy (Calcutta, India)
ICORT	International Conferences on Oral Rehydration Therapy (I -- 1983; II – 1985; both held in Washington, D.C.)
IDWSSD	International Drinking Water Supply and Sanitation Decade (1980s; UN-sponsored)

IV	Intravenous therapy applied by introducing fluids by needle directly into the veins
LCD	Less Developed Country
NAMRU	Naval Medical Research Unit
NCDDP	National Control of Diarrheal Diseases Project
ORS	Oral Rehydration Salts
ORT	Oral Rehydration Therapy
ORW	Oral Rehydration Worker
OTEP	Oral Therapy Extension Program (Bangladesh)
PAHO	Pan American Health Organization
PATH	Program for Appropriate Technology in Health
PCI	Project Concern International
PRICOR	Operat ns Research in Primary Health Care
PRITECH	Technologies for Primary Health Care
SAWSO	Salvation Army World Service Office
SCF	Save the Children Foundation
SUPPORT	Supply Procurement and Promotion of ORT
TALC	Teaching Aids at Low Cost
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WASH	Water and Sanitation for Health project
WHO	World Health Organization
WN	World Neighbors
WVRO	World Vision Relief Organization

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A Global Challenge: Saving Children Through ORT

This technology can be administered in hospitals, clinics, communities, and in homes. It is safe, effective, and inexpensive. Most importantly, it can save millions of lives.

– M. Peter McPherson, Administrator, Agency for International Development, 1981–87, at ICORT II

The formula is simple: a combination of sugar, water, and mineral salts. Yet the compound, so easily prepared, is remarkable, a treatment recognized by doctors, nurses, and other public health practitioners as potentially one of the most important medical breakthroughs in the 20th century. Combined with proper feeding, the technology known as Oral Rehydration Therapy (ORT) could save the lives of 4 million children who die every year from diarrheal dehydration, the leading killer of children in the developing world.

Each year the troubling news and grim statistics appear in newspapers and scientific reports – compiled almost entirely from the poor, the undernourished, and the very young:

Every minute, seven or eight children die.

One out of every ten children die before the age of five.

As many as 30 percent of all childhood diseases are associated with diarrhea.

As many as 30 percent of all hospital beds are occupied by children with diarrhea.

Thousands of children die of cholera.

WHO estimates 744 million to 1 billion diarrheal episodes per year in children below five years of age in Asia (excluding China), Africa, Latin America, and the Near East.

However, ORT is dramatically reducing infant and child mortality. In the towns and villages throughout the developing regions of Africa, Asia, Latin America, and the Near East, home to half of the world's population – about 2 billion people – this new intervention is creating a revolution in child survival.

Oral rehydration is being promoted today in more than ninety-five developing countries. In some nations it has brought diarrheal mortality down by at least 40 to 50 percent. Hospital admissions due to diarrheal disease are being significantly reduced, in many countries by more than 50 percent. Less malnutrition among healthy children is being reported. And both family and government health agencies are reporting less drain on already strained budgets.

"So Much Hope"

Far cheaper than intravenous (IV) fluids and the largely ineffective drugs that until the late 1960s constituted the accepted treatments for diarrhea, ORT reverses dehydration in about 95 percent of acute cases, usually within three to seven hours. Most important, ORT is getting health care out of the hospitals and into the villages, for, unlike IV, the essential ORT nutrients can be mixed and administered in the home and outpatient clinics.

Though not a panacea, ORT is, in the words of the influential British journal *The Lancet*, "potentially the most important medical advance this century." UNICEF, in its 1986 *State of the World's Children* report, termed the technology "an incredibly cheap, simple, safe, and effective method by which parents themselves, however poor, can protect the lives and growth of their children against one of the most common causes of child malnutrition and child death in the modern world." President Ronald Reagan, in a message to ICORT II, praised the technology as holding "the promise of so much hope to so many families that we must make that hope a universal reality."

At that meeting, M. Peter McPherson, then A.I.D.'s Administrator, summed up the sentiment: "This technology can be administered in hospitals, clinics, communities, and in homes. It is safe, effective, and inexpensive. Most importantly, it can save millions of lives."

"Significant progress has been made worldwide over the past years," he added. "ORT is now widely recognized as appropriate and desirable at all levels of the health system; many countries have developed policies and plans to address the diarrhea problem; mothers are now regarded as key to the treatment of diarrhea; and there is agreement that integrated communication channels, such as face-to-face contact, print, and radio and television, are necessary to promote ORT messages."

The Rationale: "Replace What Is Lost"

The human body is more than two-thirds water. In a healthy person, at least 70 liters a day of salt-laden fluids are exchanged (secreted and reabsorbed) across the walls of the intestines. The brain, heart, kidney, and virtually every other vital organ depend on these fluids to function. As the body takes in the water and salts it needs, it loses or excretes those it does not need through urine, stools, and sweat. Thus, the secretion and absorption rates are kept in balance.

During "diarrhea"—the body's cleansing mechanism to flush pathogens, toxins, and other injurious agents from the gastrointestinal tract—the stool excretion rate may increase by six to thirty liters a day. This creates a tremendous outpouring of water and the accompanying electrolytes (body salts)—sodium, potassium, chloride, and bicarbonate—and impairs the gastrointestinal tract and its capacity to reabsorb the fluids and electrolytes it needs.

In many efforts to explain what happens during diarrhea, an infant or child is often compared to a pot of water containing salt—with "a hole in the bottom." Within about six hours, the pot must be refilled with salt and water before, as happens in about one-tenth of diarrhea episodes, dehydration sets in. (See Figure 1.1.)

At first, when the loss of fluid amounts to only 2 percent of body weight, the signs may be only thirst and scanty urine. However, when the fluid loss reaches 4 percent, the pulse may become fast and faintness may set in. When 6 percent of the body weight has been lost, both blood pressure and kidney function decline.

Dr. Norbert Hirschhorn, an expert with worldwide experience in implementing diarrheal control programs, knows too well what happens next, when the child has lost about 10 percent of body weight in fluid, and death is near:

"The child has hollow, sunken eyes; its pulse is feeble or absent; its breathing is deep and rapid; the skin, when pinched, tends to

Step 1. Dehydration. The person with diarrhea 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).

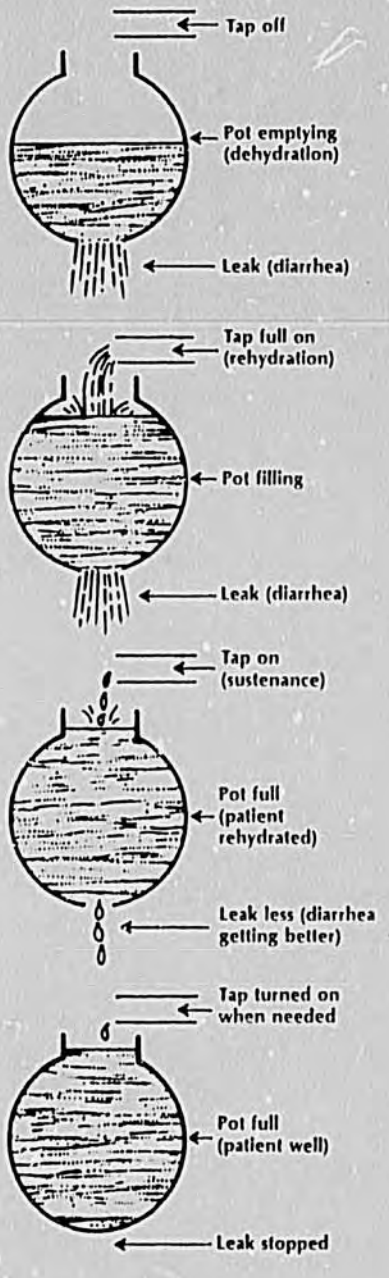
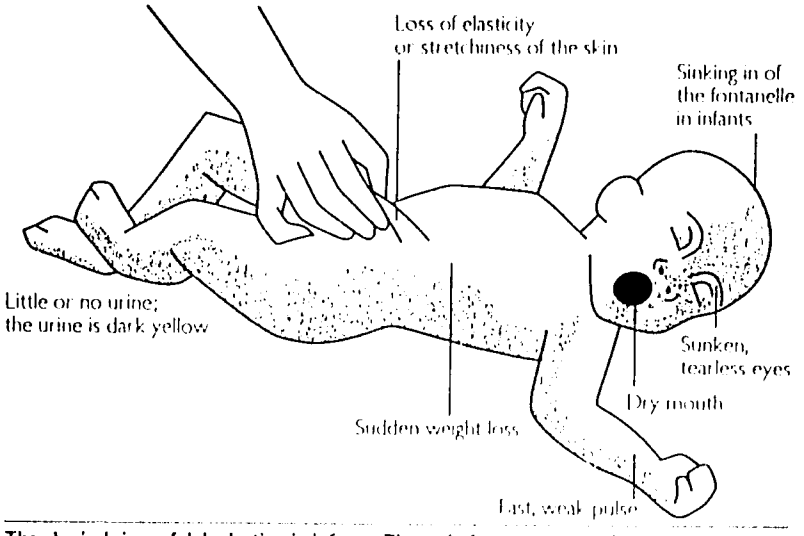


Figure 1.1. The five steps of diarrhea and its management.
Source: WHO.



The physical signs of dehydration in infancy. The main features are much the same in older children and adults.

Figure 1.2. The physical signs of dehydration in infancy.
Source: Dialogue on Diarrhoea, *Issue No. 3, November 1980. Preventing and Treating Diarrhoea, An Information Sheet to Help Teachers.*

remain dented and inelastic; the abdomen may be distended; urine has ceased to flow; the mouth is parched; the eyelids do not quite shut properly; there are no tears. Dry as the child may be, vomiting and watery diarrhea persist nearly to the end." The child may reach this stage as little as ten to twenty hours after the onset of diarrhea, when ORT, given early, could have stopped or slowed down the dehydration process. (See Figure 1.2.)

There is just one thing to do. As Dr. Perla D. Santos Ocampo, Professor and Chairperson of the University of the Philippines' Department of Pediatrics, told a Latin American symposium on child health in 1984: "Just replace what is being lost. If we can get this short message across, then we have succeeded."

For infants and young children, with their higher body metabolism and immature kidneys, diarrheal dehydration is always dangerous. If the condition is not to become life-threatening – as it does in about 10 percent of all diarrhea episodes – rehydration must take place, either intravenously or orally. The patient must be treated.

Contrary to some beliefs, ORT is not a *cure* for diarrhea, although it is a successful treatment. The primary goal is not the immediate

end of the passing of liquid or watery stools, but the early replacement of the lost water and salts. The diarrhea itself may run its expected course, continuing if necessary for three to four days or sometimes longer, until the natural defense mechanisms of the patient have overcome the infection causing the diarrhea.

Meanwhile, the sugar in the solution will allow the intestine to efficiently absorb the fluid and salts needed to prevent dangerous dehydration, for ORT is based, as we shall see, on the discovery that glucose accelerates the absorption of essential salts and water in the intestine.

A Low-Cost So'ution

ORT offers a simple and effective first step in the 'reatment of dehydration—a way of combatting a huge health problem without buildings, operating rooms, and extensive medical training. Because the therapy does not require any of the paraphernalia or trained personnel usually associated with intravenous therapy, ORT's costs are low: less than 50 cents per patient in many places, compared to at least $5 per patient for IV, according to the estimates of the A.I.D.-sponsored PRITECH consortium that is helping developing nations reduce infant and child mortality.

The main costs relate more to transport, distribution, and information campaigns than to production of the ORS packets themselves. And homemade rehydration solutions, which can be made from ordinary household ingredients, cost even less.

In some countries, ineffective anti-diarrheal drugs consume up to 10 percent of family income, while costly visits to pharmacies, health clinics, and hospitals tax overcrowded facilities. The hospitals themselves may be out of reach of most people.

In addition, ORT achieves a more natural absorption of fluid than IV and does not produce side effects, such as convulsions, that sometimes can result from rapid variations in the levels of fluids and electrolytes.

WHO compares intravenous therapy and ORT:

Intravenous Therapy	**ORT**
Applicable in all cases requiring rehydration	Applicable in all cases except where shock or severe vomiting interfere (1 to 5 percent)
Preventive use not feasible	Easily administered in every case of diarrhea; if begun early may prevent dehydration
Requires fixed medical care facility	Can be prepared and administered in village and home
Supplies cumbersome to deliver to rural areas	Packets of OR salts easily distributed; sugar and salt already in most homes
Administration requires well trained personnel	Can be distributed and prepared by minimally trained village workers, prepared by family members
Body can't tolerate great variations in fluid composition	Broader tolerance range, but care in mixing still needed
Monitoring needed to prevent overhydration	Early in diarrhea, satisfaction of thirst usually prevents overhydration
Requires sterile preparation and equipment	Household utensils can be used to mix
Expensive	Inexpensive
Trauma and chance of infection from intravenous needle	Possible risk in using contaminated water that might not otherwise be ingested
Mother largely excluded from care of child	Mother involved in care of child

Moreover, ORT has an incalculable impact on family planning. According to Dr. William B. Greenough III, former Director of the

ICDDR,B: "One of the best ways to reduce people's desire for more children is to make sure the children they have are healthy. ICDDR,B studies in Bangladesh have shown that fertility rates drop significantly when deaths from diarrheal diseases are minimized. In other words, when fewer children die before age five, parents may choose to have smaller families knowing they won't have to replace children who previously stood a good chance of dying. ORT has been one of the best means – and a relatively simple one at that – of indirectly accomplishing family planning in Bangladesh, for it has been proved to be a highly effective means of preventing deaths due to diarrheal dehydration."

At Harvard's Children's Hospital, the largest pediatric center in the United States, where ORT is now the norm, Dr. Mary Ellen Avery, professor and chief of pediatrics, adds, "We consider any child requiring intravenous rehydration a failure of our basic diarrhea management strategy."

ORT and Nutrition

Of itself, ORS does not provide adequate nutrition over an extended period of time. A child cannot grow on ORS alone. Thus an emphasis on feeding, particularly breastfeeding, is an important part of the ORT strategy. "ORT protects nutrition," Dr. Hirschhorn points out. "ORT is often taken to mean rehydration . . . only, when it should be defined to include continued feeding as well."

UNICEF's 1986 *State of the World's Children* report also observes: "Even for those children whose lives are not directly threatened by dehydration, ORT could become one of the most incisive of methods for cutting into the cycle of infection and malnutrition which now holds back their growth. The first and most basic element of ORT has nothing to do with technology or special formulas or foil-wrapped sachets. It has to do with informing parents that it is important to persist in giving a child food and fluids during an episode of diarrhea."

Contrary to the common reaction of parents to withhold food and fluids, including breast milk, during diarrhea – in the widely held belief that it is good to give the system a "rest" – continued feeding combined with ORT during and after an attack is hailed by health experts as the best way to help reduce dehydration and prevent diarrheal malnutrition. To withhold food from infants and small children with diarrhea is to reduce the quantity of needed sugar, salt, water, and amino acids, decrease the production of new cells

for the intestinal walls and lower nutrient absorption even further.

Dr. Mamdouh Gabr, a pediatrician on the faculty of Cairo University, cites a study in Alexandria indicating that infants with diarrhea who continued breastfeeding regained their appetite more quickly, had less diarrhea, required less oral rehydration fluid, and had a higher weight gain than a control group.

The latest medical consensus, then, is to combine ORT with small meals throughout the day – as difficult as this may be in some less developed countries. Even though the diarrhea victim may have diminished appetite, frequent feedings are seen as reversing the nutritional consequences of severe diarrhea.

Convincing Doctors and Pharmacists

Physicians and pharmacists are becoming increasingly convinced that ORT is the standard treatment for diarrheal dehydration. But this was not always the case. As late as the 1960s, the medical community was continuing to identify additional infectious agents – viruses, bacteria, or parasites – that cause most cases of diarrhea. Until the late 1960s, the cause of half of the cases of diarrhea was unknown. In the past twenty years there has been an explosion of knowledge about the organisms that cause diarrhea. In terms of numbers of cases, perhaps the discovery that viruses, especially rotaviruses, can cause diarrhea, was the most significant advance.

Doctors knew that diarrhea was caused by infectious agents – by bacteria and parasites, and in the early 1970s, it was discovered, by viruses – but failed in being able to address the lethal dehydrating effect of the infection. Instead, they felt they must prescribe drugs to deal with the infectious agents, often combined with medicines that diminished intestinal motility. The idea of using an oral solution to replace the vital chemicals and fluids lost by the body, thus treating the dehydration while allowing the natural resistance of the patient to overcome the infection, achieved only slow recognition in medical circles and in medical education. It was not until the late 1970s, when the scientific basis of ORT became widely publicized, that the emphasis was firmly placed on promoting ORT to combat the serious complication of dehydration.

For mild cases of dehydration, many doctors still regard ORT as merely a secondary, supportive approach, and continue the indiscriminate use of ineffective or harmful antidiarrheal drugs and

antibiotics – including multiple ingredient medicines – when the evidence points to ORT and tested home remedies as the best treatment for nearly all cases of dehydration caused by acute diarrhea. It should be noted, however, that long-lasting diarrhea caused by certain parasite infections may require appropriate drug treatment, but only after rehydration and identification of the causative organism has taken place.

It may come as no surprise that, as WHO reports, about 33 percent of some $350 million worth of "antidiarrheal drugs" sold each year by leading western manufacturers end up in developing countries. This is true, says WHO, despite the fact that none of the compounds it has tested has succeeded in signficantly reducing fluid losses in cases of diarrhea in therapeutic trials.

Some multiple ingredient medicines can actually prolong diarrhea. As noted in a recent edition of the widely distributed *Diarrhea Control* newsletter, published in Egypt: "It is the usual case that a child gets several of these medicines at a time, ending up with 4–5 different antibiotics or multiple doses of the same antibiotic. Many antibiotics are toxic: streptomycin affects ears and kidneys, neomycin causes malabsorption, chloramphenicol suppresses the bone marrow, sulfa drugs are a common allergen. If these drugs were effective, the risk might be worthwhile. But many bacterial pathogens are now resistant to these drugs (partly because they have been so widely used) and viral diarrheas do not respond at all to drugs."

Still Needed: A Continuing Breakthrough

Despite the reports of success due to ORT, a breakthrough of a different kind – a social, or knowledge, breakthrough – is needed to bring the message to the attention of millions more in need.

Although prepackaged sachets of ORS are now available in most developing nations, global usage rates, according to WHO, remain below 11 percent, and only 51 percent of the world's families have access to it.

The 500 million young children living in developing countries seem caught in a dilemma: most live in countries exposed to the new technology, but not nearly enough families are using it.

African countries present the greatest challenge. Africa as a whole still has the highest infant mortality rates of any continent

in the world and the largest proportion of deaths of children under the age of five, with diarrhea remaining as an important cause.

However, all Asian countries have operative diarrheal disease programs. In Bangladesh, for example, where the government's National Oral Rehydration Programme is distributing more than 17 million ORS packages, diarrhea-related mortality has dropped an estimated 7 percent. In Thailand, ORT is used by more than half of all parents to treat infant and child diarrhea. But in the Philippines, where 70 percent of mothers are estimated to know about ORT, only one of four is thought to be using it.

Latin America presents much the same picture. In Honduras, where more than 90 percent of the women now know about the new therapy, diarrheal dehydration mortality has been cut by 40 percent because of ORT. In Brazil in 1985, ORT was used to treat some 5 million cases of diarrheal illness in children.

In numerous other countries, positive results are reported. For example, in the Caribbean island nation of Haiti, one of the poorest countries in the world, a national program funded by A.I.D. and UNICEF has brought ORT to the attention of more than three-quarters of the island's mothers and dramatically reduced infant mortality. (See Figure 1.3).

Delivering the Product

But "the dilemma still remains that, in the home, particularly in countries where infant mortality is highest, insufficent progress has been made," A.I.D.'s Chief of Health Services, Anne Tinker, told ICORT II.

"Perhaps we are witnessing the natural evolution of change brought about by a new technology," she suggested. "But how can we achieve a revolution of declining diarrhea deaths in those countries where the suffering is the greatest? Science has clearly supplied us with the technology for this revolution. We must now take it to where the diarrhea is, to the clinics, and the hospitals and most importantly to the homes." This is an enormous task, complicated by traditional sociocultural behavior and attitudes, language difficulties, misunderstanding about the purpose and mechanics of the new methods, and resistance to change.

While the ORT solution itself is simple, its implementation is complex. Programs that are community based can be expected to be the most effective in reaching people in the developing world.

