Diarrhoeal Disease of Children in Indonesia

by

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Abstract

Diarrhoeal disease in infants and children up till now is still becoming a major problem with its high morbidity and mortality.

There are too many factors which can play a role in causing this disease. But by giving Oral-glucose electrolyte Solution as soon as possible the case fatality rate can be reduced as low as possible. Whereas decreasing the morbidity still needs a very long time, since it has very multi-complex factors i.e. socio-economic condition, environmental and personal hygiene and sanitation, life style of people, belief, etc.

The study on epidemiology, the influence of improvement of environmental sanitation and socio-anthropology is still very few, besides there is no satisfactory vaccin produced to prevent this disease. Meanwhile the worse of the case is that there is a tendency of decreasing breast-feeding in the big cities and to substitute it with bottle-feeding.

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Introduction

Diarrheal diseases in Indonesia and other developing countries up to now still presents itself as one of the major causes of morbidity and mortality in children under five years of age. By diarrhea is meant the changes of constitution of stools either watery, mucous, bloody or greenish or the increased frequency of stools numbering 5 times or more per 24 hours.

The following 5 most prevalent disease entities are mentioned below in the order of frequency as observed among patients attending the out-patient clinic of the Department of Child Health, Medical School, University of Indonesia, Jakarta (Sutejo et al., 1968; Sutejo, 1974; Tumbelaka, 1969):

1. Upper Respiratory Tract Infections, especially acute naso-pharyngitis;
2. Gastrointestinal Tract Disorders, mainly due to gastroenteritis;
3. Protein Energy Malnutrition (PEM);
4. Tuberculosis;
5. Vitamin A Deficiency.

A similar disease pattern was found in a nation wide household sample survey undertaken by the National Institute of Health Research and Development in 1972.

The incidence of diarrheal disease among persons in Indonesia is estimated at around 50-70 per 100 population per year of which 70-80% occur in children under the age of 5 years, with the highest incidence in children below 2 years of age. Ono Dewanoto et al. (1968) found the highest incidence during the rainy season, i.e. during November to February; the lowest during the dry seasons, i.e. in April to June. Others, however, found no correlation between incidence and seasons (Oma Rosmajadi, 1976).

The order of magnitude of diarrheal disease can also be judged from the number of hospitalized patients with diarrhea. In the Department of Pediatrics in the General Hospital Jakarta the percentage of patients admitted with gastroenteritis dehydration during 1971 — 1975 was 30% (Sutoto et al., 1974; Sunoto et al., 1976). Similar figures were found in hospitals elsewhere in Indonesia.

The case fatality rates in various hospital, departments of pediatrics in Indonesia since 1959 until 1974 were still above 15%. Kwari Satjadibrata and D. Poesponegoro (1959) reported a case fatality rate of 62.2% of 778 patients with gastroenteritis dehydration with shock admitted to the Department of Pediatrics, General Hospital Jakarta. After introducing a modified treatment, Sutejo et al. (1961) were able to reduce the case fatality rate. The experience in the departments of pediatrics of other hospitals was more or less the same.

After the Rehydration Seminar held in Jakarta in August 1974 a Rehydration Programme was started with a standardized treatment of Ringer's lactate.
and oral rehydration, which resulted in a dramatical decline of the case fatality rate.

The case fatality rate of acute gastroenteritis with dehydration in hospitals decreased to less than 10%. In 1975 this rate could be lowered to 9.1% (Adnan S. Wiharta and Suharjono, 1976), and 6% (Sunoto et al., 1976) in the Department of Child Health, Medical School, University of Indonesia. In other Departments of Child Health the figures were as follows: Sutjiningsih et al. (1976) in Denpasar, Bali, 11.3%; Sudaryat 14% (1975) and 6% (1976); Harry Hartoyo (1976) 2.5%; Moenginah et al., in Yogyakarta, 6% (1975), and 2.8% (1976); Rusdi Ismail in Palembang (1976) 3%; Wiyati Donhuijsen in Bandung 3.7% (1976).

