Oral Rehydration Therapy for Diarrhea: An Example of Reverse Transfer of Technology

ABSTRACT. On November 13 and 14, 1996, a scientific symposium on oral rehydration therapy (ORT) was held at the Johns Hopkins University School of Hygiene and Public Health in Baltimore, MD. The purpose of the meeting was to review the current treatment practices for the treatment of this disease in the United States. The group noted that diarrhea resulted in 300 to 400 deaths per year among children, ~200 000 hospitalizations, 1.5 million outpatient visits, and costs >$1 billion in direct medical costs.

ORT is well established therapy for the treatment and prevention of dehydration due to diarrhea. The principles of ORT treatment include early adequate rehydration therapy using an appropriate oral rehydration solution (ORS), replacement of ongoing fluid losses from vomiting and diarrhea with ORS, and frequent feeding of appropriate foods as soon as dehydration is corrected.

The effective use of ORT has saved millions of lives around the world. However, in the United States, ORT is grossly underused. Contrary to the recommendations of the American Academy of Pediatrics (AAP) and the Centers for Disease Control and Prevention (CDC), health care providers overuse intravenous hydration, prolong rehydration, delay reintroduction of feeding, and inappropriately withhold ORT, especially with children who are vomiting.

The expert panel noted that the majority of deaths, hospitalization, and visits to emergency departments could be prevented by the appropriate use of ORT. They generated guidelines for the treatment and prevention of dehydration secondary to diarrhea. These measures, together with training providers, could substantially reduce diarrhea mortality and decrease hospitalizations of children by 100 000 per year in the next 5 years. Pediatrics 1997;100(5). URL: http://www.pediatrics.org/cgi/content/full/100/5/e10; oral rehydration therapy, oral rehydration solution, diarrhea.

ABBREVIATIONS. ORT, oral rehydration therapy; ORS, oral rehydration solutions; AAP, American Academy of Pediatrics; CDC, Centers for Disease Control and Prevention; WHO, World Health Organization.

Diarrhea is well known to be a leading cause of mortality and morbidity in developing countries. Even in the United States, each year diarrhea results in 300 to 400 deaths, 180 000 to 200 000 hospitalizations, 1.5 million outpatient visits, and a total of 20 million episodes among children.1 In addition, there are ~2600 deaths among the elderly. However, many health professionals and health care managers do not realize that diarrhea causes significant morbidity and mortality in the United States and that there are simple therapies available that could improve the situation. Oral rehydration therapy (ORT) is a well-established form of therapy for the treatment of dehydration attributable to diarrhea. The principles of ORT are early adequate rehydration therapy using an appropriate oral rehydration solution (ORS), replacement of ongoing stool losses with ORS, and appropriate foods as soon as dehydration is corrected. The effective use of ORT has saved millions of lives in developing countries. However, in the United States, ORT is grossly underused.

On November 14, 1996, a meeting was held at Johns Hopkins University School of Hygiene and Public Health in Baltimore, MD, to celebrate the 25th anniversary of ORT use in the United States.

As part of the celebration, a scientific symposium was held among a group of national and international experts to discuss the current status of ORT use in the United States. The symposium participants noted that there are many unnecessary medical visits and hospitalizations as a result of underuse of ORT. Contrary to the recommendations of the American Academy of Pediatrics (AAP) and the Centers for Disease Control and Prevention (CDC), health care providers often unnecessarily use intravenous hydration, prolong rehydration therapy, delay reintroduction of feeding, and inappropriately withhold ORT, especially in children who are vomiting. The underuse of ORT, which leads to unnecessary hospitalizations, clinic visits, and emergency department visits, results in >$1 billion in direct medical costs each year.

The experts at the meeting recommended the following measures that could substantially reduce diarrhea mortality and decrease hospitalizations of children by 50% in the next 5 years.

GUIDELINES

1. Treatment of dehydration

The guidelines published by the AAP in March 1996 that recommend ORT as the first line of therapy for all children with mild to moderate dehydration secondary to diarrhea should be implemented as the standard of care and adopted as a performance standard.

All medical care facilities, including emergency departments and physician offices, should have ORS readily available and implement its use according to the AAP guidelines.

Parents of infants seeking medical care for diarrhea should be trained in the use of ORS and early feeding.
2. Prevention of dehydration

Educational material about the prevention and treatment of diarrhea, emphasizing the importance of early hydration with appropriate fluids available in the home and ORS, should be developed and widely distributed.

All providers should be encouraged to educate and provide materials to parents during preventive health care visits about the management of diarrhea and the appropriate use of ORS. Families should be encouraged to have ORS available at home.

3. Training of providers

Continuing educational opportunities regarding the management of diarrhea should be provided to all health care providers.

Regional ORT centers should be established for the training of health care providers charged with implementing ORT programs. The American Academies of Pediatrics, family physicians, emergency medicine, and professional organizations in the field of nursing should be encouraged to develop health professional training curricula designed to implement the guidelines published by the AAP in March 1996 for the management of diarrhea.

4. Third-party payment for services

All third-party payers, including public assistance programs, should reimburse physicians and hospitals when ORS is used for the treatment and/or prevention of dehydration attributable to diarrhea. Appropriate provider codes for ORT should be established.