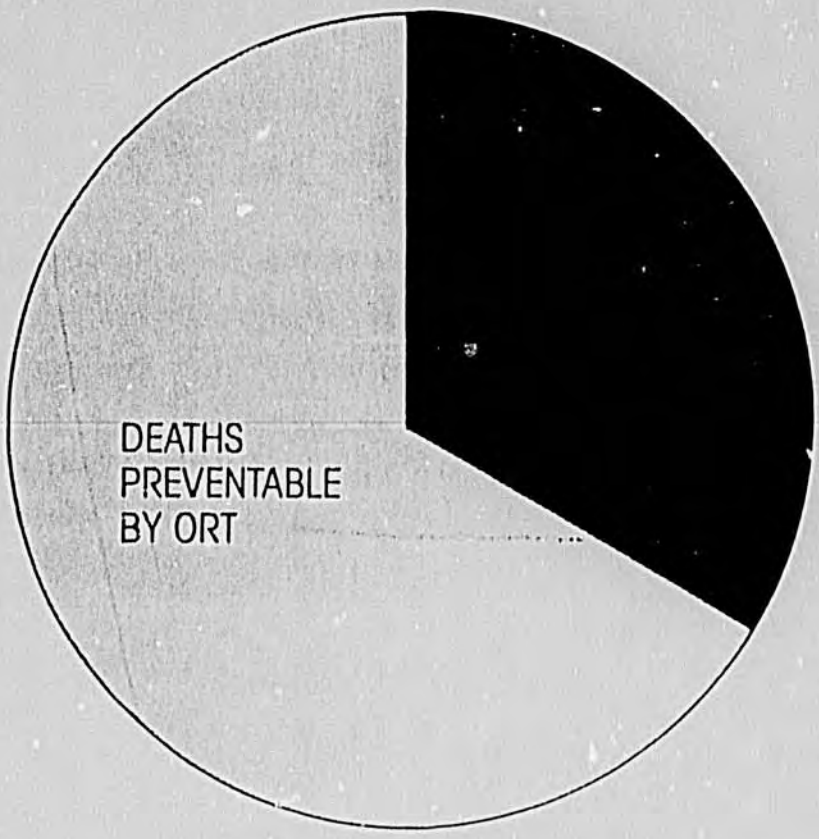


Figure 1.3. Worldwide deaths from dehydration, 1985. Source: World Health Organization estimates (excluding China), 1985.

Among the challenges that must be met are those of supplying the packets or making the ingredients available; finding ways to measure the ingredients accurately in the home; informing and educating health workers, paramedics, and families; analyzing the needs, wants, perceptions, and preferences of the target populations; and teaching health workers and mothers about the important part played by nutrition in the health of children affected by

diarrhea-related illnesses.

What if the child vomits? Does the solution have to be made in boiled water? Should it be given in one sitting or throughout the day? How much should be given?

An instructor at a village training course might say, "Oral rehydration is the most appropriate technology for the management of infants with acute diarrhea."

But a mother might wonder, "What does 'appropriate' mean?"

Others might ask, "What is 'rehydration'?" And, "What is meant by 'oral'?"

Health education programs must be launched or reinforced. This means that trainers must be trained. Mothers must be motivated. Attitudes and practices must be altered. Media must be informed.

Most important, ORT must become part of a health care system, for by itself, ORT does not equal diarrheal disease control. Other interventions, including improving water supply and sanitation facilities, child spacing, improving food hygiene and nutrition, epidemic control, vitamin supplementation, and immunizations, all complement the ORT technology.

Barriers and Challenges

Other barriers to action include rebuilding inadequate health systems, assuring a supply of ORS, and strengthening communication within the medical profession.

What is the best way to market ORT? What is the best way to reach semiliterate paramedics? When there is little or no radio or other mass media, what is the best way to mount a campaign to teach mothers how to mix a product that, if incorrectly prepared, can cause rather than cure illness? As a social, not a commercial product, ORT must be "sold."

Ongoing ORT programs must be monitored and evaluated with regard to the training of health professionals in order to confirm that the technology is reaching a sufficiently large segment of the targeted population and that it is effective and acceptable.

Among the questions that must be answered by health staff: How do you mix salt and sugar solutions? At what rate should ORT be given? How long should ORT be administered?

"The task before us now," asserts the *Child Survival Action News* newsletter, "is to make this therapy as familiar and as readily available to parents and health workers as aspirin."

ORS sachets, adds UNICEF, should be as available as soap, batteries, razor blades, or cola drinks.

The challenge is great. "There are no magic bullets or short cuts," asserts WHO's Director General, Dr. Halfdan Mahler. "Successful delivery of oral rehydration therapy requires implementation of training, supervisory, logistical and educational activities in a manner which will ensure its long-term benefit for the population. Proper use of ORT and application of other diarrheal control strategies also require sound operational research – research that is undertaken in countries by *national* institutes and scientists in collaboration with those responsible for implementation of health services activities."

Underlying all of these concerns, still another area, termed the "sociology of diarrhea," also must be examined. In a keynote address give at an Asia regional workshop on ORT sponsored by A.I.D. in 1985, Dr. John Rohde, one of the world's foremost experts on diarrheal diseases, observed that a spectrum of social and environmental factors together lead to sickness and death from diarrhea.

"Poverty, illiteracy, demographic crowding, environmental pollution, malnutrition, all combine in what is called a 'social synergy' leading to illness and death. ORT addresses only the final symptoms. We must infuse into our programs an element of comprehensiveness that addresses these valid concerns. An effective ORT program strategy is in fact a consumer-oriented, behavioral change strategy that must penetrate the very beliefs and practices of each family. The correct knowledge by mothers leads to scientific action on their part. The knowledge of when and where to seek further help and the certainty to demand it is crucial."

Chief among the dividends, including the saving of lives, is that ORT is generating a new attitude among villagers, especially women, regarding the feasibility of preserving life – particularly the lives of children.

2

From Scattered Use to Major Breakthrough: ORT Comes of Age

Never in the history of medicine has so much been done for so many with so simple a technology and so little expenditure.

—Mamdouh Gabr, M.D., Faculty of Medicine, Cairo University, at ICORT II

In the high-income countries of the West, diarrhea is a symptom that may require medical care, particularly among infants, but it is not a major health threat. It usually elicits no more than the standard admonition to provide plenty of clear liquid.

In developing countries, where diarrheal dehydration always has been life-threatening, just the opposite is true. Nothing so typifies the vast differences between the West and the Third World as this most common of all childhood diseases.

For centuries, diarrhea has affected children. And for centuries the treatment for many has been the same: withhold food and drink, and administer purgatives, emetics, opium, brandy, and tannic acid enemas. Even bloodletting, calomel (mercurous chloride), and the chants of the ritual healer have been thought to be effective.

In ancient times, on the Indian subcontinent, and in other parts of the world, the treatment was with mineral salts, cereal, carrot soup, or sugar and water— leading many of the physicians, nurses, and mothers in countries who still use these remedies to claim they

have always practiced ORT.

In many ways, they have. As the ICDDR,B's former Director, William Greenough III, is fond of telling people, one only discovers things that already exist. "For example, ICDDR,B researchers have devised a rice-based ORT solution that matches one the Chinese have had for thousands of years. The glucose in ORT comes from rice, a starch. Rice happens to be a food staple in Bangladesh. In other developing countries, the food staple may be maize, wheat or another grain. Instead of sending grain to the factory to process it and obtain glucose, why not use it directly?"

The line of inquiry that led eventually to the ORT mixture we know today had to wait for an understanding of how nutrients, salts, and water are handled in the intestinal tract. Not until the 1960s, when the effectiveness of oral rehydration was proven, was the physiologic basis for the treatment firmly established.

Attempting to Cope with Dehydration

In 1830, during an era when cholera repeatedly swept the world, scientists at the Institute for Artificial Mineral Waters of Moscow tried to restore lost body fluids through intravenous (IV) therapy. Two years later, a Scottish physician, Thomas Latta, followed the recommendation of an Irish physician and injected a saline (salt) solution into the veins of fifteen dying cholera victims. But not realizing the vast amounts of fluid that were required, Latta halted the treatments too soon. Only five patients survived, and for more than seventy years the medical and scientific world gave little consideration to IV therapy—even at the turn of the twentieth century, when mortality from cholera had reached a frightening 60 percent.

In 1908 in Calcutta, an English pathologist, Sir Leonard Rogers, demonstrated that the mortality rates could be cut in half when a saline solution was allowed to drip slowly through a needle into the veins of patients. The high salt content of "Rogers' solution" often proved fatal, however. In 1909, Dr. Andrew Sellards, working in the Philippines, improved the solution by adding bicarbonate to restore the acid-alkali balance of the body. But it was not until some years later that the optimum level of electrolytes in the solution was determined and the proper mix of ingredients was refined by researchers in various parts of the world.

In the 1940s, in Baltimore City hospitals and at Yale University, while most attention still was focused on intravenous intervention, preliminary *oral* rehydration studies were conducted on infants.

Treating the Dehydration Side Effects of Cholera with IV

In 1958, when cholera broke out in Dacca, East Pakistan (now Dhaka, Bangladesh), the local office of the International Cooperation Administration (the organization that became A.I.D. in 1961) requested the assistance of an American team from the Naval Medical Research Unit No. 2 in Taiwan. The ICA also started the Pakistan-SEATO (Southeast Asia Treaty Organization) Cholera Research Laboratory in 1960, which in 1979 became the ICDDR,B.

At the time, IV therapy was thought the only sound method for treating cholera and other diarrheal diseases. But virtually all who worked in the field came to recognize that only a relatively small number of people could be served by a technique that required distilled water and sterilized bottles, depended on tubes and needles, took highly trained personnel to administer and monitor, and relied on buildings, organizations, and skilled personnel that were frequently not affordable or even available in many undeveloped areas.

The conclusion was inescapable: intravenous therapy could not begin to cope with the huge problem of diarrheal diseases.

Bangladesh: A Special Place

In 1962, research at the Cholera Research Laboratory (CRL) took the initial halting steps down the path to ORT, and Bangladesh came to play a special role. During a period of communal hostilities, an outbreak of cholera in an overcrowded camp of 10,000 persons pressed the center into service. One-third of the patients were given a so-called 5:4:1 intravenous solution for rehydration—five grams of sodium chloride, four grams of sodium bicarbonate, and one gram of potassium chloride in a liter of water. The result was startling.

A zero death rate, compared to 27 percent in one of the other two hospitals where cholera patients were taken and 47 percent in the third, was the first evidence that one standard solution might work

for everyone. In technical terms, the sodium provided the critical ion present in all body fluids; the bicarbonate treated the acidosis that occurs frequently with dehydration; and the potassium provided the critical intracellular ion related to cell functions.

These ingredients, less glucose, foreshadowed the mass production of packets of a substance that could be dissolved in water, for that was how the IV solution was at first "manufactured." Because the number of victims far outstripped the facilities in the patients' ward, a tent was constructed to handle the overflow. On a makeshift assembly line, the dry ingredients were mixed and packaged in refillable glass bottles that had been donated by a U.S. hospital, then stirred into water— the same way that years later the more developed oral therapy ingredients would be put together.

Discovering the Role of Glucose in ORT

While refining intravenous therapy, and during research on diarrhea due to cholera, scientists were experimenting on oral rehydration. When a patient drank a solution of water and salts during diarrheal attacks, they noted, neither the water nor several of the essential electrolytes lost would pass through the one-cell-thick intestinal wall. Then, as the result of years of patient work by scientists working around the world, a fairly simple method was discovered. Basic research at Yale and elsewhere had shown that glucose and other solutions would stimulate the transport of salts across membranes. In classic investigative fashion, researchers with the Calcutta and Dhaka teams such as Tiemala Uddir Ahmad, John Banwell, Richard Cash, Norbert Hirschhorn, Rafiqul Islam, A.K.M. Jamiul-allam, Dilip Mahalanobis, A.M. Molla, David Nalin, Robert Northrup, Robert Phillips, N.F. Pierce, David Sachar, R.B. Sack, and Jim Taylor experimented using the single-cell epithelial lining of the small bowel as the membrane. These scientists discovered that, when glucose was added, the absorption of salt and water was accelerated through the intestinal wall.

Somehow the bowel absorbed all four essentials— sodium, chloride, potassium, and bicarbonate— plus the water.

For energy and taste, some of the early oral rehydration solutions had used either glucose or sucrose for the sugar. But now the glucose was relied on not for the calories it provided, but for the absorption of the sodium. As the glucose passed through the

intestinal wall, it carried the sodium, chloride, and water with it.

Dr. Norbert Hirschhorn, with years of experience in Bangladesh and with Egypt's National Control of Diarrheal Diseases Program, has observed this phenomenon: "Even while bacteria can block sodium chloride absorption, the sugar glucose continues to stimulate sodium absorption. Water and other salts follow along through osmotic and electrical forces at a rate three to ten times greater than normal salt absorption without glucose."

Even contaminated water, it was later found, would work when the solution was given by mouth, making it practical for villagers with no potable, clean water or for those unable to spare the firewood, cow dung, or other fuel needed to boil the precious liquid. Because one of the functions of the intestinal tract is to cope with the germs that are constantly ingested, the rehydration fluid does not have to be sterile.

Later research showed that ORT worked with diarrhea caused not only by cholera but by other diseases. In 1964, Capt. R.A. Phillips, Director of NAMRU-2 in Taiwan, NAMRU-3 in Egypt and later Director of the then Cholera Research Laboratory, published findings that glucose-aided absorption of sodium and water occurs in even severe cases of cholera. This vital observation, later confirmed by other scientists in Dhaka and Calcutta, laid the groundwork for establishing the scientific basis of ORT.

By 1968, while drugs and IV fluids still constituted the accepted treatments for diarrhea, the first papers to detail the successes of the oral therapy were published. At the time, most doctors still were not taking the oral approach seriously, but in 1969, WHO included ORT in all its training courses, and gradually the therapy was adopted.

What Causes Diarrhea?

Describing the complex web of factors that cause diarrhea, Dr. Leonardo Mata recently explained the process: "Infectious enteric agents are transmitted by ingestion of food and water contaminated with feces or through contact of the mouth with fingers or utensils soiled with feces. All possible forms of transmission are evident to the careful epidemiologist or anthropologist who works in rural settings. Transmission involves human-to-human and less prominently animal-to-human direct or indirect contact;

animals may be important in rural settings because they may cohabitate with children."

Remarkably, as late as 1960, the medical community was still not entirely sure why a person gets diarrhea. However, with the advent of the concept of enterotoxin—a poison in the intestine—which derived from the work on cholera and the observations of Dr. S.N. De in Calcutta in the late 1950s, it was possible for the first time to identify enterotoxin-producing bacteria that caused disease.

Some of the major categories of bacterial organisms that cause acute diarrhea are: (1) *Vibrio cholerae* and some types of *Escherichia coli* that cause secretion and reduce the normal absorption of sodium and chlorine in the intestine; (2) *Shigella, Salmonella, campylobacter,* and some other strains of *E. coli* bacteria that invade the mucous lining of the intestine; and (3) *Staphylococcus aaureas* and *Clostridia,* organisms associated with food poisoning.

Of the parasites known to cause diarrhea, *Giardia* and *Entamoeba histolytica* have been identified; and of the viruses, the rotavirus particularly affects infants. (See Figure 2.1.)

Still, not all of these microbes or organisms will necessarily cause diarrhea. Acid in the stomach, movements of the intestine, natural colonization of the gut by symbiotic bacteria, and the production of natural antibodies can all moderate or even prevent bacterial infection.

The Turning Point

The Indo-Pakistan war of 1971 that established Bangladesh as an independent country also established oral rehydration as the dominant therapy for cholera and other diarrheal diseases. While 6 million refugees poured into India from the fighting in East Pakistan, the refugee camps, like battlefield casualty stations, overflowed with the sick and the dying. In the monsoon season, water-borne bacteria acted swiftly: the camps had a mortality rate of more than 25 percent from diarrheal disease.

In Calcutta, the Johns Hopkins University Center for Medical Research and Training set up treatment centers, and so woefully small was the supply of intravenous solution that circumstances dictated the use of oral therapy. No potassium was available, but

This table gives the information that will help to identify, on clinical grounds alone, the most common agents of diarrhoea. It is greatly simplified. For example, some agents produce a variety of clinical features. Only agents of major importance world-wide have been included. In certain areas, at certain times, the picture may be quite different.
Try and find out what the important causes of diarrhoea are in your area.
Caution: There are a number of other conditions associated with diarrhoea such as infections outside the gut (e.g. measles and malaria), malnutrition, food intolerance etc. Remember to look for these and give specific treatment where appropriate.
If readers find this table useful, we may present other information in the same way in future issues of *Diarrhoea Dialogue*. Please send us your comments on this clinician's guide.

COMPLAINT	ASSOCIATED CLINICAL FEATURES		INCUBATION PERIOD	EPIDEMIOLOGICAL FEATURES	ORGANISMS	FIRST LINE TREATMENT
	COMMON	OTHERS				
	•Vomiting •Fever	•Severe dehydration in some	24-72 hours	•Infants and young children •Common world-wide in all socio-economic groups •Peak in colder seasons in temperate climates	Rotavirus	•Rehydration therapy
ACUTE WATERY DIARRHOEA ➡ The stool takes the shape of the container	•Nausea •Vomiting •Abdominal pain	•Fever •Malaise •Severe dehydration	6-72 hours	•Infants and young children in developing countries •Travellers diarrhoea in adults	Enterotoxigenic *Escherichia coli* (ETEC)	•Rehydration therapy
	•Nausea •Vomiting •Fever •Chills •Abdominal pain	•Malaise	8-36 hours	•Children •Common world-wide •Food borne outbreaks (animal products) •Warmer seasons	Non-typhoid Salmonellae	•Rehydration therapy
	•Abdominal pain •Fever •Malaise	•Chills •Blood and pus in the stools	3-5 days	•World wide distribution •In developed countries may be food borne (animal products) or transmitted by handling of animals	*Campylobacter*	•Rehydration therapy •Erythromycin in severe cases
	•Vomiting •Abdominal pain	•Severe dehydration •Circulatory collapse, 'shock'	1-3 days	•Children in endemic areas •Adults in newly affected areas •Not found in Latin America	*Vibrio cholerae*	•Rehydration therapy •Tetracycline
	•Nausea •Vomiting	•Fever	6-72 hours	•Nursery outbreaks in developed countries •Uncertain in developing countries	Enteropathogenic *Escherichia coli* (EPEC)	•Rehydration therapy
DYSENTERY ➡ The stool is soft and watery with blood and/or pus	•Fever •Abdominal pain	•Malaise •Vomiting •Urgency to defaecate •Painful spasm on defaecation	36-72 hours	•Children •Poor hygiene •Malnutrition •Institutions •Warmer seasons	Shigellae	•Rehydration therapy •Ampicillin or Trimethoprim Sulfamethoxazole
PROLONGED DIARRHOEA (OR DYSENTERY) ➡ For at least 7 days, stools have been more frequent or of softer consistency (with or without blood or pus)	•Abdominal discomfort		2-6 weeks	•All age groups •World wide distribution	*Entamoeba* histolytica*	•Metronidazole
	•Abdominal distension •Flatulence	•Anorexia •Nausea •Malabsorption •Frothy stools	1-3 weeks	•Young children •Some travellers •Poor hygiene •World wide distribution	*Giardia* lamblia*	•Metronidazole

*Can be identified on examination of the stools with a light microscope. Blood and pus from Shigellae and *Campylobacter* can also be identified

Produced in collaboration with the Ross Institute of the London School of Hygiene and Tropical Medicine and The Save the Children Fund

Figure 2.1. Common causes of diarrhea. Source: Dialogue on Diarrhoea, *Issue No. 7, November 1981.*

the center's laboratory became an assembly line. Table salt, baking soda, and sugar were packaged in plastic bags and the ingredients were dissolved in water at the camps.

Patients in shock were given the little available intravenous solution, averaging less than three liters each before they were

transferred to oral therapy. All of the others received oral solution from the beginning, the adults averaging ten to twelve liters. This treatment saved many lives.

Not until the 1980s would an emphasis be placed on promoting ORT on a large scale, and not until 1982 would a comprehensive and accurate global survey of the magnitude of the problem be made—one that, using three decades of studies, would show diarrhea most frequent in infants between six and eleven months of age, with death from diarrhea the highest among infants and children below the age of two. But Calcutta would prove the turning point, so low was the mortality rate among the camps' diarrhea victims—3.6 percent overall and 1 percent among those directly under the care of the Johns Hopkins staff.

From this time on, ORT became known as the most practical way of treating the world's huge numbers of diarrhea victims, and in all but the most severe cases of diarrheal dehydration, intravenous therapy proved unnecessary. By 1973, it had been established that cholera vaccines were ineffective in controlling the spread of the disease. In May of that year, WHO declared injected cholera vaccination unneccessary until an effective immunization becomes available.

For many years following the WHO declaration, cholera vaccination continued—in the mainstream belief that it could do no harm, and might in fact do good. Ill-informed doctors, travel agencies, airlines and some governments continued to recommend the vaccinations. As late as 1983, twenty countries still required cholera vaccination certificates for travelers coming from infected areas.

Further research into oral rehydration continued in the 1970s, and different compositions of the basic formula were tried. In 1978, with proof of ORT's effectiveness firmly established, *The Lancet* proclaimed:

> The discovery that sodium transport and glucose transport are coupled in the small intestine, so that glucose accelerates absorption of solute and water, was potentially the most important medical advance this century.

Here was an accolade that expressed the culmination of decades of work, the product of thousands of scientists and physicians, the fruit of research extending back to the early 19th century.

The Standard Formulas

The same year as *The Lancet's* editorial, WHO launched its global diarrhea control program, with the immediate objective of reducing the high mortality caused by acute diarrheal diseases and their associated ill effects, particularly malnutrition.

Eventually WHO and UNICEF recommended a standard package formula. Known as oral rehydration salts (ORS), it came to consist of the following basic ingredients per liter of water:

Sodium chloride (common household salt)	3.5 grams
Sodium hydrogen carbonate (sodium bicarbonate)	2.5 grams
Potassium chloride	1.5 grams
Glucose	20.0 grams

In 1979, in a pilot study at the ICCDR,B (which gets most of its funds from A.I.D.), the standard formula was modified to include 30 grams of rice powder mixed in water and cooked for a few minutes to produce a smooth liquid. In the standard proportions, common salt, potassium, and bicarbonate were added, with enough water to make a liter of the solution. In a comparison of 124 adults and children selected for the study, the success rate was almost the same for the rice powder group as for the sugar group.