The case fatality rate in cholera (see table 1) varied between 0 - 5% as shown by Suharjono et al. (1976) 0%, Adnan S. Wiharta and Sutejo (1976) 0%, H. Santosa et al. (1976) 0%. Moenginah et al. (1976) 2.8%, Ruskandi Martaatmadja and Wiyati Donhuijsen (1976) 3.6%, and Nassir Abbas et al. (1976) 0%. In peripheral hospitals the mortality rate is also reduced to less than 5% as reported by Sutomo Talkah and Rusdi Ismail (1976) 3.6%, and Harry Hartoyo (1976) 2.5%.

**Etiology**

A great number of factors may be related to the incidence of diarrheal disease in children, such as ignorance, taboos, hot and humid climate, low purifying power, poor housing conditions, inadequate water supply, lack of personal hygiene, improper environmental sanitation, high incidence of malnutrition and infections, over-crowding, many children under 5 years of age in one household, food poisoning, food and milk allergy, lactose intolerance, etc.

It is very difficult to determine a single cause etiology among these multi-complex factors. The most important predisposing factors in Indonesia may be:

1. Poor environmental sanitation and personal hygiene;
2. Prevalence of malnutrition and infections and

Enteral as well as parenteral infections can cause diarrhea in children. (see diagram 1).

Ono Dewanoto et al. (1968) found enteral infections in 69.8% and parenteral infection in 20.9% of cases suffering from diarrhea. Sunoto et al. (1976) found acute diarrhea in 80% of pediatric patients admitted for other diseases, such as upper respiratory tract infection, otitis, bronchitis, measles, and PEM.

**Bacterial infections**

The most common pathogenic bacteria as cause of enteral infections are EPEC (Enteropathogenic E. coli), Salmonella sp., and Shigella sp. (Tumbelaka, 1965; Suprapti Thaib, 1968; Djohan Kurnia, 1973; Broto wasisto, 1974; Effek...
Diagram 1: Infection which may cause diarrheal disease in children.

- **Bacteria**
  - Pathogenic Bacteria: Salmonella sp., EPEC, Vibrio cholera, etc.
  - Non-pathogenic Bacteria: Staphylococcus albus, Streptococcus anhemolyticus, Proteus, Klebsiella, Pseudomonas, etc.

- **Viral**
  - Entero virus (Cocksackie, ECHO, Poliovirus), Adenovirus, Orbivirus, Rotavirus, Reovirus, Eke agent, Duovirus.

- **Parasitic**
  - Helminthiasis: Ascarasis, Trichuriasis, Strongyloidiasis, etc.
  - Protozoal Infection: Amebiasis, giardiasis.
  - Fungal Infection: Candidiasis (Moniliasis).

- **Parenteral**
  - Acute Otitis
  - Upper Respiratory Tract Infection
  - Bronchitis, bronchopneumonia
  - Encephalitis
  - Etc.

Diagram 2: Malabsorption Syndrome

- **Carbohydrate malabsorption**
  - Dissacharide: Lactose and sucrose intolerance (very common)
  - Monosaccharide: glucose, galactose, fructose intolerance (very rare).

- **Fat malabsorption particularly Long Chain Triglyceride (very common)**

- **Protein Malabsorption (very rare)**

- **Vitamin malabsorption (very rare)**
Alamsjah et al., 1975; Gracey et al., 1973; Sunoto et al., 1976). Besides pathogenic bacteria, overgrowth of non-pathogenic bacteria may also play a role in causing diarrhea of childhood (Gracey et al., 1973).

1. *Enteropathogenic Escherichia coli*

*EPEC* is a well-known pathogenic bacteria which can cause endemic or epidemic diarrhea in neonates and infants. Bintari Rukmono (1965) in a study of 99 infants living in a crowded area of Jakarta isolated EPEC in the majority of the infants with or without diarrhea. The serotypes 0111 B 4 was regarded as the most pathogenic serotype followed by 0 125 B 15, 0 55 B 5, and 0 127 B 8.

