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*From the Medical School, University of Gadjah Mada,  
Yogyakarta, Indonesia*

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## Rehydration in the Field \*

by

JON E. ROHDE

The clinical efficacy of oral-glucose electrolyte (GE) solutions in the treatment of profound fluid losses in cholera is dramatic testimony to the persistent ability of the intestine to absorb glucose, salt and water in the face of severe diarrhea. Many thousands of patients have been successfully saved from almost certain death by drinking sufficient quantities of rehydration fluid. This treatment was developed in 1968-1969 in Calcutta and Dacca under carefully controlled conditions measuring fluid-input and losses in stool, urine and vomitus, serum electrolytes and proteins, along with intensive nursing. Oral fluid composition was rigidly standardized at first, avoiding the hypertonic fluids that had failed so miserably during the first oral trial in the Philippines in 1962 (Ringer's lactate with 5% Dextrose). Over the ensuing five years a dramatic simplification of care has evolved which embodies only the

following general principles for all patients presenting with dehydrating disease:

- 1) Thirst is an important measure of hydration - let the patient consume GE solution as his thirst requires. Offer 10% of body weight as a start.

- 2) Replace all losses - with equal volumes of GE solution.

- 3) Composition of GE solution is not terribly important to its success providing that ionic strength is some  $\frac{1}{2}$  to  $\frac{2}{3}$  of body fluid and glucose does not exceed 2½%.

Thus, sophisticated measures of dehydration (serum protein, serum Sp gravity) are not essential. Initial rehydration volume is easily estimated from body size - 10% being a safe figure and adequacy of rehydration is reliably and easily ascertained through the presence of a strong peripheral pulse (I like to use the dorsal pedal pulse of the foot) and

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the presence of a reasonable output of urine (once every 2-3 hours). Although there is no substitute for a measured collection of stool output to determine fluid losses accurately, it has been demonstrated that the volume of each stool is relatively constant in a patient with diarrhea (100-200 ml in children, 250-500 ml in adults). Severe diarrhea is characterized by more frequent passage of liquid feces, not larger volumes of each passage. A reasonable estimate of replacement needs can then be made on the basis of one glass of fluid (200 cc) for each stool in children, two glasses in the adult.

Numerous clinical trials with fluids of varying composition (Na 50 - 120 meq/L, K 5 - 20 meq/L,  $\text{HCO}_3$  25 - 45 meq/L and Glucose 90 - 180 Mol/L) have proven that a wide range of acceptable concentrations exists making highly accurate measurement of ingredients unnecessary. This has allowed the field use of measuring spoons and bulk supply of market bought reagents (glucose, table salt, baking soda and a potassium salt) making treatment costs a few cents per liter with no weighing or packaging expenses.

Experience in rural Bangladesh showed a small percentage of patients arrived at our rural rehydration center in irreversible shock or had already died during several hours travel by boat to reach the center. We thus supplied each village mid-

wife with packets of G-E Sol to be dissolved in a simple, cheap liter flask. Any patient with diarrhea was given the flask containing a fresh, properly mixed liter of GE solution and told to drink it all on the way to the rehydration center. Deaths on or before arrival virtually stopped. The only cholera fatalities in the area then became those who refused to go to the center.

A dramatic, though unfortunate opportunity to test the widespread rural use of oral therapy arose during the mass exodus of refugees from Bangladesh during the war of independence in 1971. Crowded into rain soaked camps, cholera and other severe diarrheas ravaged the 10 million refugees. In one area over 3000 cholera cases were treated during July alone with oral glucose electrolyte fluids administered by paramedics - mortality was 3.6%. We then began a crash program of education for volunteers - non medical workers, who were armed with a liter jug, a 5 cc teaspoon, and cartons of glucose, table salt, baking soda and potassium citrate. The importance of level spoonfuls was emphasized, using a stick to pass across the spoon surface removing extra content. The following formula was used: glucose 8 spoons (20 gm), salt 1 spoon (4 gm), baking soda  $\frac{3}{4}$  spoon (3.5 gm), potassium citrate  $\frac{1}{4}$  spoon (1.6 gm). Dissolved in one liter of water this made a solution of Na-110 meq/L,

HCO<sub>3</sub> - 42 meq/L, K 18 meq/L in 2% glucose. This is an ideal composition for cholera losses in adults but should be diluted further, especially in the pediatric age group by using the same formula in 1½ liter of water. Stool losses in children contain less electrolyte than adults and their insensible water losses are greater - thus they need a hypotonic solution for replacement: One half isotonic is a good guideline. If either baking soda or potassium were not available the quantity was replaced by table salt. The resulting solution lacks any base, but if it is given early in diarrhea the patient should not yet be acidotic. Potassium can be repleted slowly over the ensuing days from such rich sources as coconut water, banana or citrus.