Initially, a number of Western medical journals declined to publish the results of the study. But *The Lancet* published them in 1982, and it has been recognized ever since that the rice powder solution offers several advantages. Digestion releases the glucose in rice slowly, whereas giving too much glucose or sucrose too quickly can increase diarrhea.

Other ICCDR,B studies went on to bear this out, and in December 1983, ICCDR,B introduced the rice-based oral rehydration solution in routine treatment at the center's hospital in Dhaka. In 1985 it was reported that rice ORS also substantially reduced diarrhea both in severity and duration.

In 1984, in an attempt to encourage more extensive ORT use, WHO recommended a change in the standard formula replacing the sodium bicarbonate with trisodium citrate, dihydrate. After seven comparative studies, it was found that the trisodium citrate corrected acidosis—excessive acid—as quickly as the bicarbonate.

which in a damp atmosphere reacts with the glucose, resulting in carmelization of the powder.

According to WHO, the ORS-citrate mixture results in better stability and longer shelf life. It consists of the following ingredients per liter of water:

Sodium chloride	3.5 grams
Trisodium citrate, dihydrate	2.9 grams
Potassium chloride	1.5 grams
Glucose, anhydrous	20.0 grams

Some pediatricians maintain that the formula contains too much sodium for infants, but the risk is minimized by continued breastfeeding or by giving other additional fluids. Also, since 40 grams of sucrose (common sugar) equal about 20 grams of glucose, sucrose can be used.

Homemade Solutions

Doctors generally recommend the carefully measured, prepackaged ORT solutions, fearing in particular that too much salt can be dangerous, especially for infants because their kidneys may not yet be able to excrete an excess of sodium. Too little salt does not help rehydration, but too much salt could make an infant vomit or even die from hypernatremia. With too little sugar or none at all, there may be no rehydration as the salt and water pass straight through the child's body; with too much sugar the absorption rate may decrease sharply and perhaps diarrhea will be aggravated.

However, despite the fact that A.I.D., UNICEF, WHO, and other international donor groups are supplying millions of ORT packets, the prepackaged formula is still not available in many areas of the developing world.

In many areas, particularly remote ones, people rely on various home-based solutions. Such substitutes have proved effective and offer the advantage of being available as soon as diarrhea begins.

One do-it-yourself version is simply eight teaspoons (assuming a teaspoon of about 5 ml) of sugar and one level teaspoon of salt in one liter of water. Crude or refined household sugar will do, as will rice powder or other cereals (or soy) containing amino acids or carbohydrate.

In Bangladesh, where salt *(lobon)* and molasses *(gur)* are available in many households, the Oral Therapy Extension Program of

the Bangladesh Rural Advancement Committee has taught millions of women how to use these ingredients. A three-finger pinch of salt and a four-finger scoop of molasses, which also contains some potassium and bicarbonate, are dissolved in half a "seer" (a local measure equivalent to about half a liter) of water.

Rice-Based Solutions

Other effective home treatments are based on corn or millet or a variety of juices, coconut water, tea, and—because rice is a staple of 60 percent of the world's population—rice powder. In Nepal, for example, where rice powder or flour is a traditional weaning food, rice powder, salt, and water are mixed. Because rice contains more calories and other nutrients than ORS, rice is seen as more of a food. It also has been shown to produce less vomiting than the traditional ORS solution and to reduce the volume of stool in acute cholera and other diarrhea-related cases by 40 to 50 percent.

It is important to note that there is a difference between rice powder and rice water ORS. Rice powder solutions use a standard amount of rice powder to replace the glucose in the WHO-UNICEF formula, to maintain the correct balance of carbohydrate and electrolytes. Rice water is also used as an early home remedy, but because it is the liquid that is drained from rice after it is cooked, it will result in only a small amount of fluid and is not generally suitable for oral rehydration because it contains an insufficient amount of salt and a variable amount of rice starch.

Dr. Majid Molla, a leading pediatrician and scientist at the ICDDR,B, was asked by *Dialogue on Diarrhea* how much rice powder ORS fluid should be given to a child with diarrhea. He replied: "The same amount as you would give of glucose ORS solution. This depends on the size of the child and the severity of the diarrhea. For example, to replace what has already been lost in a midly dehydrated child, 50 ml per kg body weight should be given. For a child weighing 10 kg this would be 500 ml (half a liter, or roughly a pint) over four hours."

Asked how long a rice ORS solution can be kept once it has been made up, he responded: "It should be protected from contamination like any other food and drink. Our preliminary findings suggest that it can be kept safely for about eight hours in a hot tropical climate and up to twenty-four hours in a colder climate."

Production of Prepackaged ORS

Reliable data indicate that ORT prevented 350,000 deaths in 1984 alone. Since ICORT I, the production of ORS packets has increased from about 60 to 250 million a year, with most of the packets produced in the developing countries themselves. Some forty countries are known to have undertaken evaluation of their country programs, many have conducted diarrheal mortality and morbity surveys, and A.I.D., WHO, UNICEF, and other groups all have plans to increase the production and distribution of ORS packets. (See Figure 2.2.)

Expressing enthusiasm about stepped-up ORS production plans and noting the well-established interaction between diarrhea and malnutrition and the effects of malnutrition on physical, mental and emotional development, Egypt's Mamdouh Gabr said at ICORT II: "A much larger, unquantifiable number of children have been spared further threat to their lives. Many more millions of deaths and handicaps from diarrhea can be averted if we carefully perfect and correctly implement and expand our program for oral rehydration."

According to WHO, the following developing countries are producing oral rehydration salts:

Americas	Argentina
	Brazil
	Colombia
	Dominican Republic
	El Salvador
	Haiti
	Honduras
	Mexico
	Paraguay
	Peru
	Venezuela
Near East and North Africa	Afghanistan
	Egypt
	Gaza Strip
	Iran

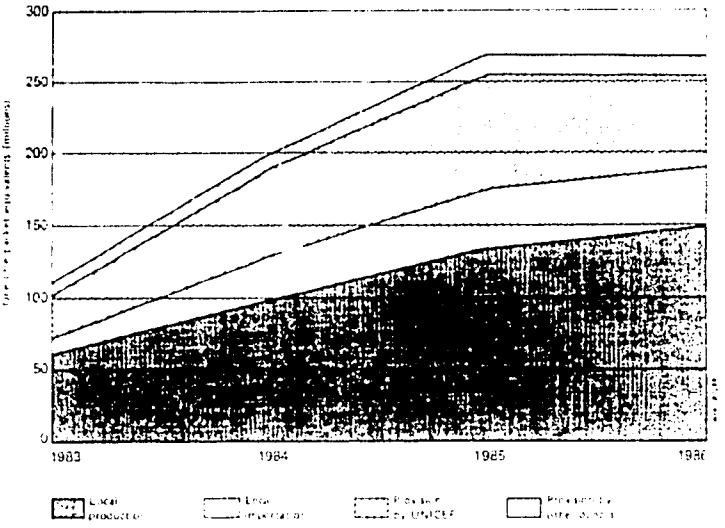


Figure 2.2. Global Supply of ORS, 1983-1986. Source: WHO.

(Near East and North Africa)	Iraq
	Morocco
	Pakistan
	Syria
	Tunisia
	Turkey
Southeast Asia	Bangladesh
	Burma
	India
	Indonesia
	Nepal
	Mongolia
	Sri Lanka
	Thailand
Sub-Saharan Africa	Burkina Faso
	Burundi
	Ethiopia
	Kenya
	Mozambique
	Zaire

Western Pacific	Cambodia
	China
	Malaysia
	Philippines
	South Korea

3

ORT Around the World: Reaching Mothers, Health Workers, and Traditional Healers

We are at the start of possibly the greatest breakthrough for the health of children in recorded history.

—James P. Grant, Executive Director, United Nations Children's Fund (UNICEF), at ICORT II

The revolution in child survival is being fought in almost every developing nation in the world. It is being waged by large international organizations such as A.I.D., UNICEF, and WHO, and by cooperating governments and private voluntary organizations, as well as doctors, nurses, pharmacists, health workers, and entire ministries of health. WHO's targeted goals for ORT promotion through 1989 are shown in Figure 3.1.

But it is also being fought in the villages and neighborhoods of the poor, by mothers, fathers, grandparents, local healers, and shop owners—all using the weapons they have at hand: a container to measure water and a spoon device to measure sugar and salt. In Gambia the bottle and cap from a local soft drink are used; in Ecuador, a plastic bag; in other nations, a simple gourd, a coconut shell, a bottle cap, a match box, even a tin can.

In Egypt, a well-known actress has helped in the cause. In Bangladesh, teams of oral rehydration workers (ORWs) have taken

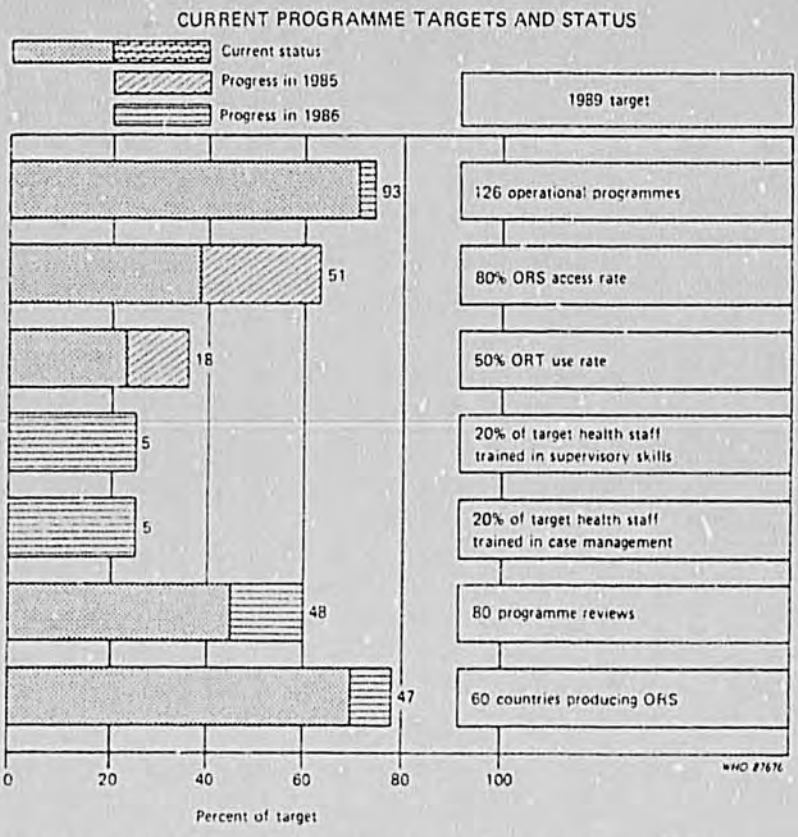


Figure 3.1. Current program targets and status. Source: WHO.

the ORT message to millions of households. "Happy Baby" flag ladies have carried the ORT banner in The Gambia. In Swaziland, "yellow flag" volunteers are doing the same. Brazilian *resadeiras*, or traditional healers, have proved an example for modern medical practitioners, taking the ORT message to people who for centuries have viewed diarrhea as a sign of the evil eye.

Most of all, the revolution is being fought by the families of children with diarrhea. At an international health congress in Tunisia in 1984, Dr. Robert Northrup of AID's PRITECH project spoke of a "steadily accumulating barrage of evidence" that mothers are remarkably capable, both at home and in the hospital, of managing diarrhea. "There is the inescapable fact that mothers are

the first line of defense against dehydration, indeed the only health worker available in the home to give oral fluids when diarrhea begins, and seek help if it persists."

One year later, at ICORT II, UNICEF's Executive Director, James P. Grant, described a public health care "infrastructure" involving not just the medical worker or medical facility but the school and radio, and even the village priest. He reminded his listeners that in the 1950s and 1960s, people somehow overlooked the fact that "the front line of health is the family itself."

Traditional Healers

Next to mothers, the most important element in preventing and treating dehydration and delivering ORT could be the practitioners of folk religion, herbalism, and ancient remedies—those people called traditional healers.

In rural northeastern Brazil, 76 percent of mothers seek out traditional healers, or *resadeiras*, as their first source of help. A study by AID's PRICOR project designed to mobilize and integrate the healers into the official health system found them meticulous in preparing the glucose and salt solution. Each served about fifty to one hundred households without a fee, believing it wrong to take monetary gain for something "that comes from God."

"They are dedicated, available 24 hours a day, 365 days a year and display a warmth and love for their clients that could be an example for modern medical practitioners," the study said. "It would appear that healers of this kind can play a very significant role in preventing and treating dehydration. Primary health care program managers might consider the feasibility of using traditional healers for many types of village health work."

Reaching Doctors

Dr. Samuel W. Hynd, Minister of Health for Swaziland, recently described a "miracle" he witnessed in his country: "We had one packet of UNICEF oral rehydration salts which we mixed up in a liter bottle of water. A nurse sat down with a cup and spoon to give the fluid to the child, with the mother watching anxiously. Within

three hours, a miracle had occurred, the child was alert, and everyone, including myself, was very impressed. Since then, we have seen hundreds of infants restored to health in the clinic, using the same simple treatment and basic utensils."

But not all doctors are so convinced. Dr. Robert Northrup has called doctors the most important health workers needing to be convinced about ORT, and often the most difficult. "Doctors control the health care system in most countries. They control where resources—money, time, manpower—are concentrated. They control what technologies are implemented, what are ignored. Without their solid support, at all levels of treatment and administration, it is difficult to imagine an ORT program being successful."

Yet doctors still need to be convinced that diarrhea is an important problem, he said. "Because of their training, their nonrepresentative patient population and the lack of valid statistical data in many countries, doctors may not be aware that diarrhea is the major preventable killer in their countries. They then must be convinced that ORT, not IV therapy, should be the mainstay of diarrhea management, both in hospital and in the primary health care system."

Why are doctors so reluctant to accept ORT? One reason, Northrup suggested, is that it requires time to teach mothers. "Doctors, particularly in private practice, do not want to spend time talking to one mother when they could be seeing another patient or two . . . . They prefer to give a quick prescription, and on to the next patient. Also, ORS is cheap, and I believe that doctors, like patients, believe unconsciously that the usefulness of a medicine is directly proportional to its price."

Speaking from his Egyptian experience, Dr. Mamdouh Gabr recently called for a change in medical curricula, not only to advocate ORT but to stimulate greater interest in the effort to mobilize the medical profession. "Western textbooks that are commonly used by medical students and graduates in developing countries should include a chapter on ORT. Unfortunately, since infantile gastroenteritis is so rare in the developed world, this is often lacking."

9:00

9:15 AM

10:00 AM

1:15 PM

An Egyptian infant—dehydrated from the effects of diarrhea—is treated with life-saving oral rehydration therapy under a project supported by AID. At 9:00 a.m., the child's sunken fontanel is a clear sign of dehydration. In the space of hours, the child is out of danger and can resume breastfeeding by 1:15 p.m. Source: A.I.D.

Focusing on the "How"

Success is becoming infectious. The developing nations are no longer studying the "what" or the "whether," but are focusing on the "how"—how to get the ORT message across, how to administer, manage, and monitor the distribution system, how to get health workers, doctors, hospitals, and parents to implement the strategy, how to change the attitudes of those using the therapy, and how to cope with the obstacles to implementation.

In the developing world, no assumption is safe. People who are illiterate, for example, may find it difficult to "read" pictures. Villagers unaccustomed to looking at a series of instructional drawings will not necessarily view them from left to right (or right to left) as expected; they may need to be taught how to do this, just as they must be taught to understand that the drawings are meant to serve as instructions.

"Pictures alone are not enough," Peace Corps volunteers are told in a 500-plus page manual on ORT. "Use drawings to capture the villagers' attention, to reinforce what you say, and to give them an image to remember, but always give a clear and full oral explanation of your subject in addition to showing the drawings." The manual explains that in Liberia, where the symptom of loose or watery stools is commonly known as "running stomach," homemade ORS is promoted by UNICEF and the Ministry of Health and Social Welfare as "running stomach medicine" that can put the water back in the child's body. Mothers are told: "Give the medicine when the stomach starts to run. Do not wait until the person poo-poos plenty."

In an approach typical in the developing world, picture and text handouts have helped Liberian mothers learn the essentials of ORS preparation:

> THINGS WE NEED FOR THE MEDICINE:
> A clean soda bottle filled with clean water; an orange or half a grapefruit; sugar lumps; and water.
> 1. Measure one full soda bottle of water and put it in the cup or dish.
> 2. Take a three finger pinch of salt and add it to the water.
> 3. Put in two sugar lumps.
> 4. Squeeze the juice of an orange (or 1/2 a grapefruit) into the solution.
> 5. Stir it with a clean spoon.

Because it is important for the mothers to understand why the "running stomach" medicine works, the following simplified reasons are given:

We add *water* because we need to put back the water lost with too much watery poo-poo.
We add *sugar* to give strength to the sick person.
We add *salt* to put back the salt that is lost in the poo-poo.
We add *orange* (or grapefruit or even paw-paw) juice to put back the potassium that is lost in the poo-poo.

Social Programs Are Hard to Sell

"If you can sell toothpaste," the question goes, "why can't you sell good health?" And the answer is that good health *can* be sold, and with many of the same techniques used to sell such commercial products as soft drinks, automobiles, perfume, diet aids, and toothpaste.

While the emphasis on commercial selling is the product, the emphasis on "social selling," or "social marketing," is on some socially beneficial cause, service practice, or product, such as seat belts, cancer detection, dental hygiene, eating less salt—or learning a new formula to treat diarrheal dehydration. These new "products," really lifestyle changes rather than actual products, also require new ways of marketing. *Social marketing* describes a new genre of marketing expertise that adapts principles from the commercial sector to the very difficult problem of positive social change.

The U.S. National Cancer Institute uses social marketing principles to educate American women and health professionals about breast cancer detection. The American Cancer Society uses the same techniques to persuade people to give up smoking. A.I.D. is sponsoring a number of programs to further the development of social marketing and its application to international development. Communication for Child Survival, or HealthCom, is using social marketing to promote ORT, immunization and other child-survival interventions, and Social Marketing for Change, or SOMARC, is using it for family planning and also encouraging the development of indigenous social marketing organizations. In the developing world, in Bangladesh, Sri Lanka, Thailand, India, and El Salvador, commercial marketing principles are being employed to promote the use of contraceptives. In the Dominican Republic, Ghana,

Kenya, Indonesia, Tunisia, Costa Rica and other countries, SOMARC is applying the same principles to launch numerous social marketing programs.

Dr. William A. Smith of HealthCom points out: "Social marketing is a new organizing principle for the effective delivery of these vital health services. It is much more than advertising glitch—slogans, jingles, and a star spokesperson. When supported by adequate resources, based on careful audience and market research, and sustained over two to five years, social marketing has the potential for significantly reducing infant mortality from diarrheal dehydration."

A 1984 workshop by A.I.D.'s PRITECH project summed up the factors that make social marketing difficult:

> (1) There is greater resistance to audience research and audience segmentation in social programs; (2) governments are rarely able to maintain continuity and support long-term marketing efforts; (3) social programs have much less control over the delivery system (government intermediaries are not motivated by sales incentives); (4) social marketers are asked to teach many things at once, not just focus on the single most important benefit, for example, of a new suntan lotion; (5) consumer research is difficult because of the very nature of social products; and (6) competition often comes from colleagues in other social ministries so we find ourselves defending "health" as more important than "food" in order to compete for scarce government resources.

Still, social marketing has proved extremely effective for carrying the ORT message. When planned by experts in health and communications, and when combined with radio, graphics, and the training of health workers to teach mothers how to prepare the oral rehydration solution, it has produced numerous examples of success.

Bangladesh: "Seven Points to Remember"

Health workers have found that they can overcome several difficulties simply by talking to mothers. In 1980, when the Bangladesh Rural Advancement Committee (BRAC) set out to reduce the high rate of sickness and death associated with diarrhea, it established

an Oral Therapy Extension Program that featured a team of oral rehydration works (ORWs) who would visit 2.5 million households.

The idea was to talk, not lecture, to the mothers and incorporate into their conversations "seven points to remember" about home-prepared ORT remedies, including the use of a locally produced crude sugar called "gur" and a rice-based oral rehydration solution, pioneered at the ICDDR,B laboratories in Dhaka.

The ICDDR,B team had found that an otherwise standard oral solution using fifty grams of rice powder (boiled in water) halved the duration of diarrhea. In the BRAC campaign, in a carefully planned social marketing strategy, a team coordinator visited a village and met with community leaders to discuss the therapy the ORWs would teach and the plan for the campaign. Traditional village practitioners were also brought into the discussion to acquaint the mothers with the effectiveness of ORT.

Then the main work began. To spread the word about the ICDDR,B-approved home remedies, the ORWs made door-to-door visits and spent half an hour with each mother to discuss the technique. They explained that it was a mistake to try to "dry up" diarrhea by not giving food and drink, showed the women how to prepare the home mixture, and then watched while the mothers went through the process themselves.