Ono Dewanoto (1968) found EPEC in 163 (36.2%) out of 448 patients with diarrhea of which 110 were mono-infections and 53 were mixed infections. Suprapti Thaib (1968) found EPEC in 164 (37.1%) out of 442 infants; the most frequently isolated serotypes were 0 126 B 16, 0 125 B 15, 0 127 B 8, and 0 124 K 86. During an outbreak of diarrhea in the neonatal and low birth weight infant wards, Poey et al. (1969) found positive EPEC in 39 (58%) out of 67 neonates and 16 (64%) out of 25 low birth weight infants. The serotypes were 0 119 K 69, 0 127 K 63, 0 126 K 71, and B 1810 in neonatal ward, and 0 119 K 69, 0 142 K 86, 0 111 K 58, 0 126 K 71, 0 55 K 59, and B 1810 in infant ward.

Djohan Kurnia (1973) found 36.0% EPEC as the causative agent of diarrhea in a community study in Ujung Pandang. Gracey et al. (1973) found 35.0% EPEC in 20 malnourished children with diarrhea, while Effek Alamsjah et al. (1975) found EPEC in 23.4% out of 60 patients with acute infantile diarrhea. The most common serotype isolated was 0 119 B 14. Azhali et al. (1972) in a 5-year study of EPEC infections in the Department of Pediatrics, Dr. Hasan Sadikin Hospital, Bandung, found EPEC in 497 cases ranging in age from 0 - 12 years.

The highest incidence was found in the 0 - 3 months age group; 72.7% were found in cases under 1 year of age; boys were more involved than girls. The frequency of serotypes varied by years, i.e. 0 125 in 1964, 0 126 in 1966, 0 26 in 1967, and 0 126 in 1968. The peak time incidence of all infections differed from year to year, i.e. July in 1964, November in 1965. October in 1966, April in 1967, and July in 1968. The most common cause of death was serotype 0 128. Rosmajudi et al. (1976) found EPEC in 47.71% of 1.625 pediatric gastroenteritis with dehydration admitted to the hospital, 34.09% of them were children below 1 year of age.

In the meantime a question arises whether this EPEC is really the cause of diarrhea, since it is found also in diarrhea and non-diarrhea children. The ETEC (Enterotoxigenic *E. coli*) may be more important as the cause of diarrhea.
than EPEC in Bangladesh and Indonesia (Teluk Sebodo et al., 1977).

2. *Salmonella* species

*Salmonella* species as an associate bacteria in children with diarrhea seem to be increasing lately. Tumbelaka (1965) in Jakarta found *Salmonella* sp. as a cause of diarrhea in 2%. Ono Dewanoto et al. (1968) and Suprapti Thaib et al. (1968) in Bandung found *Salmonella* sp. in around 2.5%, Djohan Kurnia (1973) in Ujung Pandang 2.8%, Effek Alamsjah et al. (1974) 8.3%; and Komalarini and Sanborn (1976) in Jakarta 6.7%.

Sunoto et al. (1976) found *Salmonella* sp. in 34 (17%) out of 202 acute infantile diarrheal cases visiting the children out-patient clinic of the General Hospital in Jakarta. Hence more attention should be paid in the future to *Salmonella* sp.

3. *Shigella* species

Gambiro (1961) in a study of epidemic diarrhea in the Regency of Pemalong, from late 1960 through 1962, found 9% of the stool samples *Shigella* positive, most of them *Shigella* shigae and *Shigella* flexneri. Tumbelaka (1965), Gracey et al. (1973), Effek Alamsjah et al. (1974), and Sunoto et al. (1976) reported *Shigella* sp. in the Department of Pediatrics of the General Hospital, to be 5%, 5%, 3.3%, and 4% respectively of all diarrheal cases admitted during that year of study.

Komalarini and Sanborn (1976) found 7.9% in the Department of Pediatrics, Sumber Waras Hospital, Ono Dewanoto (1968) and Suprapti Thaib (1968) in Bandung found 10.3% and 11.2% respectively, Djohan Kurnia (1973) in Ujung Pandang found 4.5% and Moenginah et al. (1976) and Teluk Sebodo et al. (1977) in Yogyakarta reported 6.7% of diarrheal cases positive for *shigella*.