In many areas, glucose is the limiting ingredient, being virtually unavailable in rural markets. Fortunately, in India glucose is readily available and cheap, so the problem did not arise. Sucrose, the common form of sugar, is a dimer of glucose and fructose which must be cleaved by sucrase in the gut before absorption of its individual components. Although sucrase deficiency is quite rare, even in the undernourished, this method of obtaining glucose has the disadvantage of increasing osmotic activity of the fluid through the presence of the fructose molecules. Sucrose has been used in some clinical trials and found to be effective

at least in cholera, but controlled comparisons with glucose are not yet published. Whereas glucose remains the sugar of choice, substitution with sucrose (molar amounts will therefore be halved) is more useful than a salt solution alone.

Volunteers were instructed to give as much of this fluid as possible to diarrhea patients until they passed urine, then to give 1-2 glasses per stool passed. The evaluation of success can only be anecdotal, but reports came from crowded refugee camps and the distant battlefield that people were being saved. Simple instructions were printed in Bengali and circulated in camps and behind the military lines. Daily, Radio Free Bangladesh broadcasted simple instructions on how to make and use this fluid in the distant rural areas. Word filtered back of cures from cholera, and more important, people stopped searching for the vaccines and other injections and began to seek fluid. Through intensive education efforts and, more important, word of mouth, public demand to receive the "oral saline" increased - people came early seeking hydration rather than after in a state of shock expecting to be cured by a single injection. Once the battle of public attitudes is won, diarrhea can be eliminated as a cause of death. This is the major medical lesson of the Bengali tragedy - when the public understands and accepts the impor-

tance of fluid replacement, dehydration deaths almost cease.

This experience dramatized the effectiveness of oral GE solution both by the massive numbers reached and in combating the scourge of cholera. Fortunately, we in Indonesia face no threat of massive epidemic cholera. However, dehydration remains a major cause of death, especially in the younger age group. Although diarrhea is not easily prevented, dehydration is. The causes of diarrhea are many including virus, overgrowth of normal bacteria, food poisons and intolerance, parasites, allergy and, in a very small percentage, bacterial pathogens. Over 90% of cases are self limited, ceasing within 36-48 hours. This is the reason that so many varied agents and treatment regimes are considered effective by medical personnel and the public alike; after one day of diarrhea they seek medical help - within another day the illness has past. Thus we see the widespread use of such varied and proven useless agents as: streptomycin injection, sulfaguandine and one day of chloroquine-derivative amoebicide, not to mention vitamin B<sub>12</sub>. They appear effective because the diarrhea stops - it would have ceased in any case. Recently 100 consecutive cases of childhood diarrheal disease admitted to Rumah Sakit UGM Bagian Kesehatan Anak, were treated with fluids only. There was not a single case of protracted

illness, not a one that required addition of antibiotics or other agents - recovery was quick and complete.

In Indonesia the annual incidence of diarrhea approaches one episode per person and is close to two per year in younger children. Some 4-5% of these episodes will lead to significant dehydration and it is among these that death may occur. Early provision of sugar-salt fluids can effectively prevent virtually all of these deaths. The challenge is to both the public and the many members of the medical fraternity (dukuns, mantris, other paramedical personnel, bidans as well as physicians) to the crucial importance of early fluid replacement. When GE fluid is sought for diarrhea as readily as "ke rokan" for "masuk angin" (common cold), dehydration will effectively disappear. It is not enough to provide special GE packets in the Puskesmas (Health Center) it is open only a few hours a day and, by necessity is many kilometers from most of the population it serves. The Puskesmas should lead the campaign to put oral glucose electrolyte solution into every "kampung" and "desa" (villages) to imbue it with the prestige of a folk medicine, a "jamu" (herbs). Posters and simple leaflets should be printed and widely distributed, not only to "Puskesmas", but also in each "kampung" and "desa". Let us take a tip from the enormously successful marketing techniques

of the babymilk companies who virtually saturate the public with claims for their product. Village leaders, "LSD", "PKK" and other local groups need simple direct and readily available information about preventing dehydration. When not only physicians understand the simple principle that "for diarrhea we must replace that which is lost", but also

this is widely accepted by dukuns and the public, we will then see "Djago" and "Air Mancur" (brand of herbs) GE Solution "Jamu" sold in every warung (small shop); each dukun will mix her own. Death from dehydration will then become a rarity, regarded by the people as a breakdown in village culture rather than in Health Care delivery.

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