Working in pairs, the ORWs visited about ten households per village a day and spent about thirty minutes with each mother. While one worker actually prepared the mixture, the other discussed the seven vital points they would later be asked to remember:

1. The symptoms of diarrhea
2. The danger of diarrhea
3. Advice on eating, drinking, breastfeeding, and hygiene
4. Understanding the ingredients and advantages of a homemade ORS
5. Preparing the solution
6. Advice on administering the ORS
7. Basic guidance on nutrition during and after diarrhea

If there were any children with diarrhea in the household, the worker prepared a solution for them as well. And, as a follow-up a month later, a supervisory team visited a random sample of the households originally visited.

"Do you recall the 'seven points to remember'?" the mothers were asked. Each mother was also asked to prepare a solution and the team then checked a sample to make sure the mixture was correct. Only if the mother mixed the solution correctly were the ORWs paid their salaries (about $30 a month).

Monitoring results to date have indicated a decline in infant and child mortality in Bangladesh due to diarrheal dehydration and major successes in getting the mothers to recall the crucial "seven points to remember."

Gambia: "Happy Babies"

In 1982, this small West African country's Medical and Health Department decided on a contest to publicize ORT. The rural population was predominantly illiterate. But transistor radios were common and pictorial graphic materials could be understood by most villagers. Why not, it was reasoned, offer simple prizes to mothers who learned how to mix an oral rehydration solution correctly? Call it the "Happy Baby Lottery."

In September and October of that year, following six months of research, a unique project supported by A.I.D.'s HealthCom program was launched to teach a home sugar-salt rehydration formula. A pictorial handbill was designed that showed the mothers how to mix the solution, and, combined with face-to-face teaching by health workers and intensive radio programming in four local languages—Wolof, Fula, Mandinka, and Serehule—the contest began.

As a measuring device, the bottle and cap for a local soft drink, "Julpearl," were used for the standard formula: three Julpearl bottles of water, eight Julpearl caps of sugar and one cap of salt. (See Figure 3.2.)

Some 200,000 handbills were distributed to twenty health centers and dispensaries, which, in turn, distributed them to the mothers and hundreds of village volunteers trained by local government health workers. The idea was for the mothers to seek out the colorful handbills, which showed the bottle and cap mixture, and listen to a series of radio programs that explained how to interpret the handbills and mix and administer the solution.

The mixing picture was the "ticket" for entering the contest, which got underway when the radio announced the names of

A Bangladesh mother spoon-feeds her baby the lifesaving "oral rehydration solution"—sugar, salt, and water—which a British medical journal hailed as "potentially the most important medical advance this century." Source: Earthscan; Photo: Mark Edwards.

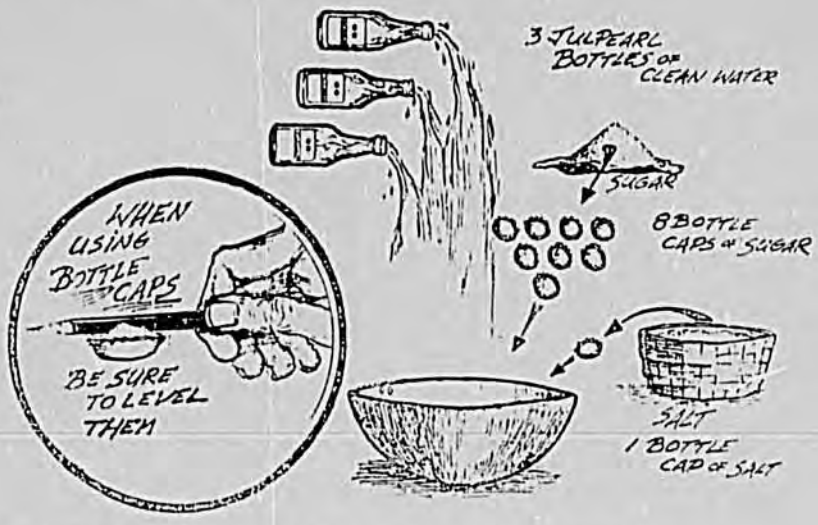


Figure 3.2. Homemade ORS formula promoted in Gambia. Source: Academy for Educational Development.

eighteen villages to be visited by judges (wearing "Happy Baby" T-shirts). More than 11,000 mothers attended the village contests that were held over a five-week period, and about 6,500 entered the mixing competition. The mothers who came to the contest with a mixing picture became eligible to mix the solution and enter a drawing if they mixed it correctly.

Twenty selected winners were given a one-liter plastic cup as a prize. Second prizes, consisting of locally made soap, were given to mothers who could answer at least three out of five questions about the solution, and the winners became eligible for a grand prize drawing. On a broadcast of Radio Gambia, the Gambian President's wife, Lady N'Jaimeh Jawara, announced the names of fifteen winners, each of whom was given a radio-cassette player. The seventy-two villages that participated most actively were each given a fifty-kilogram bag of sugar and a hundred-kilo bag of rice.

As a result of the effective selling of ORT in this way, as many as 40 percent of the country's rural mothers learned how to mix the water-sugar-salt solution. After only eight months, knowledge of the correct formula rose from zero to 66 percent, and 47 percent of the mothers reported using the solution to treat their children's diarrhea.

A rural Gambian mother learning to mix a household oral rehydration solution of water, sugar, and salt. Source: Academy for Educational Development.

A Stanford University evaluation of the project reported: "Mothers learned the importance of continued breastfeeding during diarrhea. More than three-quarters of the mothers used the water-sugar-salt solution at least once during the campaign. After only one year, Gambian mother reported that half of the diarrhea cases in the previous 2 weeks had been treated with the solution. After 2 years, repeated use had climbed to two-thirds of the sample."

Honduras: A Different Tune

In the different media environment of Honduras, where there are more than a hundred radio stations (compared to Gambia's one government station), the social marketing strategy focused on a two-year promotion popularizing a locally produced ORS called Litrosol.

Before the project got underway, specialists from the Academy for Educational Development, working with the A.I.D. program that assisted the Ministries of Health in both Gambia and Honduras, spent nine months surveying how rural women viewed diarrhea. One finding showed that mothers wanted a remedy for diarrhea, not for "dehydration," a big, "scientific" word which they did not easily comprehend. Thus, the initial message "Litrosol does not cure diarrhea" proved ineffective. The message "to replace the liquid your child loses, give your child a glass of Litrosol every time he has a movement" was much more acceptable, said the Academy, "first, because there was a clear cue; second, because the volume prescribed carried more validity than 'a liter a day'; and third, because the message explained why a glass per stool was advocated—to replace what was lost."

But the successful home management of diarrhea involves more than just Litrosol. Breastfeeding, for example, was also part of the intensive village education program. To the accompaniment of soft guitar music, a gentle radio voice urged:

> Mother,
> that little one who kicked your
> tummy has finally arrived.
> His little eyes are now looking at
> you and smiling.
> His little hands still have no

strength, Mother, but they squeeze
anyway.
He, that is so tiny, depends on you
to grow, Mother
Care for your child from the
moment he's born.
Give him your breast so he will
grow.
Give him the vigor that only your
breast can give, Mother.

This loving, caring theme, which emerged from the preliminary village research, became the overall theme of the program, as was also expressed in the red heart logo and gentle voice of the principal radio spokesperson, a fictitious Dr. Salustian, or "Dr. Healthy."

One year into the program, the recognition of Litrosol reached 93 percent, compared to zero at the start of the campaign. Almost 50 percent of the mothers reported using the packets at least once to treat diarrhea; 94 percent of the mothers mixed the solution correctly, almost half administered it correctly, and most important, infant mortality from diarrheal diseases dropped by 40 percent.

Egypt: The "Solution"

As recently as 1980, as many as 150,000 Egyptian infants and young children died annually from diarrhea-related illnesses. In the under-three-year-old group, more than 60 percent of all deaths were from diarrheal diseases, and most were simply from diarrheal dehydration. Today, Egypt has become a rallying point for primary health care, with ORT playing a major role.

Previously, where IV therapy was available, it was often difficult to reach, particularly from rural areas. When children were brought into clinics, it was often too late to save them from the effects of dehydration.

In 1982, after a pilot study determined that the lives of many thousands of children could be saved, the Government of Egypt and A.I.D. developed the National Control of Diarrheal Diseases Project (NCDDP). The next year, in 1983, a five-year project was launched with the arrival of a technical assistance team from John Snow, Inc.

The goal was clear: reduce deaths from diarrhea by at least 25 percent—by changing the behavior of Egyptian mothers and all other persons, including health personnel, pharmacists, and administrators involved with the management of diarrheal dehydration programs (see Figure 3.3).

It was an immense social marketing task, requiring, first of all, the adoption of a popular logo. A picture of a mother, at first dressed in black, was redone in white and her solemn look replaced by a smile. A wedding band was put on her finger, the size of the spoon she was using to feed her infant was made larger, and for the ORT mixture a name—"The Solution"—was selected in place of the cumbersome "The Solution for the Treatment of Dehydration."

At the same time, it had to be made clear that The Solution was not meant to stop diarrhea but to treat the dehydration that resulted. So, an Egyptian Arabic word, *gaffaff*, which was usually used in terms of dryness or drought in relation to agriculture, was selected to help separate the concepts of diarrhea and dehydration.

After the planning of TV and radio messages and poster illustrations, the campaign was launched in the summer of 1984. The first pilot commercials featured "Uncle Fouad," who was a well-known comedian named Fouad El Mohandes. Uncle Fouad, however, did not go over as planned, particularly among physicians, who thought the subject matter too serious for such a figure. When a well-known actress, Karima Mokhtar, was chosen instead, doctors, nurses, pharmacists, and mothers alike approved of her role as an advisor in the ads.

Reporting on results of the campaign, Dr. Norbert Hirschorn wrote in the *Development Communication Report:*

> Between early 1983 and late 1984, knowledge of ORS rose from 1.5 percent to 96 percent. Ninety-eight percent of all Egyptian pharmacies have ORS available and it is now the leading sale item (in volume) of all diarrhea-related drugs according to a survey of 300 pharmacists nationwide.
>
> Careful documentation shows that mass media alone increased the use of ORS from one percent to nearly 70 percent of episodes. Statistically significant mortality reductions in children under 2 have been documented nationwide, approximating a 50 percent drop in diarrhea-associated deaths, concomitant with project activities. Monitoring of all process and outcome measures continues.
>
> The success of the NCDDP project in Egypt indicates that mass media can help change behavior, but that all other elements of a mass campaign must be equally well-planned and coordinated to achieve this success.

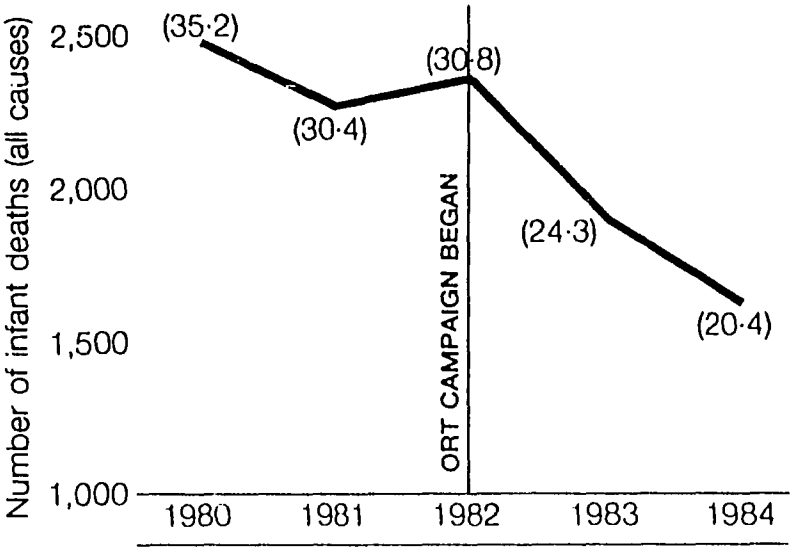


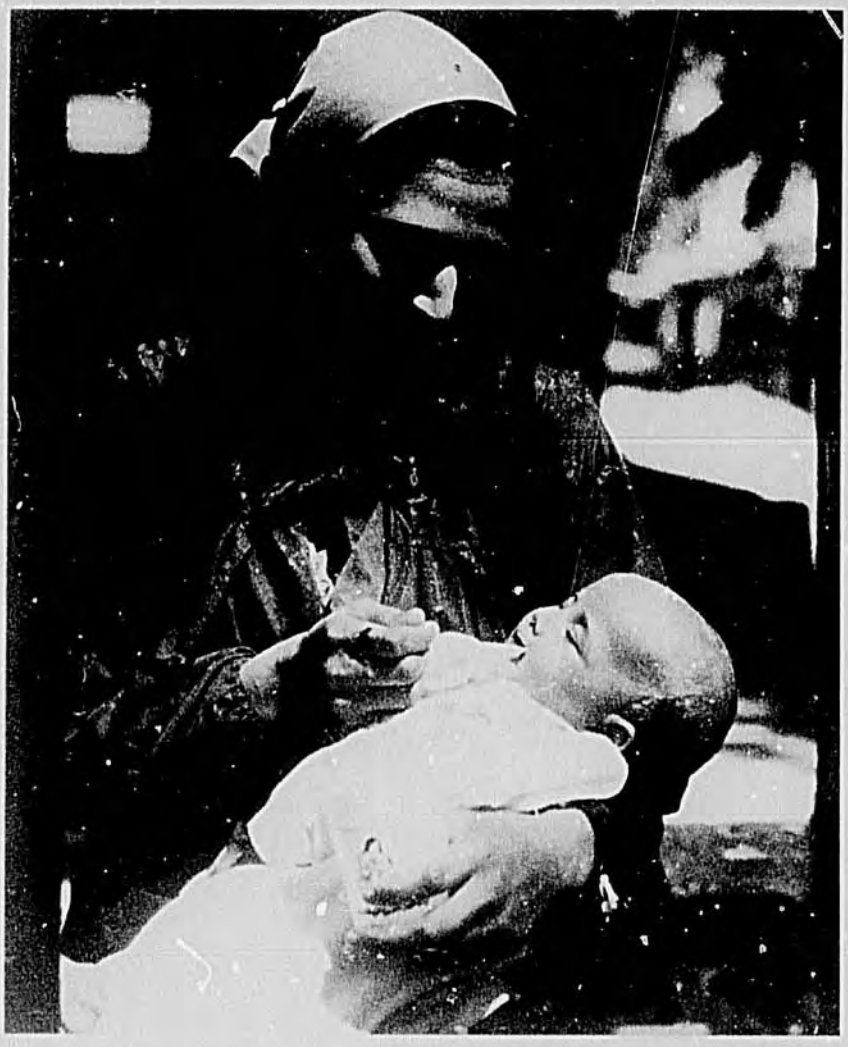
Figure 3.3. Impact of ORT on infant deaths, Alexandria, Egypt, 1980-1984. Source: Diarrhoeal Control Newsletter, National Council of Diarrhoeal Diseases Project, Egypt, 1984.

Each of the campaigns outlined were different, but they shared some important fundamental characteristics: they were marked by strong audience orientation; they focused on a few actionable messages; they employed intensive promotion; and they were part of a comprehensive program.

Bringing Infant Mortality Down

In other countries around the world, attempts to reduce infant mortality are succeeding.

Swaziland: Since 1984, when thousands of "yellow flag" volunteers, hundreds of thousands of colorful mixing flyers and scores of "Diet for Diarrhea" and "Diarrhea Management" posters were called into the battle, along with the country's traditional healers, dozens of radio programs have been produced in a cooperative program between the Swaziland Broadcasting System and the Ministry of Health.



Diarrhea related deaths were reduced significantly in A.I.D. projects in Cairo, Egypt, as a result of intensive ORT education. Source: A.I.D. Photo: Robert Clay.

The strategy for furnishing ORS packets and promoting the use of a homemade sugar and salt solution was spearheaded by the Academy for Educational Development through A.I.D.'s HealthCom project, with cooperation coming also from the Combatting Childhood Communicable Diseases (CCCD) project.

An evaluation of the impact of these public health communications activities, conducted by the University of Pennsylvania's Annenberg School of Communications, showed that rural women were learning and could repeat the correct formula, helping to bring down Swaziland's high (133 per 1,000) infant mortality rate.

Ecuador: An active diarrheal disease control program has been in effect in Ecuador since 1977, but not until 1983, when the government made child survival a priority, did this have the effect of raising ORT utilization rates. A.I.D.'s HealthCom project assisted the national program.

The original Ministry of Health program to promote a standard one-liter ORS sachet through existing health posts was expanded to a network that included rural village volunteers. Plastic bags that served as measuring tools were distributed along with the ORS sachets. At the same time, radio spots broadcast educational messages that included recognition of the signs of dehydration, while a new name, "Suero-Oral," was adopted to identify the product. *"Niño con diarrhea debe Suero-Oral"* ("A child with diarrhea needs Suero-Oral"), said the colorful flyers.

In 1985 the program that focused on diarrheal diseases was expanded to include immunization, monitoring, and breastfeeding, and grew from an original target population of 100,000 in three provinces to embrace eight million people throughout the country. Supported by A.I.D., UNICEF, and PAHO, the national program was headed by the First Lady of Ecuador and became the first to distribute ORS packets through its mass immunization days.

According to a Ministry of Health evaluation, 93 percent of the mothers knew of the product, and 80 percent of users knew how to properly measure and mix the ORS packets.

Haiti: Since 1980, when a Rehydration Unit was established in the University Hospital in Port-au-Prince, diarrhea mortality has dropped from more than 30 percent to less than 1 percent. Suddenly, in the poorest country in the Western Hemisphere, it was being shown that ORT, and not the commonly used antidiarrheal preparations or antibiotics, was the most effective way to save lives from diarrheal dehydration.

With oral rehydration declared the number one health priority, mothers came to the hospital to receive immediate and affordable

care for their infants and children. Staff from each of fifteen rural district hospitals came too, to learn how to care for patients. They in turn took the training to rural health personnel. In a national plan, thousands of health workers took ORT to the people, with packaged ORS manufactured and sold at *postes de vente* for15 cents per packet. Community leaders, small village stores, traditional healers, teachers, army posts, and volunteers all joined in the effort, which was helped along by radio messages, posters, brochures, and even the encouragement of police and military personnel.

As knowledge of ORT spread throughout the country, increasing to 50 percent from less than 5 percent in many rural aras, ORT became the standard treatment for diarrhea and was used to encourage greater emphasis on other primary health care innovations, including immunization and a national program for the detection and treatment of tuberculosis. (See Figure 3.4.)

When ORT Doesn't Work

ORT is not always the automatic success it may sometimes give the impression of being. Problems with producing the ORS packets,* incorrect instructions to mothers, errors in container size, conflicts with traditions and beliefs, and inadequate distribution plans all may contribute to the failure of ORT to achieve effective diarrhea control.

For example, after a March 1986 visit to Mozambique, a country that suffers from one of the highest mortality rates in the world for death from diarrheal dehydration, David Werner, director of the Hesperian Foundation, Palo Alto, Calif., reported that the country's investment in ORT was not producing adequate results. Citing an epidemiological study of mortality related to diarrhea in Mozambican children conducted in July 1985 by Dr. Ana Novoa and a group of medical students in the city of Beira, he noted that the mortality of children under five years of age was 36.4 percent and observed that "almost half of those children, or 14.7 percent of all children under five years of age, died of diarrhea."

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*Indeed, quality control problems in packets produced in the United States led to the deaths of four children in a hospital in Lima, Peru, in 1986.

Plan	*Advantages*	*Disadvantages*	*Situation*
Pre-packaged WHO formula.	Effective even for severe cholera. Standardized. Highly visible and identifiable. Effective for cholera and mild diarrhea.	More expensive. Ingredients may not be locally available. Can lead to hypernatremia* if incorrectly used.	Effective for a health system reaching the bulk of the population.
Pre-packaged WHO formula with sucrose.	May cost less. Sucrose may be more readily available.	Less effective for severe diarrhea. May increase vomiting. Ineffective if sucrose deficiency develops.	Effective for a health system reaching the bulk of the population.
Local mixing using WHO formula (spoon set).	No dependence on central facilities. No packaging costs.	Increased risk of error. Storage of ingredients may be a problem.	Effective for a system of urban and rural clinics with outreach to patients.
Home mixing using salt/sugar formula (double spoon).	Reduced costs. Direct participation of community and family. No dependence on health system. Permits early institution of treatment at home.	Not as effective as WHO formula. Requires individual instruction of users. Requires a proper sized container in the home.	Effective where majority has no access to a centralized health service but where there is strong community involvement in health.
Local mixing using salt/sugar (no spoons).	Requires no packets, spoons or devices. Minimum investment. Encourages self-reliance.	Measurement of ingredients is more variable. Efficacy of solution cannot be assumed. Requires instruction, standardization and frequent follow-up.	Effective where provision of measuring spoons is not practical.
Any distribution scheme using formula with lower sodium content (e.g., 60 meq/L).	Decreased risk of hypernatremia.	Risk of hyponatremia.** Less effective in severe diarrhea caused by *V. cholerae* or *E. coli*.	Effective where supervision and surveillance is impossible.

*condition caused by too much sodium in the blood

**condition caused by too little sodium in the blood

Figure 3.4. Comparison of different ORT strategies. Source: World Federation of Public Health Associations.