4. *Vibrio* species

*Vibrio* cholera has become endemic in Indonesia since 1970. In 1970, 1971, 1972, and 1974 respectively 6,500; 23,000; 43,000; and 45,000 cases of *cholera* were reported (Brotowasisto, 1974). Djohan Kurnia (1973) found *V. cholera* Eltor in as many as 10% of diarrheal cases in Lingkungan Layang Ujung Pandang, while Sudigbia and Anggoro Djawabaru found *Vibrio cholera* in 45.0% out of 358 gastroenteritis cases with dehydration admitted to the Department of Pediatrics of Dr. Kariadi Hospital in Semarang. *V. cholera* El Tor type was firstly reported in Makassar by de Moor in 1939.

Jeni Iswandari (1973) found 20.2% cases positive for V cholera Eltor out of 328 infants and children admitted to the Department of Pediatrics, Sumber Waras Hospital. In the last 4 years, cholera and paracholera Eltor have been reported also in children below 2 years of age. Haroen Noerasid et al. (1975) reported 56 (10.98%) out of 510 patients showing positive para *cholera* Eltor.
these children are bottle fed. Budi Santoso et al. (1976) reported a case of V. cholerae in a 2-month-old baby. Komalarrini and Sanborn (1976) and Suharjono et al. (1976) also found Vibrio cholera in children below 2 years of age among their cholera cases.

**Viral infections**

During the last few years virus as a probable cause of diarrhea has been already proven by several authors in developed countries (USA, Australia, Great Britain etc.). Several of the virus isolated from patients with acute gastroenteritis were orbivirus, rheovirus, rotavirus and duovirus. All these are the same virus with different names (except Nor walk agent) and still to be proved that these viruses cause diarrhea. In collaborative studies between Jakarta and Perth, and between Yogyakarta and Melbourne, duovirus were also found in Indonesia as a cause of diarrhea in children in 47.7% and 14% respectively (Gracey et al., 1975; Moenginah et al., 1976; Teluk Sebodo et al., 1977).

**Intestinal parasites**

Helminthiasis of the gut may play a role also in causing diarrheal disease of children (Tumbelaka, 1965; Sunoto, 1972, 1976). The most common helminthiasis of the gut in causing diarrhea are ascariasis and trichuriasis.

1. **Ascariasis**

Ascariasis is the commonest worm found in children; its frequency is very high and varies from 30-90%.

Jo Kian Tjay et al. (1968) reported from Medan, North Sumatera, the incidence of 15.4% in infants, 48.6% of them in children above 1 year of age. Ono Dewanoto et al. (1968) in Bandung and Suprapti Thaib et al. (1968) reported the incidence of 25% in a study of children between 0-2 years of age with diarrhea. Sjamsir Daily (1972) in Padang, Nurhajati and Sunarno (1973) reported the incidence of ascaris in Yogyakarta 53.0%, whereas in Surakarta it is 33.5%. Budining Wirastari et al. (1976) in Jakarta, and Nassir Abbas and Palada (1976) in Ujung Pandang, South Sulawesi, reported 34.2%, 43.1%, and 51.3% respectively. Many of them sometimes have 1 or more kinds of worms, usually ascariasis + trichuriasis. These findings, of course, are not conclusive of diarrhea being caused by ascaris.

2. **Trichuriasis**

Trichuriasis may cause chronic diarrhea with bloody and mucous stool in childhood, sometimes causing prolapse of anus (Sunoto et al., 1972; Alisah Na oemar, 1976; Subianto et al., 1976). The incidence of trichuriasis in Indonesian children was reported by several authors, among others were Jo Kian Tjay et al. (1968) in Medan who reported 3.4% in infants, 32.2% in children above 1 year of age; Suprapti Thaib et al. (1968) in Bandung 10.0%; Sjamsir Daily et al. (1972) in Padang 21.1%; Nurhajati and Sunarno (1973) reported the incidence in Yogyakarta and Surakarta, 60.3% and 26.2% respectively.
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Budining Wirastari et al. (1976) in Jakarta 9.7%; Nassir Abbas and Palada (1976) in Ujung Pandang 13.2%. This worm is usually very rarely found as a single cause of diarrhea. The presence of trichuris is usually accompanied with ascaris, amoebiasis, shigellosis, or giardiasis (Alisah Naemar and Sri S. Margono, 1976).