ORS should be included in all formularies. Epidemiologic and economic research leading to cost– benefit analyses should be conducted to further strengthen the case for reimbursement.

Ironically, the successful use of oral rehydration solutions for treatment of diarrhea was first documented by Harold E. Harrison in Baltimore in 1945. The ORS formulation used by Harrison contained (in mmol/L) sodium 62, potassium 20, chloride 52, lactate 30, and glucose 180 (3.3%). This formulation was remarkably similar to some commercial solutions currently available in the United States. The glucose in the ORS was used for its protein-sparing effect. The dangers of inappropriately increasing the carbohydrate concentration in ORS, which increases the osmotic load and results in increased secretion of water into the gut (thus aggravating the diarrhea), were also not known. As a result, in the 1950s solutions containing inappropriately high concentrations of carbohydrates were dispensed commercially in powder form throughout the United States. In addition, parents were not given proper education about appropriate mixing of the ORS. As a result of the inappropriate composition and improper mixing of ORS, many cases of hypernatremia occurred in the United States.

Therefore, in the 1960s physicians generally returned to the use of intravenous therapy for the treatment of diarrhea.

In the mid- to late 1960s, a number of animal and human physiologic studies were conducted to evaluate the absorption of different ORS formulations from the gut. Subsequently, in the 1970s many clinical studies were conducted in developing countries to document the safety and efficacy of ORT. As a result, ORT was adopted by the World Health Organization (WHO) in 1978 as its principal strategy for preventing diarrheal deaths. This strategy was quickly adopted by several international agencies including UNICEF and USAID and national programs throughout the developing world. As a result, millions of children were saved. Despite the remarkable success of ORT in developing countries, US pediatricians were reluctant to use ORT among children primarily because of their concern about hypernatremia.

The WHO-recommended ORS was first evaluated in the United States among the White Mountain Apache Indians in Arizona in 1971. There were also concerns raised about lack of comparable data among US children. Studies conducted among Apache Indian children were thought to be irrelevant by many pediatricians because Apaches were not considered to be a representative US population. ORT was dismissed as third world medicine. In the 1980s, a number of controlled trials in the United States demonstrated the safety and efficacy of ORT among US children. Based on these studies, the AAP first endorsed the use of ORT for diarrhea in 1985. In 1993, the AAP also published guidelines for the management of diarrhea, which were revised in 1996. Despite the endorsement of the AAP and the CDC, ORT is appropriately used in cases of diarrhea in the United States.

What are the reasons for this gap between the scientific knowledge about ORT and its practical implementation? Experts at the 25th anniversary meeting noted a lack of training of all categories of health care providers about the proper use of ORT. In addition, appropriate information is not provided to parents and guardians about the use of ORT for treatment and prevention of dehydration. The successful implementation of the guidelines outlined in this manuscript is dependent on the cooperation between the health care providers, parents, health care administrators, and major professional organizations like the AAP, family physicians, emergency medicine, and professional organizations in the field of nursing. These organizations should provide appropriate training opportunities and develop appropriate educational material that can be distributed to parents and practitioners at all levels. The educational objectives should ensure that health care providers know the following facts about ORT: 1) It is a simple cost-effective method of treating acute diarrhea, regardless of etiology, in patients with mild to moderate dehydration. 2) Vomiting is not a contraindication for using ORT. 3) Rehydration therapy should be instituted as soon as diarrhea begins. 4) Appropriate feeding should be instituted as soon as initial rehydration therapy has been completed.

Physicians should provide training to their staff about the appropriate use of ORT. In addition, parents
should be given information at well-child visits about the management of diarrhea and the importance of replacing fluid loss as soon as diarrhea begins. Physicians should also encourage parents to keep a supply of ORS at home at all times. In many developing countries, ORT training centers have been created that have been very successful in training providers. There is no reason why similar regional training centers could not be created in the United States. The experts at the symposium identified third-party payment services as a significant barrier to the use of ORT. Unfortunately, many insurance carriers do not reimburse physicians and hospitals for ORT use. Studies designed to demonstrate the relative costs and benefits of ORT are urgently needed.

If our goal is to promote the use of ORS for most episodes of diarrhea, it has to be easily accessible to all families. Unfortunately, it is not currently available in many formularies. In the commercial pharmacies, the cost of 1 L of ORS can range from $2 to $9. This can be a significant barrier to ORT use in some sectors of the population.

Finally, if we are to have success in delivering health care to children, we must empower the parents to handle the illness appropriately. ORT involves simple technology that enables parents to treat one of the most common illnesses among children.

For decades, technology has been transferred from the United States to developing countries. However, ORT has been primarily developed in emerging countries and has the potential to benefit enormously the developed world. If this reverse transfer of technology is properly implemented, it will both save lives and prevent unnecessary clinic visits and hospitalizations. In addition, it would save millions of health care dollars each year. This type of program can be successful only if there is a commitment from all sectors of the medical system, including providers, health administrators, managed care officials, insurance carriers, and health care providers. The United States must be a leader not only in high-technology medicine, but also in implementing the most effective technology, even if it is considered a low-technology, low-cost strategy.

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**REFERENCES**

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