Dr. Werner, whose foundation in 1985 won WHO's first international award for education in primary health care, had visited Mozambique as a consultant to the Ministry of Health and gave the following as reasons for low ORT effectiveness. They included several reasons that have been cited in other countries for slow ORT acceptance: inadequate packet supply; the common practice of giving only one packet per case of diarrhea; popular misconceptions; difficulty in supplying packets to outlying areas; inadequate educational component; out-of-date teaching methods; insufficient consideration of people's beliefs, traditions, and home remedies; and an inadequate health care system, especially in remote areas.

He cited some specific drawbacks in Mozambique: mothers often use ORS packets for making cakes, because sodium bicarbonate is not obtainable elsewhere; most mothers who are given packets are not advised about when to come back to the health center, about the danger signs of dehydration, about how to make a "home mix," or about the fact that ORS does not stop diarrhea; some health workers and mothers regard ORS as a medicine and give it like a medicinal syrup or tonic—one spoonful or half a cup three times a day; mothers do not realize that putting in enough liquid, not stopping the diarrhea, will save the child's life; some mothers believe that sex poisons breast milk and therefore wean children when they need continued breastfeeding to survive episodes of diarrhea; mothers are given too much education on what to do rather than *understanding why;* and division chiefs constantly shift plans and priorities.

Werner, a biologist and former high school teacher, has suggested the following approaches as appropriate and cost-effective to ORT in Mozambique. Some of these might be applicable to other countries as well:

1. Creation of a Central Committee for Diarrhea Control, authorized to coordinate an integrated multisectoral approach to diarrhea control and ORT.
2. Involvement of the school system as a promoter of home-based ORS, in collaboration with the local women's organization and party organization, with support of the mass media.
3. A process of "participatory research" involving school teachers, school children, and mothers in investigating modern and traditional diarrhea management in homes, in order to facilitiate a study on how best to adapt ORT to different parts of the

country. Investigation and promotion of different types of home mixes, with emphasis on rice powder, maize powder, and other cereal-based mixes, especially for areas where sugar is not available.

4. Development of "people-centered" educational methods and clear, simple, well-illustrated educational materials, for use in schools, health posts, and homes.

Other Countries

There are numerous, more positive examples that demonstrate the potential of oral rehydration therapy.

Indonesia: About 10 million cases of diarrheal illness are reported every year, and more than half the population has access to ORS. The Indonesian Ministry of Health has instituted a national Diarrhoeal Disease Control Program whose major objectives are: (1) to prevent dehydration and reduce mortality related to diarrhea through the promotion of ORT; (2) to provide early detection and control of diarrhea epidemics; and (3) to promote improved environmental health practices nationwide. Surveys of twenty-seven provinces showed a three-fold increase between 1978 and 1985 in the number of professional workers trained in ORT and a 10 percent drop in the mortality rate due to diarrhea for children under five (see Figure 3.5).

India: Paralleling an effort to immunize every child by 1990, a national move against diarrheal dehydration is also taking place. In one area of the Punjab, some 18,000 people in thirteen villages saw their infant mortality rates halved by ORT in less than two years; in other parts of the country, after the promotion of locally manufactured ORS, death rates from diarrheal dehydration fell to levels 80 percent lower than in nearby villages.

Costa Rica: Hospitals report an 80 percent drop in child deaths from dehydration since ORT was introduced—resulting in a saving of millions of dollars in hospital services.

Guatemala: In one section of the country, after "health promoters" began teaching mothers how to use locally made ORS packets, child deaths were reduced by half.

Trinidad and Tobago: In the General Hospital, Port-of-Spain, five years after ORT replaced intravenous feeding, the mortality rate from diarrheal infection dropped by 60 percent.

Item/Year	1978/79	1984/1985
1. Infant Mortality Rate (per 1,000 live births)	103	90
2. Number of diarrhoeal cases in children under 5 (millions)	42.2	44.6
3. Mortality rate of under 5 (per 1,000 under 5)	39	34.6
4. Population with access to ORT (millions)	41.5	96.3
5. Population which uses ORT (millions)	1.7	9.5
6. Access of ORT for under 5 (millions)	6.2	13.4
7. Usage of ORT for under 5 (millions)	1.9	5.4
8. Number of CDD Health Centers	1400	3213
9. CDD area Development :		
a. Health Center accessibility of ORT	27%	60%
b. Usage ORT	11.3%	24%
10. Case Fatality Rate (Out Break) : (%)	5.1	1.9
11. Distribution ORS (millions of liters)	2.3	5.6
12. Number professional workers trained in:		
a. clinical aspects	985	3321
b. managerial aspects	–	293
c. laboratory aspects	–	22

Figure 3.5. Survey data from twenty-seven Indonesian provinces. Source: Indonesian Ministry of Health.

A health worker in Indonesia administers ORS to a boy at a weighing post. Her colleague holds up a nutrition education poster for the mothers assembled for the demonstration. Source: UNICEF. Photo: Mangunwidjojo.

A primary health care worker in Thailand gives a child ORS to treat diarrhea. Source: WHO. Photo: Searo.

Bolivia: Numerous international groups have joined in the effort. Some 1,800 mothers' clubs organized by Caritas/Bolivia and assisted by Catholic Relief Services and PRITECH have distributed ORS packets in Bolivia and are active in ORT training.

Sri Lanka: In this country, where more than 2,000 children die from diarrheal dehydration each year, pharmacies, general practitioners, and 10,000 retail outlets are making ORS available.

Thailand: More than half of parents have turned to ORT to treat diarrheal infections.

Sudan: More than six million ORS sachets were distributed in 1985.

Thus, encouraging health changes are taking place in country after country. Together with improved vaccine technologies and new emphasis on personal hygiene and sanitation, oral rehydration therapy is improving the lives of millions of Third World children.

4

Not by ORT Alone: Integrating ORT with Other Health Activities

We know how to reduce infant mortality. We must now deliver on this promise.

– Dr. Kenneth J. Bart, A.I.D. Director for Health

Each year, more than 100 million children are born in the developing world, and each year millions of these children die– when for as little as five dollars each, according to UNICEF, they could be protected against the half dozen common diseases that are most likely to afflict them: measles, whooping cough (pertussis), tetanus, poliomyelitis, tuberculosis, and diphtheria. ORT and immunizations are the "twin engines" of A.I.D.'s Child Survival Strategy.

WHO's Director General, Halfdan Mahler, says, "ORT and immunization go hand in hand, complementing one another– one curative, one preventative; one immediately life-saving, one potentially life-saving."

Yet, just as millions of people are not yet aware of oral rehydration therapy and still insist on drugs for diarrhea treatment, fewer than 40 percent of Third World children have been fully immunized, and life expectancy in the developing world remains at a level found in the industrialized countries in the 1920s and 1930s.

In 1985, two million children died from the effects of measles, one million were killed by tetanus, and half a million died from whooping cough. Yet almost 100 percent of neonatal tetanus, paralytic polio, and diptheria can be prevented by immunization; 95 percent of measles cases and 80 percent of whooping cough cases can be avoided.

Breaking the Cycle of Illness

For at least twenty years, vaccines have been available to the poor and isolated rural families of developing countries. They are inexpensive and cost-effective. However, for a variety of reasons, many of the people who need them the most fail to use them.

Somehow, therefore, while the ancient scourges have yielded to medical knowledge and better health practices, the children of Asia, Africa, and Latin America continue to be caught in a cycle of illness. A child's life can be saved through immunization, but the same child can die from diarrheal dehydration; families that cannot grow or buy enough food face death from malnutrition; and malnutrition, in turn, erodes physical, mental, and emotional development.

For breaking the cycle, A.I.D.'s former Administrator, M. Peter McPherson, pointed to the new health technologies that can save the lives of millions of small children—oral rehydration therapy, immunization, improved infant feeding, and related child survival practices. "More research needs to be done," he urged, "but clearly the technologies we now have need to be rapidly adopted by health systems throughout the world. Experiences from Honduras, Gambia, Egypt, Bangladesh, Colombia, Indonesia, and Swaziland demonstrate that mass media, social marketing, and strategies for behavioral change work well when integrated into health delivery systems."

Treat the Child, Not the Stool

All experts agree that if ORT is to work in reducing child morbidity and mortality, numerous basic health strategies must be employed to ensure that once a life is saved, it stays saved. In addition to ORT, immunization, and infant feeding, this means providing nutrition and counseling, monitoring growth, advising mothers on child spacing, and reaffirming the importance of breastfeeding and better weaning practices.

A.I.D.'s Director of Health, Dr. Kenneth J. Bart, has noted that ORT does not by itself reduce the risk of subsequent episodes of diarrheal disease in the same child. "We are challenged not to just integrate ORT with other health activities, but ORT must also be integrated at the level of the mother."

Mothers, he has stressed, must care for the whole child, not merely dehydration. "Mothers must be shown that ORT makes sense as part of a larger plan of improving their child's health."

A.I.D.'s Child Survival Strategy

UNICEF has generally concentrated on the production and supply of oral rehydration salts. WHO has focused on the training and management of oral rehydration therapy. A.I.D. has issued its Child Survival Strategy, which emphasizes the "twin engines" of ORT and immunization, with lesser though significant focus on birth spacing and a nutrition package that includes breastfeeding, improved weaning practices, continued feeding during diaarrheal episodes, vitamin A supplementation where appropriate, growth monitoring, and targeted supplementary feeding to children under three years old and pregnant women under PL-480 (Food for Peace) Title II where there is serious risk of malnutrition.

A.I.D.'s immunization strategy has six principal elements:

1. A primary target group of children under a year old.
2. Emphasis on vaccines to meet the needs of children and fertile-aged women, especially measles and tetanus-toxoid.
3. Development of country-specific plans, coordinated with other donors.
4. Major focus on target countries to maximize health benefits that can be obtained with available resources.
5. Emphasis on the development of institutional capacity to sustain host-country immunization programs.
6. Continued research on vaccine development, improvements in immunization technology, and health care delivery.

AID's Child Survival Strategy stresses utilization of the private sector where practicable and implementation of programs through private voluntary organizations.

"Breast is Best"

Almost all discussions of diarrheal dehydration emphasize the importance of breastfeeding. Easily digestible, a source of vitamin A, and of high caloric value, breast milk has long been recognized as the ideal infant food. States a special section on the subject in

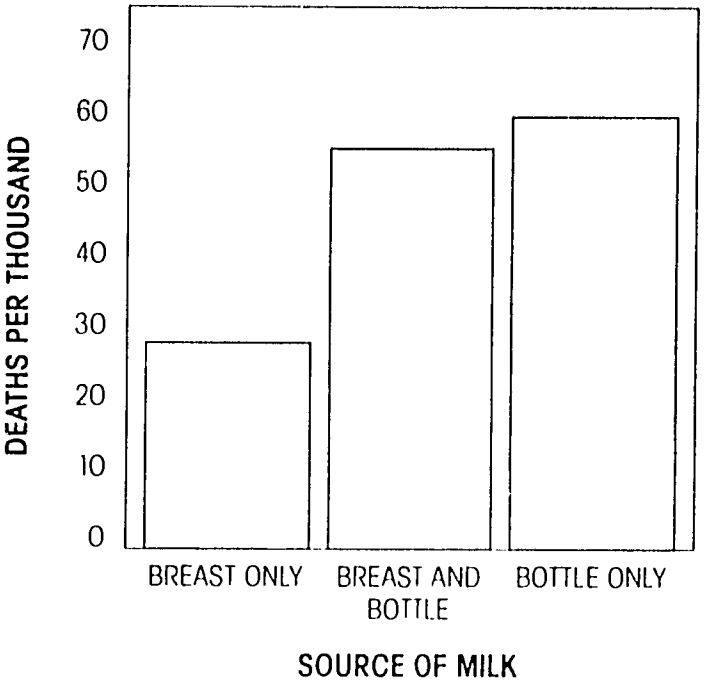


Figure 4.1. Breastfeeding and child survival: mortality between one month and one year. Source: World Health Organization (based on data from rural Chile, 1973).

UNICEF's 1986 *State of the World's Children* report: "Breast milk also provides a degree of immunity to infectious diseases, as well as having a contraceptive effect through inhibiting ovulation." (See Figure 4.1.)

In Guatemala, Dr. Leonardo Mata reports that current research indicates not only that infants grow better during the first months of breastfeeding but also that pre-term and small-for-gestational-age infants thrive if they begin at the breast from the very first days of life.

"Carry on feeding," urges *Dialogue on Diarrhoea*. "In communities where malnutrition is common, correct feeding is as important as rehydration for children who have diarrhoea." The newsletter is funded by A.I.D., UNICEF, and WHO.

Reporting on a study of children in Bangladesh that compared the normal dietary intake of children with diarrhea with that o. a

group of matched controls, the newsletter said, "The energy intake of the ill children was reduced by 40 percent, but among those children who were being breastfed the energy intake from mother's milk showed very little decrease. This suggests that the loss of appetite is mainly associated with supplementary foods. Breast milk is therefore a particularly valuable nourishment for children with diarrhoea, especially among deprived communities where it may be the main source of high quality protein."

"ORT is rehydration plus breastfeeding [or food]," Norbert Hirschhorn has emphasized.

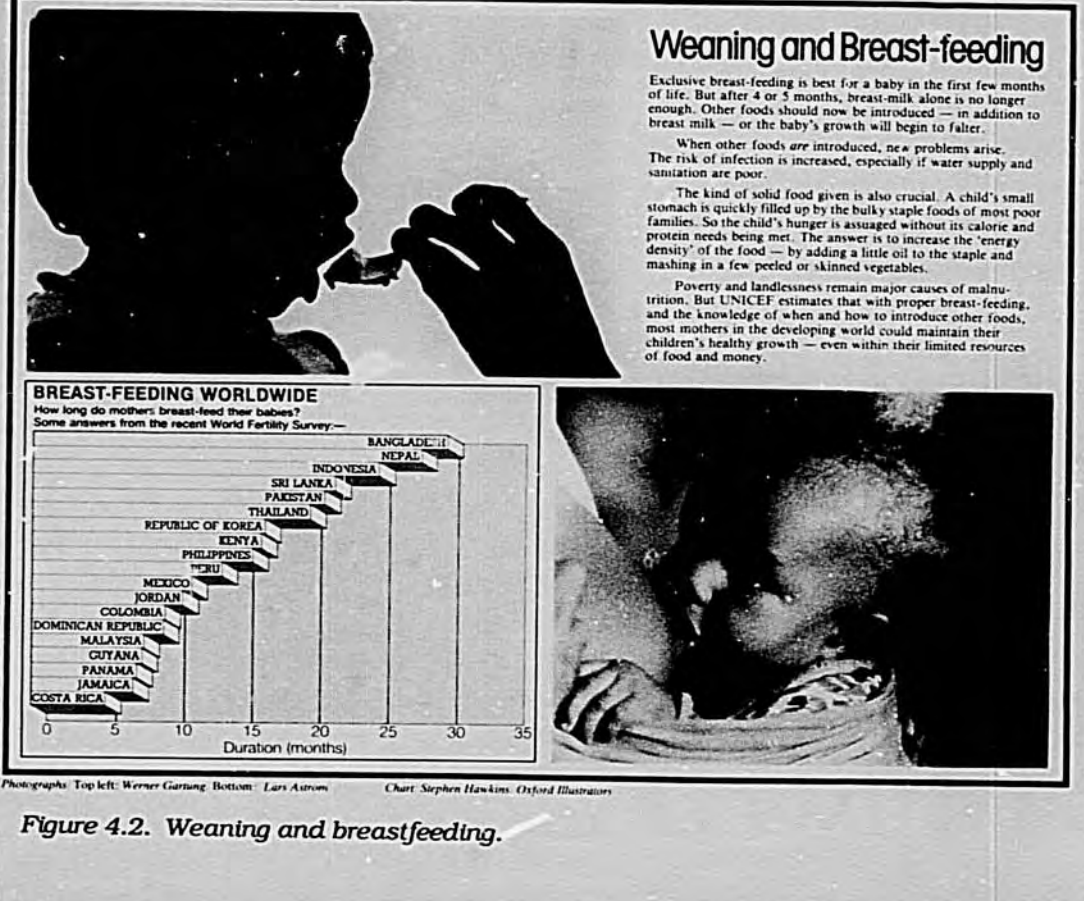
Specifically, he notes, breastfeeding can protect the child against diarrhea by providing free water to reduce the risk of hyperenatremia, by supplying extra potassium, carbohydrate, and protein to help slow diarrhea and by furnishing many other protective and immune substances.

Weaning and Child Spacing

Dr. Richard G. Feachem, head of the Department of Tropical Hygiene at the London School of Hygiene and Tropical Medicine, cites evidence from twelve countries suggesting that effective weaning education, particularly when reinforced by radio and other mass media, can improve the nutritional status of infants and children and cut back the diarrhea death toll. "On the basis of theoretical calculations," he reports, "it is estimated that weaning education can reduce diarrhea mortality rates by 2 to 12 percent in children under 5 years of age."

Adds UNICEF: "For babies who breastfeed, the weaning period is the time of greatest danger to health and life. Like breastfeeding, good weaning makes heavy demands of the mother; but knowing when and how to wean a child could drastically reduce child malnutrition in the developing world."

The process by which a child becomes accustomed to semi-liquid and solid foods will vary according to family circumstances. According to Dr. Michael Gurney, a WHO nutritional expert, "Good hygiene is essential in preparing weaning foods and keeping them well until the next feed. But it is difficult to feed a baby five or more uncontaminated meals a day when the mother can only afford to light the kitchen fire once. Local technologies need to be used to



Photographs: Top left: *Werner Gartung*. Bottom: *Lars Astrom* *Chart: Stephen Hawkins. Oxford Illustrators*

Figure 4.2. Weaning and breastfeeding.

resolve the problem." (See Figure 4.2).

Like weaning, child spacing, which involves the length of intervals between births, is also related to malnutrition, morbidity, and mortality. *Mothers and Children*, a publication of the American Public Health Association, published by the Clearinghouse on Infant Feeding and Maternal Nutrition, reports that new studies in Candalaria, Colombia, have shown that as the number of children in the family increases, the per capita expenditures on food decrease.

"When families of similar socioeconomic status with two adults and two children were compared with four children, one study found nearly a 500-calorie difference in food consumption. Where increases in family size are associated with decreases in food expenditures and food consumption it is evident that increasing spacing betwen births will ensure more food availability for children." Birth spacing also has an impact on breastfeeding duration, the newsletter observes. Citing a study in Senegal, in which one-third of all children were weaned because of a new pregnancy, *Mothers and Children* noted: "Mortality was much higher among those weaned too early, and the probability of death within one year following weaning increased by 50–150 percent."

Immunization is being used to address the six major infectious diseases, and it could play an important role in the fight against diarrhea (See Figure 4.3.)

Measles, a significant cause of diarrhea and malnutrition. A 1984 article in *Dialogue on Diarrhoea* noted the relationship between measles and diarrhea and stated: "It has been estimated that between 6.4 and 25.6 percent of diarrhoea deaths could be prevented by measles immunization."

Whooping Cough (pertussis), an acute infection of the respiratory tract. Children under five months old are most susceptible to the disease, which can lead to death through pneumonia.

Tetanus, particularly dangerous to newborns. During the first few weeks of life, about 85 percent of untreated babies die.

Poliomyelitis, virtually eliminated in developed countries through the use of vaccines. It still cripples more than 250,000 children a year.

Tuberculosis, which takes the lives of about 30,000 children under the age of five each year. TB meningitis is blamed for two-thirds of the deaths to young children.

Diphtheria, which can begin as an acute infection of the throat

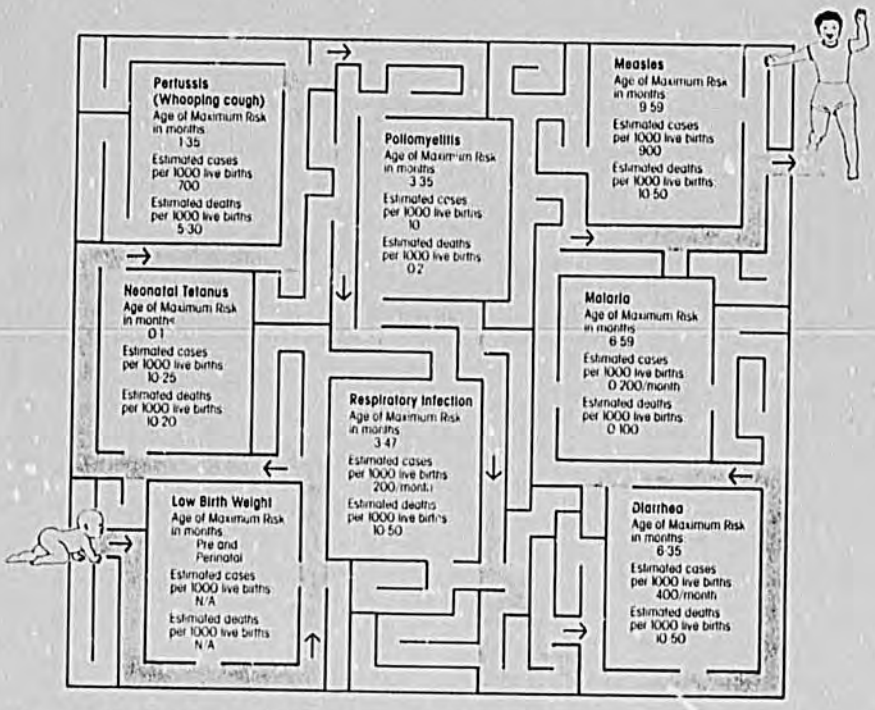


Figure 4.3. Risks to children from birth to five years. Based on estimates of incidence of major infectious diseases in Africa, CCCD, Annual Report, 1984. Source: A.I.D.

and can affect the heart and brain of young children. Premature and underweight infants are especially susceptible.