3. Protozoal infections

a. Amoebiasis

Amoebiasis is an endemic disease in many parts of Indonesia usually causing chronic diarrhea with blood and mucous in the stool. Studies done in various villages of Indonesia showed a 10-12% cyst-carrier rate (Poedjiadi, 1971). Two cohort studies done in one of the most crowded slum areas in Jakarta during 1960—1963 (Bintari Rukmono and Widodo Talogo, 1969) revealed 22% of cases of amoebiasis among toddlers, 48% among school-children, and 54% among adults, but not a single case among infants. Jo Kian Tjay et al. (1968) in Medan reported a prevalence rate of 7.3% out of 768 children and 1.4% out of 258 infants.

b. Giardiasis

Giardiasis as a cause of acute and chronic diarrhea is not clearly predominant in Indonesian children. Its frequency is relatively low compared with other etiologic agents (bacterial, viral, helminthes, and fungal infection). Ono Dewanoto et al. (1968) found a percentage of 6.5%, Jo Kian Tjay et al. (1968) 9.1%, and Suprapti Thaib et al. (1968) 2.7%.

4. Fungal infections

Several factors may be related to the high incidence of fungal infections in Indonesian children, such as poor environmental and personal hygiene, high incidence of PEM and wide usage of antibiotics in the treatment of infectious diseases.

The most common fungal infections are oral thrush and intestinal candidiasis. In a study of candida species isolations in malnourished children with diarrhea 19 (70.4%) out of 27 children were found positive for candida species (Gracey et al., 1974). They consisted of 16 Candida parapsilosis, 6 C. albicans, and 6 C. tropicalis cases.

Without identification of the species, in a study of microbial contamination of the gut in 20 malnourished children 9 (45%) of them were found harboring candida sp. (Gracey et al., 1973). Other findings of some authors revealed 38.2% (Ono Dewanoto et al., 1968), 38.1% (Suprapti Thaib et al., 1968), 53% (Teluk Sebodo et al., 1977) positive for candida sp.

Malabsorption syndrome (see diagram 2)

Malabsorption syndrome in Indonesia is commonly associated with gastroenteritis, PEC, Low Birth Weight infants,
and post bowel surgery (Suharjono et al., 1974).

The most important are:
- Carbohydrate malabsorption, particularly lactose and sucrose intolerance;
- Fat malabsorption;
- Carbohydrate intolerance.

Carbohydrate or sugar intolerance as one of the causes of diarrhea in children was investigated for the first time in 1970 by Sutejo by sending a questionnaire to Indonesian doctors; it revealed that 20.4% of 215 respondents had encountered intolerance to cow’s milk.

1. Lactose intolerance

During a 2-years study on sugar intolerance in the Department of Child Health, Medical School, University of Indonesia, Jakarta, in 838 infants and children with chronic diarrhea, 22 children with PEM, 50 "healthy" preschool-age children, and 32 neonates with post bowel surgery, sugar intolerance was found in 52.8%, 86.4%, 72.0%, and 21.8% respectively (Sunoto et al., 1971; 1973; Suharjono et al., 1971, 1972; Sutejo et al., 1971; Halimun et al., 1973; Faried Bakry et al.,1973).

Achmad Surjono in Yogyakarta in a study of lactose tolerance test (LTT) of 70 newborn infants, found that 31.4% had an abnormal response to LTT as shown by a flat sugar curve. Pitono Suparto et al. (1974) found in Surabaya lactose intolerance in 48.6% of 107 infantile gastroenteritis cases. More detailed investigations on 86 patients during the diarrheal stage comprising 23 neonates, 47 infants below 1 year of age, and 16 children above 1 year of age revealed lactose intolerance in 21.7%, 42.5%, and 56.3% respectively. During convalescence 48.8% of the patients still suffered from lactose intolerance. This suggests the possibility that lactose intolerance occurring during the diarrheal stage continues to be present in the convalescence period.

Immanuel Mustadjab and Muzief Munir (1974) in a study of 38 infantile diarrhea also found 63.2% with lactose intolerance by lactose loading test. San Diego and Agus Iskandar (1974) in Sumatera found 54% of 200 subjects suffering from lactose intolerance. Garna et al. (1976) in Bandung found lactose intolerance in 16.6% of 36 neonatal diarrhea cases by paper chromatography method. Intestinal biopsy of PEM children and gastroenteritis patients revealed notably varying degrees of villous atrophy (Suharjono et al., 1971; Yati Sonarto et al., 1974, 1976). Unfortunately, enzyme assays have not yet been undertaken in Indonesia due to lack of facilities.

