Conclusions

In the past 25 years, malaria eradication strategy has been based almost exclusively on the use of insecticides. The failure of that methodology in some areas has made it necessary to emphasize the need to deepen epidemiological studies and maintain a reasonable balance between social and biological factors that favor the transmission of the disease. This would provide a better understanding of the socioeconomic and historical processes that underlie the causal complex of the problem and make efficient antimalaria activities possible. In addition, it is important to continue to improve the systems for the epidemiological surveillance of the disease and to endeavor to incorporate in a simple way the new social and biological variables which come to light from the research process.

(Source: Research Promotion and Coordination, Division of Human Resources and Research, PAHO.)

Use of Locally Available Drinking Water for Preparation of Oral Rehydration Salt (ORS) Solution

Mothers are encouraged to prepare oral rehydration fluid using only clean water. However, most people in rural areas of developing countries have no access to potable water and in some communities the only available water is heavily contaminated with fecal material. Since only some 20 per cent of the population in developing countries has access to clean water, the risks involved in using untreated water to prepare the Oral Rehydration Salt (ORS) solution, and the need to decontaminate water before adding the ORS ingredients, have prompted researchers to initiate various investigations to explore and further expand available knowledge on this question.

The following presents current research findings relating specifically to the growth of enteric bacteria in oral rehydration solutions prepared from ORS, the risks associated with the use of ORS solution which is not bacteria-free, and possible methods of decontaminating either the water used for preparing the ORS solution or the solution itself.

In the Region of the Americas, numerous studies have been conducted in which the growth of enteric bacteria in ORS solutions prepared with various types of water were compared. A study at the University of Maryland used river water from Suriname and Honduras (containing about $10^3$-$10^5$ bacteria/ml) and distilled water after boiling both sources for 10 minutes to prepare the ORS solution. Growth of enteropathogenic bacteria (Vibrio cholerae, Escherichia coli, and Shigella flexneri) on blood agar were harvested, then diluted with phosphate buffered saline, and added to different aliquots of the solution to achieve final concentration of about $10^2$ bacteria/ml. Viable bacteria counts at 0, 6, 12, 18, 24, and 48 hours in solution while standing at room temperature (24-26°C) revealed an increase in the number of V. cholerae and E. coli at 12 hours, and a 2-3 log increase at 24 and 48 hours. S. flexneri did not increase in number and could not be recov-

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3Composition for oral rehydration as recommended by WHO.
ered at 24 hours in the Suriname and distilled water samples, but was present at a concentration of $10^3$/ml in the Honduras river water sample.

In a village-based study in Brazil, water from households with and without a piped supply was boiled, cooled until warm, and then used to prepare the ORS solution. The solution was then kept at a temperature of 29-32°C for 12-18 hours, after which samples were brought to the laboratory in sterile containers on ice and quantified by the Most Probable Number (MPN) technique for fecal coliforms. About 50 per cent of the samples from homes without running water had concentrations greater than $10^3$ coliforms/ml as compared with about 19 per cent of samples from homes with running water. The 10 villagers who prepared heavily contaminated fluid were then provided with autoclaved water; again, 90 per cent of the samples were found to contain $10^3-10^5$ coliforms/ml.

In a similar experiment, the same group of workers obtained water from a one meter deep well, prepared the ORS solution, and examined it for coliform growth at 37°C after 4, 8, 16, and 24 hours by the same technique. The solution made with river water initially contained about 4 logs more coliforms than that made with well water, but after 16 hours at 37°C both solutions contained about $10^5$ coliforms/ml irrespective of the source of water.

Although a strict comparison of study results is difficult due to the lack of uniformity in study design and techniques employed, it seems clear that an ORS solution prepared with untreated water containing organic matter can support the growth of enteric bacteria at the ambient temperature that prevails in the countries where the solution is most likely to be used extensively. Solutions made from distilled, boiled, or autoclaved water may also support the growth of enteric bacteria as these processes do not remove the nitrogen derived from any killed bacteria. The use of boiled water for preparing the ORS solution does not guarantee its sterility since contamination of such water can occur after boiling.

Although unrelated to the Region of the Americas, a more relevant study on the behavior of *E. coli* in oral rehydration fluid made with well water was recently reported from Gambia. The concentration of *E. coli* in well water alone fell slightly during 24 hours storage at 23-30°C. The same study compared the response of children (three months to four years) receiving oral rehydration fluid composed of well water with those whose fluid was made with sterile water.

In the Gambia study, no difference was observed in the isolation rates of pathogenic organisms in the 97 stool specimens obtained from children who received ORS made with "clean" water and in the 87 stool specimens from children who received ORS made with well water, although *Salmonella* and enteropathogenic *E. coli* (EPEC) were isolated from the well water itself. The incidence and duration of diarrhea and the growth rate in the two groups were also found to be similar. It was estimated that ORS solutions prepared from untreated well water and taken by a child one day out of five were unlikely to contribute more than 5 per cent of the total *E. coli* he would ingest with food prepared with water from the same source.

Theoretically, the ORS solution can be chemically decontaminated by adding a suitable bactericidal or bacteriostatic agent to ingredients at the time of packing. Such an agent would need to be:

- effective against the organisms concerned
- non-toxic to man
- effective in the pH of ORS solution
- non-reactive with the ORS ingredients
- non-corrosive for ORS packaging material
- acceptable from the viewpoint of taste, smell, and color of the solution
- non-disruptive of the absorption process in oral rehydration
- inexpensive.

At present, no known compound meets these criteria. Boiling water is an effective method of decontamination; although it presents disadvantages in the:

- cost of the fuel and difficulty in obtaining it
- time required for boiling and cooling
- risk that, after boiling, the water or the ORS solution prepared with it may become contaminated during measuring, mixing, handling, or storage
- risk that the water may be used for preparing the ORS solution before it has been sufficiently cooled
- risk that users will mistakenly boil the solution after preparation.

A second strategy, based on available information and pending more field research, is to advise mothers to use the cleanest water available when preparing the ORS solution, to boil it whenever possible, and to use the solution within 12 and never after 24 hours. The solution should also be protected from subsequent contamination and stored in a cool, dark place. To those who express concern regarding these recommendations, it should be stressed that the proven benefits of water and electrolyte replacement early in acute diarrhea far outweigh the possible risk of using contaminated water.

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5Shields et al. Electrolyte/glucose concentration and bacterial contamination in home-prepared oral rehydration solution: A field experience in North Eastern Brazil.


(Source: Enteric Disease Control Program, Communicable Diseases Control, Division of Disease Prevention and Control, PAHO.)