Child Weighing Is Not Growth Monitoring

As a pediatrician and diarrheal disease specialist known worldwide for his work in community medicine and public health, Dr. Jon Rohde emphasizes the importance of growth monitoring. Growth monitoring, Rohde maintains, is the best way to ensure the interaction necessary to change behavior. He is quick to point out that growth monitoring is not merely weighing a child and recording the weight on a growth chart. Proper growth monitoring, he

emphasizes, means getting mothers to become concerned enough about growth to demand it. It is "the nervous system of individual health care," a strategy for reinforcing appropriate feeding behavior.

"We must insist that we define growth monitoring first as measuring the growth by objective means, second recording it in a manner which is visible and comprehensible by all persons involved, third by communicating it effectively to the mother, and finally by followup feeding. All are necessary to make growth monitoring effective. By making the result of proper feeding perceptible, both when the child is well and particularly during and following acute diarrhea, growth monitoring can stimulate further action on the part of the mother."

Most important, he adds, the resolution of diarrhea, with growth monitoring as just one part of the strategy, requires "a truly broad-based approach, spanning the care of patients, effective health education, involvement of the mothers in the understanding of the care of their child, community action, mobilization of resources, environmental improvements, management, and supervisory and evaluation functions extending to the entire community." (See Figure 4.4.)

Some Examples of ORT/Primary Health Care Integration

The interventions we have mentioned may vary from country to country, with different interventions appropriate in different locales. In some countries, for example, diarrheal control activities have had to be delayed so that an immunization program could be carried out. Because ORT has been accepted much later as an intervention than immunization, it faces more hurdles, particularly since it often displaces traditional remedies.

National CCD programs are in place in ninety-five countries, including more than 72 percent of all developing countries. The following examples are typical of the way ORT is being integrated into the health programs of developing nations.

Thailand: In 1977, Thailand launched a health program that called on the residents of the country's 56,000 villages themselves to improve the country's health standards. Over a five-day period,

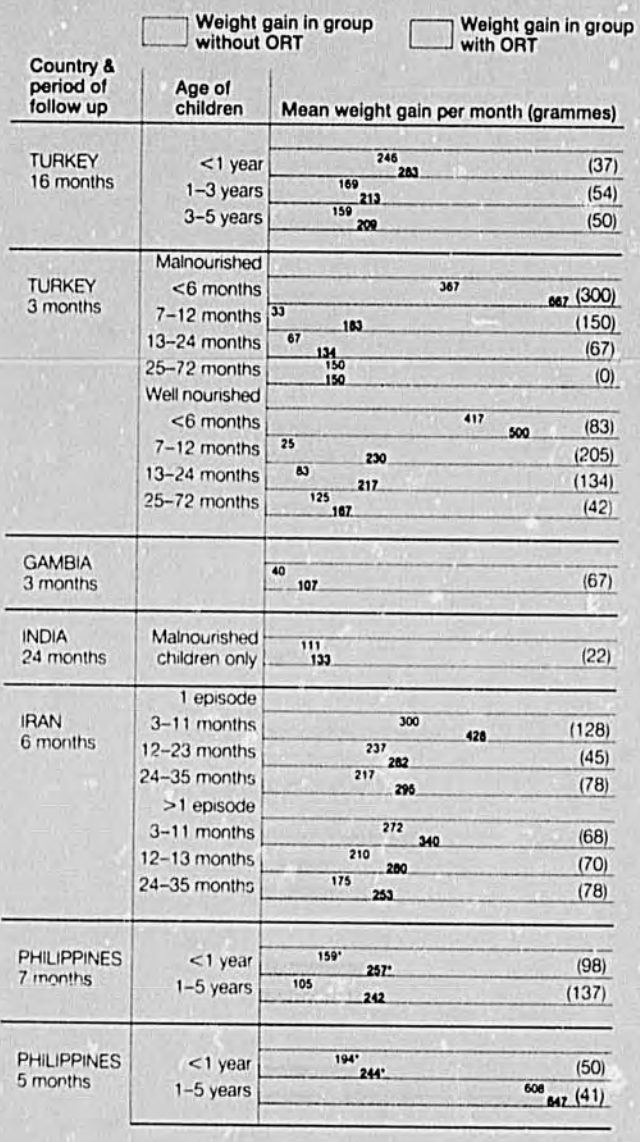


Figure 4.4. Effect of ORT on weight gain in children with diarrhea. Source: Norbert Hirschhorn, "Oral rehydration therapy: the program and the promise," paper prepared for UNICEF, May 1984.

in a still-continuing effort, villagers are trained as village health communicators (VHCs) in matters of health, nutrition, and hygiene. Selected VHCs receive additional traaining and are designated as village health volunteers (VHVs) to work closely with health centers and hospitals in programs of immunization, growth monitoring, nutrition, family planning, and oral rehydration services.

Backed by a national communications effort that includes TV, radio, posters, and leaflets, the VHCs are bringing ORT to the mothers of children under five.

Somalia: When cholera broke out in the town of Ganet in northwest Somalia in 1985, health care personnel who were already trained in ORT worked day and night with the townspeople to halt the spread of the disease. Stepping up a health care program that was already in effect, the government then increased its efforts to get mothers to register every child under five. The effort involved community meetings, training courses, broadcasts on radio and TV, loudspeaker announcements, and even the distribution of car bumper stickers to boost awareness of the vaccination centers. The effort, still underway, is designed to immunize every child in the country.

Nigeria: Market places, schools, churches, mosques, and town halls have been used as makeshift vaccination centers in an effort supported by the government and aided by Rotary International, the Paediatrics Association of Nigeria, the National Association of Nurses and Midwives, and the National Council of Women's Societies. Vaccination is being encouraged, along with an effort to promote ORT to halt the deaths of hundreds of children who perish each day from diarrheal dehydration. When an oral rehydration unit was opened at Children's Hospital in Lagos, only three children died during the first six months—compared to an average nineteen deaths a month from the same cause throughout 1984. Similar units are planned for every area in the country.

"Be Quick, But Don't Hurry"

Dr. Halfdan Mahler, WHO's Director General, has cautioned that where campaign approaches strengthen the health care system, contribute to sustained improvements in coverage, and provide a

basis for other health interventions, they are promising. However, he cautions, without adequate medium and long-term planning, such "crusades" may weaken the system, raise expectations, and detract from both other priority interventions and primary health care itself.

Whatever approach is taken, Mahler advises, there should be a strong degree of "positive impatience." Quoting the great football coach Vince Lombardi, he said at a meeting during ICORT II, "Be quick, but don't hurry."

5

Prevention: Better than Cure

Member states will assume a commitment to bring about a substantial improvement in the standards and levels of drinking water supply and sanitation by the year 1990.

– Proclamation of the United Nations International Drinking Water Supply and Sanitation Decade, 1981–1990

Halfway through the International Drinking Water Supply and Sanitation Decade (IDWSSD), there are indications of progress in most, if not all, developing nations. According to the UN Development Programme (UNDP), some 345 million Third World people, most in rural areas, have gained access to safe drinking water and about 140 million children and adults are now taking advantage of improved waste disposal facilities, thus reducing considerably the incidence of diarrheal infections.

But the task ahead remains formidable, for more than a billion people in the developing world still remain without safe water, almost 2 billion people exist without adequate sanitation, and water-related diseases and conditions, including diarrhea, are taking more than 20 million lives each year.

The ICWSSD was launched by the United Nations General Assembly on November 10, 1980. Its basic principle was: "People cannot achieve a quality of life consistent with human dignity unless they have access to safe drinking water and sanitation facilities." The decade's goal was "clean water and adequate sanitation for all by the year 1990." At a special meeting during the Assembly's 35th session, it was stated that during this interna-

tional education and action campaign member states should assume a commitment to improve the standards and levels of services in drinking water supply and sanitation—a plea to which today one hundred developing country governments, twelve United Nations system organizations, and dozens of nongovernmental organizations are now responding.

Water and Diarrheal Diseases

To a major extent, diarrheal diseases are the result of unsafe water and inadequate sanitation, which together are believed responsible for 80 percent of all human illness and disease. "Lack of adequate, safe water, lack of protection from human excreta, contaminated food, filth, and flies—all promote diarrhea," as A.I.D.'s F. Eugene McJunkin puts it in his comprehensive book, *Water and Human Health.*

Diarrhea, which frequently is caused by organisms in the water supply, interacts with malnutrition. Malnutrition, in turn, is made worse by a lack of hygienic drinking water. Water that leaves the body—in urine and perspiration—must be replaced in the form of food and drink.

Adequate sanitation facilities and practices also play a vital role in the improvement of health, with water needed for bathing, washing clothes, cooking, and other hygienic purposes.

When combined, according to UNICEF, proper access to both safe drinking water and adequate sanitation facilities could cut infant mortality in half in the developing world.

"Water? Where Do I Get It?"

While ORT can prevent death from diarrheal dehydration, it cannot stop the transmission of diarrheal infections. Better environmental conditions, particularly pure water, can. But while most Westerners take good quality water for granted, basic sanitation and potable water are still rare in many developing countries.

For decades, unsanitary conditions have been common throughout the Third World. In a typical scenario a latrine may be found situated by the side of a river used for bathing, washing

An Ethiopian woman collects water from a point near Mersa. A water system sponsored by UNICEF was installed in Mersa to prevent people from collecting impure water like this. Source: UNICEF. Photo: Bill Campbell.

dishes and clothes, fishing, and water collection. It is a setting seen often in the developing world, and usually people are unaware that they can pick up diarrhea pathogens while bathing in the river or through drinking the water that contains fecal seepage from the latrine.

Safe water available hot or cold from the bathroom or kitchen faucet; showers and bathtubs; toilets that flush human wastes into a network of sewers; even soap—all taken for granted by most people in developed countries—go beyond the imagination of three-quarters of the world's people. At best, the vast majority of them must make do with a village or neighborhood well and hand-made pump. At worst, they may have no nearby water at all. Family members may be forced to spend hours every day to reach a faraway stream and fetch the precious liquid.

Young Ethiopians collecting water from whatever source they can. A water system sponsored by UNICEF was installed to prevent people from collecting impure water like this. Source: UNICEF. Photo: Bill Campbell.

Throughout the less developed world, the story is the same. Mothers, who bear the burden of collecting water, often walk for hours to rivers or stagnant waterholes to fetch it, returning with enough water in the jugs on their heads to last for only a day or so. Hundreds of calories are expended this way. The milk the women carry for their babies may dry up, and some babies may starve in the womb.

It may come as little surprise, then, that villagers may want to use little or none of the water they have carried to wash their hands before handling food or eating. Thus they and their families risk spreading the dangerous diarrheal pathogens.

Water-Related Diseases

Diarrhea is a major symptom of all enteric diseases– those which are caused by bacteria, parasites or viruses and which affect the gastrointestinal tract of humans. All of the estimated thirty known water and sanitation-related diseases are caused by living organisms– including viruses, bacteria, and protozoa--that spend much of their lives either in or on the human body. In one way or another, the transmission of these diseases is related to water supply or sanitation, and in almost every instance better disposal of human wastes and better personal and family hygiene could contribute to prevention.

Waterborne Diseases. Waterborne diseases are transmitted from person to person. All but one, Guinea worm *(Dracunculus medinensis)*, are caused by organisms found in human excreta. People become infected when they swallow water contaminated with these organisms. (See Figure 5.1.)

Water supplies can be contaminated in any of five different ways:

1. When improperly placed latrines and privies are located uphill from or close to a spring, stream, pond, or well. The organisms get into the water supply when they are carried by liquids that seep from the latrines and privies.
2. When a water table is penetrated by seepage from a privy or soakage pit or a sewage absorption system.
3. When rainfall carrying disease-causing organisms turns into surface run-off and mixes with the water of unprotected wells and springs.
4. When, instead of using protected latrines or privies, people defecate on the ground or in pools of water.
5. When, in the case of Guinea worm, an infected person immerses a blister and releases larvae into the water. Tiny water fleas (Cyclops) eat some of the larvae and transmit it to another human being.

Water-Washed Diseases. Diseases that fall into this category include those transmitted from insufficient clean water for bathing, hand washing, and the washing of clothes and household utensils. In this category are shigellosis (bacillary dysentery),

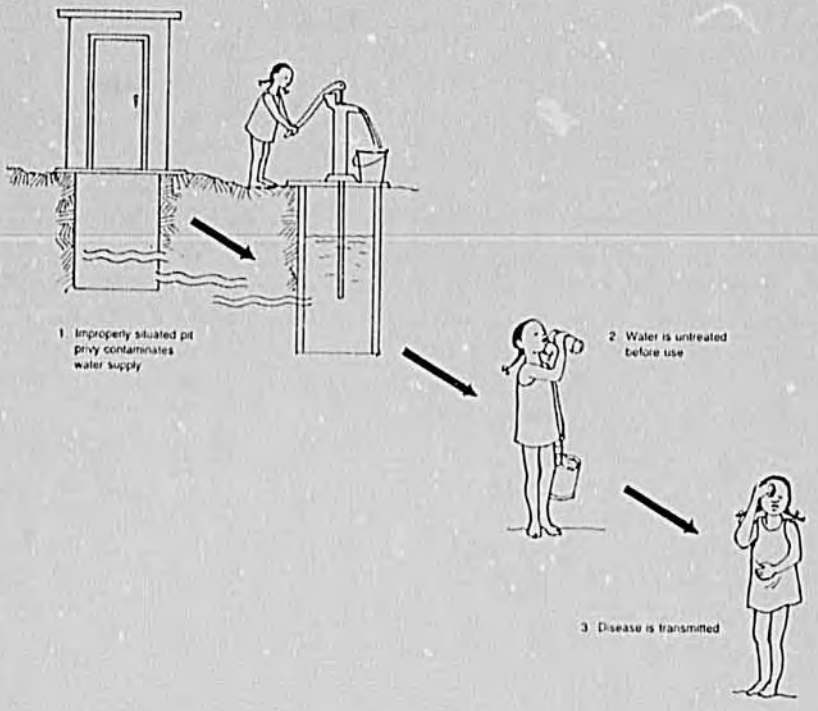
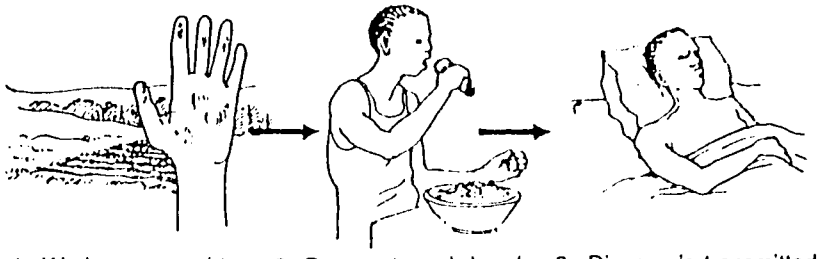


Figure 5.1. Transmission of waterborne diseases. Source: A.I.D.

salmonellosis (food poisoning), trachoma, and scabies. (See Figures 5.2 and 5.3). All of these may be spread in three ways:

1. When not enough water is available, or when only small amounts are on hand, to be used for personal hygiene.
2. When poorly protected latrines serve as breeding grounds for germs and germ-carrying insects.
3. When, not realizing the need for personal hygiene, people fail to bathe often enough, wash with water used by others, or share the same towels.



1. Worker exposed to contaminated soil
2. Does not wash hands before eating
3. Disease is transmitted

Figure 5.2. Transmission of water-washed diseases. Source: A.I.D.

Health Education: "Clean Water for All." A great deal of research has been devoted to the micro-organisms that cause diarrheal diseases. There is general agreement, however, that to a large extent diarrhea-causing infections spread from feces to food, usually on human hands, and that basic sanitary practices would go a long way toward interrupting the spread.

In the Third World, it is estimated, three-quarters of all illnesses are associated with unsafe excreta disposal, poor hygiene, and insufficient or poor quality water supplies. In many countries, therefore, programs to improve the quality of water supplies and the standards of personal hygiene contain advice on diarrhea prevention. (See Figure 5.4.)

The Voluntary Health Association of India (VHAI) suggests a six-step approach. It is typical of diarrhea prevention advice given by health workers to mothers:

1. When your child is four months old, start giving her porridge. By the time she is six months old, she should be having at least four meals a day besides your breast milk. Mixed food is better than just one kind. Add some fruits and vegetables to your child's food.
2. Always keep food and drinking water covered. Keep special pots *only* for drinking water. Never put your hand into the water pot. Keep flies away from the food.
3. Keep that place clean from where you get your drinking water. Even ponds, lakes, and rivers that look clean may cause diarrhea. Keep *animals* away from the place where you get your water. See that there is a fence around the

Category	Disease		Type of Organism	Transmission
	Common name	Medical name		
Waterborne (Water quality related)	Cholera	Cholera	Vibrio	By consuming (drinking) fecally contaminated raw water containing an infective dose of the vibrio, bacterium, protozoan or virus; except Guinea worm where transmission is by swallowing water flea infected with worm larva that was shed from skin blister on infected human.
	Typhoid fever	Typhoid	Bacteria	
	Paratyphoid fever	Paratyphoid	Bacteria	
	Bacillary dysentery	Shigellosis	Bacteria	
	Amebic dysentery	Amebiasis	Protozoan	
	Diarrhea	Salmonellosis	Bacteria	
	Diarrhea	Giardiasis	Protozoan	
	Jaundice	Hepatitis	Virus	
	Guinea worm	Dracunculiasis	Worm	
Water-washed (Water quantity; and accessibility related)	Bacillary dysentery	Shigellosis	Bacteria	Anal-oral or skin-to-skin direct contact transmission resulting from poor personal cleanliness and hygiene caused from lack of water for sufficient washing, bathing and cleaning.
	Diarrhea	Salmonellosis	Bacteria	
	Viral diarrhea	Enteroviruses	Virus	
	Trachoma	Trachoma	Intracelluar bacteria	
	Pink eye	Conjunctivitis	Bacteria	
	Itch	Scabies	Mite	
Water-contact (Body-of-water related)	Blood fluke disease	Schistosomiasis	Worm	Eggs in feces or urine hatch larvae in water, penetrate suitable snail, multiply greatly in snail, free-swimming larvae leave snail, penetrate skin when person has contact with infected water.
Water-related insect vectors (carriers) (Water-site related)	Yellow fever	Yellow fever	Virus	Mosquitoes, tsetse flies and blackflies, which breed in or near water, pick up disease organisms when they bite infected person; organisms grow in vectors and are inoculated into another person when insect bites.
	Malaria	Malaria	Protozoa	
	Filarial fever	Filiariasis	Worm	
	Sleeping sickness	Trypanosomiasis	Protozoa	
	River blindness	Onchocerciasis	Worm	
Sanitation-related (Fecal polluted soil related)	Hookworm	Ancylostomiasis	Worm	Eggs or larvae become infective when feces are deposited on soil; eggs are eaten from contaminated hands or vegetables, or larvae penetrate skin that comes in contact with infected soil.
	Roundworm	Ascariasis	Worm	

Figure 5.3. Water and sanitation-related diseases. Source: A.I.D.

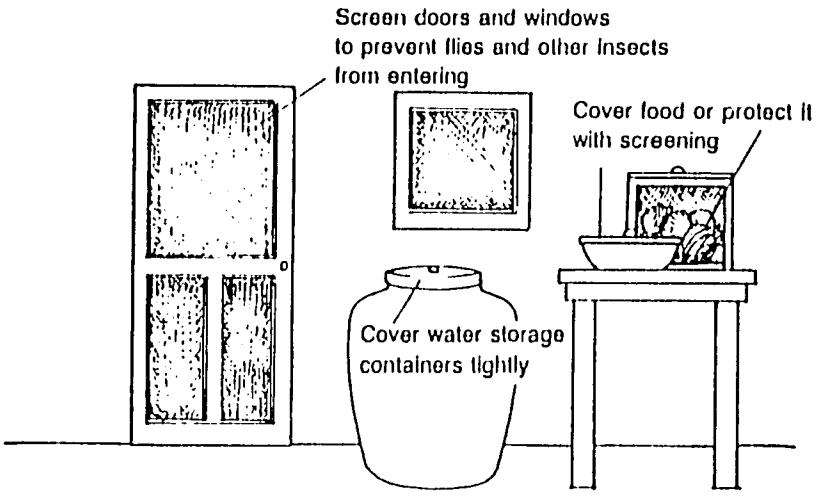
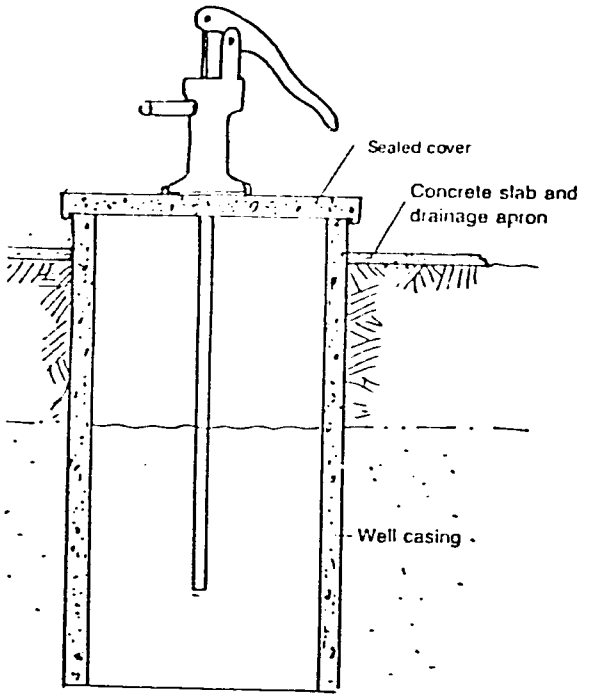


Figure 5.4. Individual preventive measures. Source: A.I.D.