2. Sucrose intolerance

Pitono Suparto et al. (1976) in a study of 86 patients found 26% of cases during the diarrheal stage suffering from intolerance to sucrose. They consisted of 4 (21%) out of 19 neonates, 15 (33.3%) out of 45 infants below 1 year of age, 4 (18.2%) out of 22 child-
ren above 1 year of age. Subijanto et al. (1976) reported a frequency of 16% of sucrose intolerance among acute infantile gastroenteritis cases.

3. Fat malabsorption

The high prevalence of PEM, LBW, and gastroenteritis in Indonesian children may be related to the high frequency of fat malabsorption. Twenty six out of 35 malnourished children with diarrhea showed fat malabsorption. The percentage of fat malabsorption in LBW infants is even higher, i.e. 89.5% out of 76 patients, while in the fullterm it is 60.9% out of 121 and in infants above 1 month of age it is 57.9% out of 31 (Suharjono et al., 1976). This high percentage of fat malabsorption may be due to insufficiency of the organs of pancreas, liver, and intestines which occurred in PCM, LBW, and gastroenteritis patients.

It is also suggested that overgrowth of bacteria in the gut might cause deconjugation of the bile salts, which could impair fat malabsorption. Diagnosis of fat malabsorption was based on macroscopic and microscopic findings of the stool and Lipiodol Absorption Test (Gracey et al., 1974).

Mixed etiology

Like in other developing countries, the etiology of diarrheal diseases is most probably a mixed one, i.e. with:

— Parenteral infection;
— PCM;
— PCM + parenteral infection;
— Malabsorption syndrome;
— Parasitic infection such as intestinal worms, intestinal candidiasis, amebiasis, giardiasis, etc.

Sometimes 2 or more mixed infections occur in one child (Sunoto et al., 1976). Ono Dewanoto et al. (1968) in Bandung in a study of 288 patients with enteral infection found 41.2% with mono-infections, and 19.4% with mixed infection of which 15.4% were double infections, 3.8 triple infections, and 0.2% quinta infections. In 81% of the patients undernutrition and PCM were found.

Suprapti Thaib et al. (1968) reported 65% with single infection, 29.7% double infection, and 5.3% triple infections, Taslim Soetomenggolo (1967) in a study of 1,345 infantile diarrhea found 61.4% of the patients with undernutrition and PCM. Oma Rusmajudi (1976) reported 11.55% accompanied with PCM, parenteral infection 29.56%, and parasitic diseases 2.61%.

Treatment

Reducing the morbidity of diarrheal disease is a long term process requiring much financial support for activities comprising:

— improvement of socio-economic condition;
— improvement of environmental hygiene and sanitation system, especially adequate water supply;
— improvement of personal hygiene and sanitation by health education;
— promotion of breast feedings, if possible of prolonged breast feeding, better nutrition etc.

Because of this long term process the first step in diarrheal disease control in Indonesia has been directed to shortening the duration of disease and reducing the case fatality rate by treatment.

I. PRIMARY TREATMENT WITH FLUID THERAPY.

In the treatment of diarrheal disease the most important factor is fluid since death from diarrhea is mainly due to loss of fluid (dehydration), irrespective the cause of the diarrhoea.

Four points should be kept in mind in treating a patient with gastroenteritis dehydration i.e.
— Composition and tonicity of the fluid;
— Route of administration;
— Amount of fluid given;
— Rate of administration.

1. Composition and tonicity of the fluid.

Tumbelaka (1965) reported isotonic, hypotonic, and hypertonic dehydration in 77.8%, 12.7%, and 9.5% respectively. Sadikin Darmawan et al. (1972) also found that most cases were either iso-or hypotonic dehydration. Achmad Surjono et al. (1972) in a study of 98 children suffering from acute and severe dehydration secondary to diarrhea revealed 47.96% isotonic, 41.84% hypotonic, and 10.2% hypertonic. From these findings, it was agreed that the routine solution for the treatment of patients with gastroenteritis dehydration was isotonic solution used in Indonesia, such as:

a. 3a's solution comprising 1/3 NaCl 0.9% + 1/3 dextrose 5% + 1/3 sodium lactate N/6. This solution up to now is still being used as a routine treatment for initial infusion in severe gastroenteritis dehydration with acidosis with satisfactory results. Unfortunately, this solution is very expensive, available only in large hospitals, cannot be kept for a long time, and contains no potassium.

b. Darrow’s glucose solution comprises 1/3 Darrow and 2/3 glucose 5—10%. This solution is usually administered for maintenance.

c. 2a’s solution consists of ½ NaCl 0.9% + ½ glucose 5%. This solution is used in the treatment of dehydration without acidosis. For correction of acidosis sodium bicarbonate should be used.

d. Half-strength Darrow in 2.5% glucose. This solution is the ideal solution, because it can be used for the treatment of cholera, non cholera diarrhea, and gastroenteritis accompanied with PCM and it contains potassium. But this solution is also very expensive and cannot be kept for very long.
e. 4 : 1 solution, consists of 4 parts glucose 5 - 10% and 1 part NaCl 0.9% or NaHCO₃. This solution is good for LBW and neonates with gastroenteritis dehydration.

f. Ringer's lactate solution. This solution is a widely used fluid for the treatment of gastroenteritis dehydration because of its availability in large hospitals as well as in rural health centers in Indonesia. It is also the cheapest and can be stored for long periods. This solution can be used for the treatment of cholera and non-cholera patients.

Several results of fluid therapy has been studied in Indonesia. Before 1961, parenteral 3a's solution was used as fluid therapy for gastroenteritis dehydration in the Department of Child Health. In cases of shock whole blood or plasma 10 - 20 ml/kg b.w/day was added. Case fatality rate was very high, i.e. 62.2% (Kwari Satjadibrata and Sudjono D. Pusponegoro, 1959). With the modification of Sutejo et al. (1961) by giving 1/3 Darrow's glucose solution (1/3 Darrow's solution + 2/3 glucose 5%) after 8 hours on 3a's solution, mortality could be reduced from 100% to 85.7% in the low birth weight infants and from 36.2% to 14.3% in fullterm infants.

Kho et al. (1963), in a study of 200 children below 2 years of age and 48 children between 2-12 years, found that addition of plasma or whole blood had no significant effect on case fatality. Suto et al. (1975) in a study of blood gas analysis of children suffering from gastroenteritis and severe dehydration and treated with half-strength Darrow's solution in 2.5% glucose, found that this solution could be used as a single solution for gastroenteritis and dehydration with mild to moderate acidosis. For severe acidosis the 3a's solution still seemed to be better, since this solution contained more base corrector.

Hernawan et al. (1976), in treating 50 patients suffering from gastroenteritis dehydration with Ringer's lactate solution for maintenance, found a mortality rate of 6%. For cholera, several solutions have been used with results as shown in Table 2. Recently, after the Rehydration Seminar held in Jakarta in 1974 and the standardization of treatment of cholera, especially with "ROSE" system (Suharjono, 1976), the mortality of cholera could be reduced almost to nil in large hospitals and less than 5% in rural hospitals, health centres and even in emergency field treatment centres. "ROSE" system indicates the four principles in the treatment of diarrhoea with dehydration, i.e.: rehydration, continuation in administration of sugar (glucose if possible) and electrolyte or oralyte, simultaneous rehydration, i.e. intravenously and orally at the same time, education of the parents.

2. Route of administration.

There are 4 routes of administration for fluid replacement in dehydration:
a. parenteral or intravenous fluid drip (ivfd);
b. intraperitoneal;
c. intragastric;
d. oral.

Parenteral or ivfd is very effective in treating patients with severe dehydration and shock, this can be done either by cutting the veins (v.c) or by using a scalp needle (wing needle). The latter is preferred since no vein will be injured. For treatment of shock sometimes 1 or 2 peripheral veins are used. Kovacks apparatus as proposed by Achmad Surjono and Ismangoen (1971) can also be used.