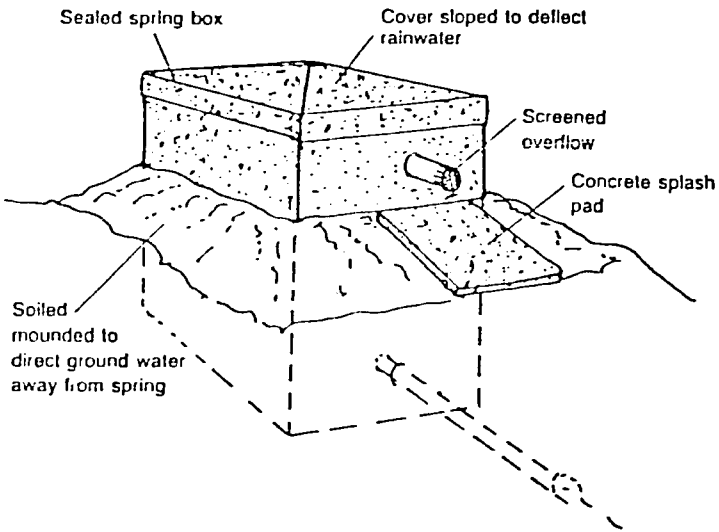
4. Do not let anyone pass stools, spit, or throw garbage near the place where people get their drinking water.
5. Wash your hands well after passing stool and also after cleaning your child who has had a stool.
6. Cut your nails short and keep them clean. Wash your hands before feeding the children.

Other hygiene advice is offered in other public health education programs. (See Figure 5.5.) The "Water for the World" educational materials, for example, were produced by the National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. The basic tips they offer are typical of advice contained in the hygiene educational programs of numerous Third World countries:

1. Build latrines at least 15 meters from any water supply or household.
2. Locate latrines downhill from any water source.
3. Do not excavate pits in the water table.
4. Make sure that all latrines are sanitary, with a concrete floor, and cover the hole through the floor when the latrine is not in use.
5. Accustom people to use latrines.
6. Provide for a safe supply of water for the community.
7. Cap springs to prevent their contamination.



a. Well



b. Spring

Figure 5.5. Proper protection of water supplies. Source: A.I.D.

Easy access to water is a major problem in drought-stricken Uganda. The restoration of hand-pumped boreholes is an urgent need since reliance on other sources—even if readily available--raises the incidence of water-borne diseases. Source: UNICEF. Photo: Arild Vollan.

8. Treat water where wells and springs are not protected or where surface water sources are used.
9. Wash fruits and vegetables before eating them.
10. Keep the house clean by sweeping it daily.
11. Dispose of all garbage correctly.
12. Train food handlers to wash their hands and to follow other rules of personal hygiene.
13. Eat well.

6

New Directions: Promises for the Future

A "Super-ORS" which visibly helped to reduce the diarrhoea and vomiting as well as invisibly preventing dehydration would . . . be a more marketable as well as a more effective therapy.

— 1987 State of the World's Children

For more than a decade, ORS has been used in treatment, successfully rehydrating some 90 percent of patients suffering from acute diarrhea. While the basic breakthrough has been accomplished, a major effort is being focused on improving the solutions. Because the present ORS formulations (including the one containing trisodium citrate) do not reduce the volume, frequency, or duration of diarrhea, scientists are working on a new ORS formula—a "Super-ORS" that would enhance the absorption of sodium from the small intestine and slow down diarrhea during rehydration.

Super-ORS is just one of a number of exciting new technologies being hailed as promising interventions against diarrheal disease. Other areas under study are improved vaccines—including new cholera vaccines now being tested in the field—that promise to reduce further the diarrhea mortality rate, and genetic engineering techniques for controlling viruses, bacteria, and parasites.

Super-ORS

Super-ORS is based on the application of water-soluble organic molecules and substances—such as neutral amino acids, dipeptides, tripeptides of neutral amino acids, D-hexoses, nutrients, starch, and other proteins or cereal-based rehydrating fluids—to regular ORS in order to improve the efficacy of the solution in the small intestine. The goals are to: (1) reduce the volume, frequency, and duration of the diarrhea; (2) minimize treatment failure by more effectively correcting dehydration and maintaining hydration; and (3) provide nutritional benefits. According to Dr. Dilip Mahalanabis of the World Health Organization in Geneva:

> It has been hypothesized that optimum exploitation of this phenomenon could lead to the development of an improved ORS formulation that would not only successfully replace the deficit of salts and water in diarrhea, but also actively induce the reabsorption of endogenous intestinal secretion and thus reduce the volume and duration of diarrhea—that is, act as an absorption-promoting anti-diarrheal drug.

Around the world, five principal Super-ORS formulas are being tried: four contain a starch, a peptide, and a dipeptide in different combinations, and the fifth is a cereal-based formula. At the same time, scientists are trying a protein-rich legume, the mung bean, in an effort to enhance the absorption of sodium and water in the small intestine.

Rice and Other Food-Based ORS

Another kind of Super-ORS, one providing even more calories than the standard Super-ORS currently being developed, takes advantage of the starches and proteins in cereals. This is a formula that works because in the intestinal tract the digestive processes break down the starches and proteins to release those organic solutes—glucose, amino acids, and peptides—that enhance the absorption of sodium and water.

A recent report of a study carried out during an epidemic of cholera in Bangladesh between December 1982 and March 1983 showed that, even under epidemic conditions or in cholera-like diarrhea, the glucose or sucrose component of oral rehydration

solutions can be replaced by rice powder with improved results. "Glucose and sucrose are manufactured products which are costly and not always available in countries where diarrhoeal diseases are a problem," the report pointed out. "Rice, a staple food in many of these countries, reduces the fluid requirements when used in ORS and also provides increased nutrition even in the acute stage of illness."

Further documenting the effectiveness of a rice-based solution, Mahalanabis described fairly recent advances against diarrheal diseases to an international gathering in Saltsojobaden, Sweden, in June 1985: "It was demonstrated using retrospective controls that a rice powder-based ORS was as effective as sucrose-based ORS in adults and older children with cholera." He cited a subsequent controlled clinical trial in infants and small children (three months to five years of age) with non-cholera diarrhea. "It was demonstrated that ORS containing cooked rice powder could significantly reduce the volume (by 49 percent) and the duration (by 30 percent) of diarrhea."

A subsequent clinical trial found that rice powder could reduce the volume of diarrhea stool in adults and children by 28 percent and 24 percent, respectively, and the quantity of ORS required by 27 percent and 30 percent.

Many other experts join in praising the cereal-based ORS studies. Explaining the effectiveness of starch in the search for a new formula, Dr. John Rohde has explained:

> "Starch molecules string long chains of glucose together to make them less osmotically active, overcoming the restraint that we should not exceed two percent glucose or four percent sucrose in a solution because of its osmotic effect. But the intestine's ability to absorb carbohydrate is almost completely intact in all cases of diarrhea studied, and starch molecules are an excellent way of delivering it. Furthermore, starch is generally available in every human diet from tubers to cereals while sometimes sugar is considered a luxury and not so widely available."

Dr. Michael Merson notes that both the chemical and cereal categories have already proven their effectiveness. Merson has observed that the cereal-based ORS has already been shown in limited clinical studies to reduce diarrhea considerably—by as much as 50 percent. The cereals or legumes have a maximum effect of around 40 to 50 percent. With further research, cereal-

based ORS, in the right combination with proteins and dipeptides, may increase that percentage to 70 percent.

In Bangladesh, where rice powder ORS is being encouraged instead of sugar or glucose, experiments are being carried out using wheat, maize, millet, and sorghum and potato. "It is still too early to recommend any of these," says the ICDDR,B's Dr. Majid Molla, "but we are very confident that, in many countries, rice-powder ORS is the most effective and appropriate treatment for diarrhea." A.I.D. sources say more research is needed before conclusions are made.

Ultimately, however, many considerations will play a part in the distribution of any new ORS. Packaging technologies will be a factor, for instance, as will be the availability of rice. Although studies on rice-based and glycine-based ORS have shown a reduction of as much as 30 percent in the duration of diarrhea, rice is not universally obtainable.

Other questions remain. For example: How long will it take the mix to ferment? If it is not long, say as little as four hours, should the family be asked to make up the solution every few hours? Will they have enough fuel to do this? In addition, more information must be gathered on the need for cooking rice powder before use, on the use of rice-powder ORS in infants under three months of age, and on the effects of bacteria overgrowth. Some physicians remain reluctant to recommend any cereal-based ORS, associating them with allergic, immunological, and digestive problems.

New and Improved Vaccines

A decade ago, it was not possible to isolate bacterial or viral pathogens from most patients with acute diarrhea, leaving doctors only to wonder about the cause of diarrhea. With the development of electron microscopy, however, it became possible to look for viruses that would not grow in cell culture. In this way, at least five new groups of diarrhea viruses have been identified: Norwalk viruses, rotaviruses, enteric adenoviruses, astroviruses, and coronaviruses. All are believed to infect and destroy the outer layer of cells lining the small intestine, which, in turn, causes the loss of fluid and electrolytes that results in diarrhea.

Today, it is generally agreed that viruses, rather than bacteria,

Artist: Hector Catalina

"The mother is the highest level health worker—not in training or in qualifications but in time and love, in the special knowledge of her own children, in the breadth of integrated services she provides, and in the permanent presence she brings to her child's life."

cause most of the acute infectious diarrhea in young children. Statistics vary from year to year and place to place, but many hospital-based studies have shown that as many as 50 or 60 percent of acute diarrhea cases are caused by rotaviruses. These very infectious viruses, which spread mainly through fecal or oral contamination, occur mainly in the winter in countries with cold winters. But in other countries, where there is little variation in temperature, the same infections occur throughout the year.

New rotavirus vaccines are currently under development and are being given field trials. The possibility of developing a vaccine to prevent rotavirus infections has been enhanced by the isolation of rotaviruses in tissue culture and the identification of new kinds of rotaviruses.

According to Dr. Richard Feacham, rotaviruses may be responsible for about 6 percent of all diarrhea episodes and 20 percent of all diarrhea deaths in children under the age of five. "A rotavirus vaccination program that achieves a 60 percent coverage of children by an average age of six months with a vaccine having 80 percent efficacy might reduce the diarrhea morbidity rate by 2.4 percent and the diarrhea mortality rate by 7.7 percent among children under five years of age."

Looking ahead to the day when a rotavirus vaccine is available, scientists suggest that it could be added to existing vaccination programs for as little as two dollars per child. Feachem reports: "Assuming an annual diarrhea morbidity rate and mortality rate of 22 and 1.4, respectively, per 100 children under 5 years of age, the cost-effectiveness of *rotavirus immunization* would be $5 per diarrhea episode averted and $220 per diarrhea death averted among children under 5 years of age."

To date, scientists have identified four serotypes of rotaviruses. But research is continuing into the question of whether infection with one serotype immunizes children against infection with other serotypes. States Dr. Ruth Bishop of the Department of Gastroenterology at the Melbourne, Australia, Royal Children's Hospital: "The most exciting recent development occurred when Japanese research workers succeeded in growing human rotaviruses in cell culture. This will make it possible to grow and compare rotavirus strains from many different countries."

Dr. Bishop, who ten years ago first described rotaviruses in *The Lancet*, says rotavirus infections can occur at any age but are most severe in children six to fourteen months old. Antibodies received from mothers, particularly in breast milk, she says, protect most babies at birth from severe rotavirus disease.

Among other viruses, the milder Norwalk group viruses are a common cause of diarrhea but do not account for high mortality. The astroviruses also are believed responsible for only mild diarrhea. Enteric adenoviruses are currently being tested in Sweden to determine how common they are in Third World countries. And coronaviruses, which are believed to be an important cause of diarrhea, are still undergoing preliminary research.

Before any type of diarrhea vaccine is marketed, it should be noted, several years of field trials will have to be carried out. This leaves the simple, low-cost, and highly effective oral rehydration technique to deal with all forms of acute infectious diarrhea.

Genetic Engineering

Gene splicing, or recombinant DNA (deoxyribonucleic acid), which modifies the hereditary characteristics of a living creature by transplanting foreign genes, opens vast possibilities for the attack on diarrheal diseases.

Among many physicians and scientists looking toward this technique, Dr. William Greenough III, the former ICDDR,B director, has pointed to the possibility of developing an oral vaccine from live, genetically engineered "organisms" or from nonliving components. "We now have the means—genetic engineering—of controlling the viruses, bacteria and parasites that cause the diseases. The ICDDR,B is developing competency in microbial genetics and thus improving its ability to study living oral vaccine strains. That's why we're encouraged by the successful development of a very highly effective oral vaccine against typhoid. We also have the ability to test the effectiveness of other interventions in the household environment."

According to Dr. Thomas H. Flewett of the Regional Virus Laboratory in East Birmingham Hospital, England, genetic engineering techniques open up new possibilities for making vaccines:

> Rotavirus antigen could be implanted in common bacteria which normally colonize the small bowel and they would reproduce the antigen and in this way immunize the patient. Alternatively, the strain of typhoid bacillus, Ty21a, used in the new anti-typhoid vaccine might carry the rotavirus antigen. The effectiveness of such vaccines is uncertain. The technology to make the experiment does, however, now exist.

The new strains of typhoid bacillus, which are believed suitable for use as a live oral vaccine, have undergone field trials in Chile and Egypt. They are seen as eventually taking the place of the long-available, injectable anti-typhoid vaccines, which are effective but tend to cause fever and pain and swelling at the injection site.

The quick availability of any vaccine for use against diarrheal dehydration should not be expected, however. As Flewett points out: "Before a diarrhea vaccine is marketed, fully adequate field trials must guarantee its effectiveness and these will need to be carried out over several years because of the variation in viruses and the periodic nature of viral diarrhea."

Cholera Immunization

New cholera vaccines, also currently under development and field trials, have a potential impact that varies from country to country, depending on the extent to which this disease cause diarrhea. Feachem, taking the extreme example of Bangladesh, where cholera is believed to account for about 0.4 percent of all diarrhea episodes and 8 percent of all diarrhea deaths in children under the age of five, notes that values for the efficacy of a new cholera vaccine have to be assumed. He observes: "A cholera vaccination program that achieves a 60 percent coverage of children at an average age of 24 months with a vaccine having 70 percent efficacy would reduce the diarrhea morbidity rate by 0.1 percent and the diarrhea mortality rate by 1.7 percent among children under 5 years of age in Bangladesh."

Again reporting on cost analysis, he says research into this area suggests that for an average of about $4 per child, cholera vaccination could be added to an existing vaccination program. "Assuming an annual diarrhea morbidity rate and mortality rate of 22 and 1.4, respectively, per 100 children under 5 years of age, the cost-effectiveness of *cholera immunization* in Bangladesh would be $220 per diarrhea case averted and $2,000 per diarrhea death averted among children under 5 years of age."

Measles Immunization

The known interaction of measles and diarrhea has led scientists to speculate whether immunity to measles would have a significant effect on the control of diarrheal diseases. This, in turn, has led to a call for greater measles immunization campaigns. In some developing countries, measles has almost been eradicated by vaccines. But measles immunization has yet to become a major priority in campaigns to wipe out diarrhea.

According to Drs. M. and V.I. Mathan of the Christian Medical College Hospital in Vellore, India, "Assuming five million deaths each year due to diarrhea among preschool children in the developing world, this estimate suggests that between 60,000 and 1 250,000 diarrhea deaths a year could be prevented by an effective measles immunization campaign. Clinical experience suggests that the cases that would benefit most from this are the children who develop severe diarrhea and, possibly, diarrhea associated with invasive organisms."

Writing in *Dialogue on Diarrhoea*, the doctors contend that a major constraint for the control of diarrheal diseases among children in developing countries is the prohibitive cost—taking into consideration the overall cost of improved sanitation and water supplies, better nutrition, and health education. "Most clinicians who have experience with acute diarrhea in developing countries feel that measles immunization would be a useful immediate weapon at a comparatively trivial cost," they write. Calling for well-controlled field trials, they present the possibility that more effective and widespread measles immunization could in the future dramatically alter the diarrhea mortality and morbidity picture.

Vitamin A

While it is well known that vitamin A prevents nutritional blindness, there is some evidence that vitamin A deficiency predisposes children to more frequent or severe episodes of diarrhea. Where vitamin A deficiency is common among children, therefore, it may

be advisable to promote the use of appropriate, locally available foods that are rich in vitamin A and/or to provide supplementary vitamin A.

It is believed that such intervention can also be useful during episodes of diarrhea to (1) contribute to overall efforts to control xerophthalmia, the eye disease that results from a severe vitamin A deficiency, and (2) avert subsequent xerophthalmia. Children with severe diarrhea are at increased risk of vitamin A deficiency because they usually eat less, their metabolism is higher, and their bodies can absorb less of what vitamin A their food contains.

Should ORS be fortified with vitamin A? A 1987 meeting of WHO and the International Vitamin A Consultative Group (IVAGG) said no– the amount of vitamin A necessary to benefit children in need is too high to be safe for adults who also use ORS, particularly pregnant women. However, it was suggested that a message emphasizing the need for vitamin A in children with diarrhea might be incorporated on the label of ORS packets.

In addition, training material should stress the importance of extra vitamin A as part of routine treatment of diarrhea. Health workers who treat acute diarrhea should encourage increased intake of vitamin A, and this should include promotion of appropriate, locally available food rich in vitamin A.

The Challenge Ahead

There is as yet no "magic bullet" or short cut to combat diarrhea. Such promising drugs as chlorpromazine, indomethacin, berberine, nicotinic acid, and aspirin have been tested in the isolated intestine or in animals, but, unlike ORT, have not been proven efficacious in humans. Dr. Norbert Hirschhorn recently praised ORT, predicting that "no such medicine which is simultaneously effective, safe and cheap will be found before the next ICORT."

While much research remains to be done on a reliable vaccination against diarrhea, ORT still is looked on as the best bet. For the

present, the major hurdle to effective diarrheal rehydration is the lack of understanding, by family members and physicians, that ORT is the best known strategy for child survival.

Addressing the issue of future directions at the closing session of ICORT II, A.I.D.'s Director of Health, Dr. Kenneth J. Bart, spoke of the promises of the future:

> The next several years will bring affirmation of methods to ensure effective usage of home prepared ORT. We will see the development and use of new and innovative channels of communication with mothers, those traditionally disenfranchised, even in the remotest areas, reinforcing appropriate responses when diarrhea occurs and teaching correct use of ORT.
>
> We will see the increasing recognition and acceptance of the importance of the role of mothers as central figures in ensuring the survival of their children—through home prepared ORT, through mother retained weight and immunization records, which will indicate her appropriate responses, and through breastfeeding and improved weaning foods, and through child spacing.
>
> We will begin to see the widespread use of measles vaccine which will have a major salutory effect on the morbidity and mortality due to measles associated diarrhea.
>
> We will see the testing of vaccines for shigella, typhoid, rotavirus and cholera, and the development of a new generation of vaccines through genetic engineering and protein synthesis techniques, some of which may be available in the next decade.
>
> We will begin to see the accumulated effect of a decade of investment in water and sanitation projects and will rediscover and again reaffirm the necessity to invest in primary prevention.

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Appendix A

Organizations Active in ORT

Numerous international and national organizations, including many governmental and private agencies and groups, are active in the promotion of information on diarrheal disorders and ORT. The following is a partial list (alphabetically arranged).

Academy for Educational Development (AED), 1255 23rd St., N.W., Washington, D.C., 20007. AED is a nonprofit service organization under contract to A.I.D. to provide technical direction and assistance in health communications.

Agency for International Development (A.I.D.), Office of Health, Bureau for Science and Technology, Washington, D.C. 20523. The Agency coordinates U.S. foreign assistance efforts and has provided technical consultant support and support for meetings, workshops, and special projects to disseminate ORT. It helps fund many of the other organizations listed here.

American Public Health Association (APHA), Clearinghouse on Infant Feeding and Maternal Nutrition, 1015 15th St., N.W., Washington, D.C. 20005. Publishes *Mothers and Children*, a newsletter about infant feeding and maternal nutrition, three times a year.

Appropriate Health Resources and Technologies Action Group (AHRTAG), 85 Marylebone High St., London W1M 3DE, England. Publishes a quarterly newsletter, *Dialogue on Diarrhoea*, in English, French, Spanish, Portuguese, and Arabic, on all aspects of prevention and control of diarrheal disease.

Diarrheal Diseases Research and Rehydration Center (DDRRC), 20A Gamal El Din Aboul Mehassen St., Garden City, Cairo, Egypt. Publishes *Diarrhea Control* newsletter twice a year.

Hesperian Foundation, P.O. Box 1692, Palo Alto, California 94302. Supports a network of independent village centers covering 5,000 square miles of rural Mexico. Its village health care manual, *Where There Is No Doctor*, has been used as a handbook and training manual by rural health programs in more than 100 countries.

International Centre for Diarrhoeal Diseases Research, Bangladesh (ICCDDR,B), P.O. Box 128, Dhaka, Bangladesh. Conducts research on all aspects of diarrheal disease; publishes *Glimpse* eight times a year and the *Journal of Diarrheal Diseases Research* four times a year.

International Nursing Services Association (INSA), Atlanta, Georgia. A puppet show play produced by INSA is being performed by the Girl Scouts in the U.S. and by Girl Guides in India.

League of Red Cross and Red Crescent Societies, National Headquarters, Washington, D.C. 20006. The League is a federation of 137 Red Cross and Red Crescent societies. Its "Child Alive" program is designed to stimulate and support action on the diarrhea problem and related nutritional issues.

Pan American Health Organization (PAHO), 525 23rd St., N.W., Washington, D.C. 20037. As the WHO regional office for the Americas, PAHO has provided technical consultants, supported national and regional meetings, and provided research grants, equipment and materials in the promotion of ORT.

Peace Corps, 806 Connecticut Ave., N.W., Washington, D.C. 20526. In a joint Peace Corps/A.I.D. initiative, Peace Corps volunteers play a critical role in disseminating ORT techniques and formulas.

Program for Appropriate Technology in Health (PATH), Canal Place, 130 Nickerson Street, Seattle, Washington 98109. PATH works to adapt, develop, introduce, and promote health technologies that are appropriate to a specific country's capabilities and needs.

Teaching Aids at Low Cost (TALC), Tropical Child Health Unit, Institute of Child Health, 30 Guilford Street, London WC1N 1EH, England.

Technologies for Primary Health Care (PRITECH), Information Center, 1655 N. Ft. Meyer Dr., Arlington, Virginia 22209. This A.I.D.-funded project maintains an ORT database and has published an annotated ORT bibliography and manual of guidelines for ORT implementation. It is a consortium of expe-

rienced, internationally known organizations and individuals working together to assist developing nations to reduce infant and child mortality through ORT and other proven disease control technologies.

United Nations International Children's Emergency Fund (UNICEF), 866 U.N. Plaza, New York, New York 10017. UNICEF, which publishes the annual *State of the World's Children* report, has been a major supplier of ORS packets.

United Nations Development Programme (UNDP), 1 U.N. Plaza, New York, New York 10017. The UNDP administers and coordinates the great majority of technical assistance provided through the United Nations system.

Water and Sanitation for Health Project (WASH), 1611 N. Kent Street, Room 1002, Arlington, Virginia 22209. This A.I.D.-sponsored project provides A.I.D. Bureau and Missions with technical services to support its rural and urban drinking and sanitation programs.

World Health Organization (WHO), Diarrhoeal Diseases Control Programme (CCD), 1211 Geneva 27, Switzerland. WHO is a multinational agency helping countries obtain the information they need in order to determine which interventions and strategies are most appropriate. Its CDD has played a pivotal role in stimulating the use of ORT.

World Neighbors (WN), 5116 N. Portland, Oklahoma City, Oklahoma 73112. Publishes *World Neighbours in Action*, a quarterly "how-to-do-it" newsletter on primary health care.

Appendix B

Estimated A.I.D. Funding for ORT Interventions: Fiscal Years 1987 and 1988

Bureau for Africa

Kenya—Family Planning Support and Services, Project 6150232. Health appropriation: Fiscal Year 1987 $28,000.

Malawi—Multiple Assistance Schemes in Health, Project 6120226. Health appropriation: FY 88 $350,000.

Mali—Integrated Family Health Services, Project 6880227. Health appropriation: FY 88 $100,000. Sahel Development Fund appropriation: FY 87 $170,000.

Niger—Health Sector Support, Project 6830254. Child Survival Action Program appropriation: FY 87 $690,000. Sahel Development Fund appropriation: FY 87 $1,750,000. Health appropriation: FY 88 $936,000.

Senegal—Rural Health Services II, Project 6850242. Sahel Development Fund appropriation: FY 87 $458,000.

Sudan—Child Survival, Project 6500084. Child Survival Action Program appropriation: FY 87 $600,000, FY 88 $1,200,000.

Swaziland—Primary Health Care, Project 6450220. Health appropriation: FY 87 $168,000, FY 88 $168,000.

Uganda—Child Survival, Project 6170110. Child Survival Action Program appropriation: FY 87 $130,000, FY 88 $650,000.

Zaire—Basic Rural Health II, Project 6600107. Health appropriation: FY 87 $152,000, FY 88 $114,000.

Regional—Africa Child Survival Initiative CCCD, Project 6980421. Child Survival Action Program appropriation: FY 87 $2,699,000, FY 88 $802,000. Health appropriation: FY 87 $2,370,000, FY 88 $2,699,000.

Bureau for Asia and the Near East

Bangladesh—Family Planning and Health Services, Project 3880071. Child Survival Action Plan appropriation: FY 87 $200,000, FY 88 $200,000. Health appropriation: FY 88 $150,000.

Bangladesh—Urban Volunteer Program, Project 3880073. Child Survival Action Plan appropriation: FY 87 $100,000.

Burma—Quality Care for Child Survival, Project 4820013. Health appropriation: FY 87 $102,000, FY 88 $194,000.

Egypt—Control of Diarrheal Diseases, Project 2630137. Economic Support Fund appropriation: FY 87 $10,000,000.

India—PVOs for Health II, Project 3860511. Child Survival Action Program appropriation: FY 87 $805,000. Health appropriation: FY 88 $230,000.

India—Child Survival Health Support, Project 3860504. Health appropriation: FY 88 $1,270,000.

Indonesia—PVO Co-Financing II Operations Program Grant, Project 4970336. Health appropriation: FY 87 $40,000, FY 88 $30,000.

Indonesia—Health Sector Financing, Project 4970354. Health appropriation: FY 88 $1,050,000.

Jordan—Primary Health Care Nursing Development, Project 2780270. Economic Security Fund appropriation, FY 87 $450,000.

Nepal—Integrated Rural Health/Family Planning Services, Project 3670135. Health appropriation: FY 87 $51,000.

Nepal—Child Survival and Family Planning Services, Project 3670157. Health appropriation: FY 88 $250,000.

Pakistan—Healthy Children, Project 3910496. Child Survival appropriation: FY 88 $3,000,000.

Philippines—PVO Co-Financing II Operational Program Grant, Project 4920367. Health appropriation: FY 87 $141,000, FY 88 $109,000.

Philippines—Primary Health Care Financing, Project 4920371.

Health appropriation: FY 88 $398,000.

Philippines—Integrated Maternal and Child Health for Child Survival, Project 4920406. Health appropriation: FY 88 $200,000.

Yemen—Accelerated Cooperation for Child Survival, Project 2790082. Health appropriation: FY 87 $13,000, FY 88 $131,000.

Bureau for Latin America and the Caribbean

Belize—Child Survival Support, Project 5050037. Child Survival Action Program appropriation: FY 88 $159,000.

Bolivia—Self-Financing Primary Health Care, Project 5110569. Child Survival Action Program appropriation: FY 87 $26,000. Health appropriation: FY 87 $8,000, FY 88 $11,000.

Bolivia—ORT Growth Monitoring, Project 5110590. Child Survival Action Program appropriation: FY 87 $64,000, FY 88 $85,000.

Bolivia—CARE Water and Health, Project 5110599. Child Survival Action Program appropriation: FY 87 $107,000. Health appropriation: FY 87 $12,000.

Bolivia—ORS Packets, Project 5110600. Child Survival Action Program appropriation: FY 87 $450,000, FY 88 $500,000.

Bolivia—PVO Health, Project 5110601. Child Survival Action Program appropriation: FY 88 $214,000.

Dominican Republic—Child Survival, Project 5170239. Health appropriation: FY 87 $550,000.

Ecuador—Integrated Rural Health Delivery System, Project 5180015. Child Survival Action Program appropriation: FY 87 $288,000. Health appropriation: FY 87 $70,000.

Ecuador—Child Survival, Project 5180071. Child Survival Action Program appropriation: FY 88 $350,000. Health appropriation: FY 88 $16,000.

El Salvador—Save the Children, Project 5190300. Child Survival Action Program appropriation: FY 87 $61,000, FY 88 $15,000. Health appropriation: FY 87 $27,000, FY 88 $16,000.

El Salvador—Health Systems Support, Project 5190308. Child Survival Action Program appropriation: FY 87 $600,000, FY 88 $280,000. Health appropriation: FY 87 $179,000, FY 88 $182,000. Economic Support Fund appropriation: FY 87 $29,000.

El Salvador—Health and Jobs for Displaced Families Operating Program Grant, Project 5190281. Health appropriation: FY 88 $250,000.

Guatemala—Immunization/ORS for Child Survival, Project 5200339. Child Survival Action Program appropriation: FY 87 $1,191,000. Health appropriation: FY 87 $74,000.

Guatemala—Improved Family Health, Project 5200357. Child Survival Action Program appropriation: FY 88 $870,000.

Haiti—Voluntary Agencies for Child Survival, Project 5210206. Child Survival Action Program appropriation: FY 87 $600,000, FY 88 $600,000.

Haiti—Rural Health Delivery System, Project 5210091. Health appropriation: FY 87 $75,000.

Haiti—Targeted Community Health Outreach, Project 5210172. Health appropriation: Fy 88 $500,000.

Honduras—Health Sector I, Project 5220153. Economic Support Fund appropriation: FY 87 $204,000. Health appropriation: FY 87 $49,000. Population appropriation: FY 87 $58,000.

Honduras—Health Sector II, Project 5220216. Child Survival Action Program appropriation: FY 88 $960,000.

Peru—Child Survival Action, Project 5270285. Child Survival Action Program appropriation: FY 87 $245,000, FY 88 $271,000.

Peru—Expanded Feeding Program, Project 5270247. Food and Nutrition appropriation: FY 87 $18,000.

Peru—Caritas Feeding Program, Project 5270248. Food and Nutrition appropriation: FY 87 $20,000.

Peru—Basic Infrastructure for Pueblos Jovenes, Project 5270261. Food and Nutrition appropriation: FY 87 $11,000.

Peru—Program Development and Support, Project 5270000. Health appropriation: FY 87 $30,000, FY 88 $21,000.

Peru—Reduction in Child Mortality, Project 5270311. Health appropriation: FY 87 $87,000.

Peru—Integrated Health/Family Planning, Project 5270230. Population appropriation: FY 88 $48,000.

Regional Office for Central America Programs—ORT, Growth Monitoring and Nutrition Education, Project 5960115. Health appropriation: FY 87 $320,000, FY 88 $80,000.

Regional—Intercountry Technology Transfer, Project 5980616. Child Survival Action Program appropriation: FY 88 $836,000. Health appropriation: FY 87 $1,170,000, FY 88 $393,000.

Worldwide

Bureau for Food and Voluntary Assistance—Technical Support/ Child Survival, Project 9380500. Child Survival Action Program appropriation: FY 87 $2,900,000, FY 88 $3,480,000.

Bureau for Food and Voluntary Assistance—Project HOPE, Project 9380285. Health appropriation: FY 87 $265,000, FY 88 $250,000.

Bureau for Science and Technology, Office of Health—HEALTHCOM, Project 9311018. Child Survival Action Program appropriation: FY 87 $1,200,000, FY 88 $1,138,000.

Office of Health—Technology for Primary Health Care, Project 9365927. Child Survival Action Program appropriation: FY 87 $1,800,000, FY 88 $1,013,000. Health appropriation: FY 87 $45,000.

Office of Health—ORT-HELP, Project 9365939. Child Survival Action Program appropriation: FY 88 $750,000. Health appropriation: FY 87 $968,000.

Office of Health—CSAP Support, Project 9365951. Child Survival Action Program appropriation: FY 87 $240,000, FY 88 $188,000. Health appropriation: FY 87 $193,000, FY 88 $105,000.

Office of Health—Project SUPPORT, Project 9365953. Child Survival Action Program appropriation: FY 87 $500,000, FY 88 $750,000. Health appropriation: FY 88 $82,000.

Office of Health—HEALTHTECH, Project 9365968. Child Survival Action Program appropriation: FY 88 $200,000.

Office of Health—Technology for Primary Health Care II, Project 9365969. Child Survival Action Program appropriation: FY 87 $1,305,000, FY 88 $1,350,000.

Office of Health—PHS Details, Project 9365970. Child Survival Action Program appropriation: FY 88 $200,000.

Office of Health—Family Health and Demographic Surveys, Project 9363023. Health appropriation: FY 87 $20,000, FY 88 $20,000.

Office of Health—Operations Research in Primary Health Care (PRICOR), Project 9365920. Health appropriation: FY 87 $500,000, FY 88 $375,000.

Office of Health—Diarrheal Disease Research, Project 9365928. Health appropriation: FY 87 $850,000, FY 88 $875,000.

$500,000, FY 88 $375,000.

Office of Health—Diarrheal Disease Research, Project 9365928. Health appropriation: FY 87 $850,000, FY 88 $875,000.

Office of Health—MEDEX Support, Project 9365932. Health appropriation: FY 87 $50,000, FY 88 $25,000.

Office of Health—DIATECH: Diagnostic Technology, Project 9365935. Health appropriation: FY 87 $200,000, FY 88 $210,000.

Office of Health—Water and Sanitation for Health (WASH II), Project 9365942. Health appropriation: FY 87 $216,000, FY 88 $1,275,000.

Office of Health—Applied Diarrheal Disease Research, Project 9365952. Health appropriation: FY 87 $1,020,000, FY 88 $1,275,000.

Bureau of Science and Technology, Office of Research and University Relations—Research Grants to Historically Black Colleges and Universities, Project 9365053. Health appropriation: FY 87 $86,000, FY 88 $89,000.

Office of Research and University Relations—Joint Health Memorandums of Understanding, Project 9365057. Health appropriation: FY 87 $127,000, FY 88 $127,000.

Appendix C

A.I.D.'s Involvement in the History of the Development and Promotion of ORT

Early Clinical Studies

1960s U.S. Navy (NAMRU-2) builds on early work and initiates clinical balance studies on adults documenting the importance of glucose in oral rehydration therapy for cholera in San Lorenzo Hospital, Manila. AID and NIH fund the Pakistan SEATO Cholera Research Laboratory (CRL) in Dacca, East Pakistan (now Dhaka, Bangladesh). NIH funds the International Center for Medical Research and Training at the Infectious Disease Hospital, Calcutta (ICMRT) through a grant to researchers at the Johns Hopkins University. Researchers in these institutes conduct research that confirms NAMRU's work and take the lead in research on oral fluid therapy.

1968 CRL researchers publish reports of use of oral rehydration solutions as maintenance therapy for eight adult cholera patients.

1969 ICMRT researchers report even more favorable results in 30 patients. Only one patient required intravenous solutions to recover.

1970 CRL researchers report successful use of ORT in dehydrated children. CRL, ICMRT researchers report successful use of ORT for dehydration produced by diarrheas of diverse etiologies.

1971 WHO sponsors conference that recognizes current glucose, sodium, potassium, bicarbonate formulation developed by CRL and ICMRT.

1972 Ex-CRL researcher reports use of ORT in Apache children in the United States. This is the first use of ORT for rehydration of children outside the Indian subcontinent.

Field Studies

1970 A.I.D. continues as lead donor to CRL as research moves to field studies. CRL researchers report that ORT can be used successfully under field conditions in rural treatment centers during epidemic outbreaks of cholera.

1971 Indian investigations from the Johns Hopkins/ICMRT (Calcutta) group demonstrate the effectiveness of ORT in reducing IV fluid requirements and deaths in refugee camps during the war in which Bangladesh gained independence.

1975 CRL researchers report use of ORT in a crowded camp for Bangladeshi refugees during epidemic; 3,703 patients were treated with 3.6 percent mortality compared to 25 percent in camps not yet using ORT.

1975-76 Researchers in the Philippines document the nutritional benefit of ORT in a large field trial. A.I.D. funds research at ICDDR,B to improve formulation to enhance nutritional benefits of ORT.

Development and Institutionalization

1978 U.S. supports World Health Assembly resolution calling for creation of systematic attack on diarrheal diseases. This leads, in the 1980s, to development of a program for Control of Diarrheal Diseases (WHO/CDD) to assist National Diarrheal Disease Control Programs in collaboration with UNICEF, A.I.D., UNDP, and other donors and countries.

1979	CRL is reorganized as the International Center for Diarrheal Disease Research, Bangladesh (ICDDR,B). A.I.D., still the largest single donor, pledges to support work of the Center at the same level it had supported CRL.
1983	Technology for Primary Health Care (PRITECH) Project launched.
1983	ICORT I conference sponsored by A.I.D.
1985	ICORT II conference sponsored by A.I.D.
1980-87	A.I.D. funds ORT delivery programs in nearly a score of countries in Africa and Latin America.

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Appendix D

Introduction, A.I.D. Policy on Health Assistance

The goal of A.I.D.'s health assistance program is to improve the health status in A.I.D.-assisted countries as reflected in increased life expectancy. Most health problems in developing countries stem from poor environmental conditions; lack of health care and knowledge; malnutrition; infectious diseases (including diarrheal diseases, respiratory illnesses, measles, tetanus and tuberculosis); and parasitic diseases. Hundreds of millions of adults suffer from chronic illness, but children are the most vulnerable group. Half of all deaths in developing countries occur in the age group of five and under. The most direct way to increase life expectancy and general health status in developing countries is by addressing the health problems of children and their mothers. Thus, within A.I.D.'s health assistance program priority will be given to support for child survival and improved maternal and child health.

Child health will be approached primarily through selected child survival interventions—immunizations, diarrheal disease control (specifically ORT), improved nutrition, and adequate birth spacing. These interventions will also provide the basis for building up more comprehensive primary health care systems over time. Priority will be placed on immunizations and diarrheal disease control/ORT, but the choice of which interventions to support will be made on the basis of country-specific conditions.

A.I.D. recognizes that other health interventions in addition to the four listed above can make important contributions to child

survival and that other health problems in developing countries not specific to children or their mothers also need to be addressed. Therefore, other health activities, including primary health care, water and sanitation projects, and vector-borne disease treatment and control, will also be supported where there is a need to meet pressing country-specific health problems. Health financing concerns should be addressed in all health projects. However, in some countries improving the financing of health care may be the main A.I.D. activity. Where health programs beyond the four direct child survival interventions are proposed for A.I.D. support, an additional burden of proof will be required to demonstrate their appropriateness.

Because substantial resources will be required to reach developing country goals in health, A.I.D.'s policy emphasizes investment in interventions known to be cost-effective. Such interventions are essentially preventive in nature, reducing potential future expenditures by averting diseases and conditions which are very costly to treat. Because of the high cost of curative care, A.I.D. will not generally support curative activities except to deal with common conditions for which prevention is either difficult or even more costly than treatment. Given current technologies, examples are diarrheal disease, acute respiratory infection (ARI), malaria, and certain water-borne diseases. Major investments in the construction of physical infrastructure, the operation of which will increase host country recurrent cost burdens, will not be supported.

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Glossary

Acute Diarrhea: In any 24-hour period, more than two abnormally loose or watery stools, frequently accompanied by fever, abdominal pains, and/or vomiting.

Cholera: A bacterial disease spread by contaminated food and water that is marked by severe diarrhea, vomiting, dehydration, cramps, prostration, and suppression of urine. The disease, which is due to the Vibrio cholera (notably the El Tor strain), can spread fast and has a high mortality if treatment is not readily available.

Chronic Diarrhea: Persistent diarrhea, lasting for more than three weeks, caused when infection, malabsorption, and malnutrition have disturbed conditions in the intestinal tract. As with acute diarrhea, ORT should be the initial treatment.

Dehydration: Loss of extracellular fluids and chemicals caused by diarrhea, which upsets the body's fluid balance and leads to physiological disturbance.

Diarrhea (or Diarrhoea, the British spelling): A symptom of a disease (not a disease by itself) characterized by frequent passage of abnormally loose or watery stools.

Enteric Diseases: Diseases—of which diarrhea is a major symptom—caused by bacteria, parasites, or viruses that affect the gastrointestinal tract.

Intravenous (IV) Therapy: A procedure that allows a fluid solution to drip slowly through a needle into the patient's veins.

Oral Rehydration Salts (ORS): Either of the standard WHO/UNICEF recommended formulas, generally provided in prepackaged dry form.

Oral Rehydration Therapy (ORT): A simple, effective, and inexpensive technique for preventing and treating diarrheal dehydration. It includes continuation of feeding during diarrhea.

Rehydration: The correction of dehydration.

Rotavirus: The organism believed responsible for about 30 to 40 percent of all cases of acute childhood diarrhea. Infection from rotavirus usually causes an attack that begins with vomiting and is followed by watery diarrhea.

Social Marketing: The application of commercial marketing principles to advance a social issue, cause, behavior, product, or service.

Super-ORS: A modified ORS formula containing water-soluble organic substances or cereal for improving the absorption of water and sodium in the small intestine and reducing stool volume and duration of diarrhea.

Weaning: The gradual process by which a baby becomes accustomed to semi-liquid and solid foods. Note that weaning does not refer only to the stopping of breastfeeding. It is complete when the child begins to eat the regular family diet.