Intraperitoneal administration was suggested by Pierce (1971) during the WHO Rehydration course in Surabaya for the treatment of moderate and severe dehydration without shock, but up to now it is still not popular in Indonesia because of fear of complication, particularly septicemia (Haroen Noerasid et al., 1975).

Intragastric administration can be used in the treatment of mild to moderate dehydration (Ig. Sudigbia and Anggoro Djawabaru, 1976).

Oral rehydration has become very popular in the last few years, especially after the Rehydration Seminar held in Jakarta in August 1974. Significant results with a dramatic reduction in mortality have been obtained by several investigators (Sunoto et al., 1976; Suharjono, 1976; Suharjono et al., 1976; Adnan S.W. and Sutejo, 1976; H. Santosa et al., 1976; Djoeanda and Wijati Donhuijsen, 1976; Soetomo Talkah and Rusdi Ismail, 1976; etc.). Ig. Sudigbia (1971) has reported success treatment of children with mild gastroenteritis. Since 1974 oral rehydration has become a very important feature in the national diarrheal diseases control programme in Indonesia.

The most widely used composition of the oralyte has been NaCl 3.3 gm/1., NaHCO₃ 2.5 gm/1., KCl 1.2 gm/1., and glucose 22 gm/1., resulting in an electrolyte composition of Na 85 mEq/1., K 15 mEq/1., Cl 70 mEq/1., HCO₃ 30 mEq/1., and glucose 120 mMol/1.

Moenginah et al. (1974) used RC III with the following composition NaCl 2 g/1, HCO₃ 24 mEq/1 and glucose 167 mMol with good results.

3 Amount of fluid.

The amount of fluid for treatment of gastroenteritis dehydration is calculated from previous water loss (PWL) + normal water loss (NWL). The amount of fluid given in infantile gastroenteritis is usually tabled as follows:
For older children, the amount of fluid given was calculated from the body weight of the child:

<table>
<thead>
<tr>
<th>Body weight</th>
<th>PWL (ml./kg. BW/ day)</th>
<th>CWL (ml./kg. BW/ day)</th>
<th>NWL (ml./kg. BW/ day)</th>
<th>Total (ml./kg. BW/ day)</th>
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</thead>
<tbody>
<tr>
<td>3 - 10</td>
<td>125</td>
<td>25</td>
<td>100</td>
<td>250</td>
</tr>
<tr>
<td>10 - 15</td>
<td>100</td>
<td>25</td>
<td>80</td>
<td>205</td>
</tr>
<tr>
<td>15 - 25</td>
<td>80</td>
<td>25</td>
<td>65</td>
<td>170</td>
</tr>
</tbody>
</table>

Since the amounts are very difficult to be determined by doctors and paramedical personnel, usually a simple formula is used: for initial infusion — give 10% of body weight in high speed between 0-4 hours and for the maintenance about 150-200 ml/kg. BW/day in divided doses.

For cholera the difference is in the amount of CWL, which is usually estimated as 80 - 100 ml/kg. BW/day for children less than 2 years of age and 100-200 ml. for children above 2 years of age.

4. Rate of administration.

In the conventional treatment with 3a + DG solution the rate of administration on Sutejo et al. (1961) indicated the following schedule;
- first 4-hour period : 3a solution 15 ml/kg. BW/hour;
- second 4-hour period : 3a solution 7.5 ml/kg. BW/hour;
- next 16-hour period : DG solution 7.5 ml/kg. BW/hour;

The Seminar of Rehydration held in Jakarta in 1974 recommended the treatment with Ringer’s lactate as follows: first hour : 30 ml./kg. BW following 7th hour : 70 ml./kg. BW next 16-hour : oral rehydration ad libitum or if impossible continued ivfd with ringer’s lactate dextrose with a rate of 10 ml./kg. BW/hour.
For cholera the rate of ivfd should be faster, or the use of ROSE system is preferable (Suharjono, 1976).

II. SECONDARY TREATMENT.

Besides fluid therapy, other therapy, although of secondary importance, comprises:
- anti bacterial drugs;
- anti parasitic drugs;
- anti fungal drugs;
- dietetic treatment.

1. Anti bacterial drugs.

EPEC

Up till now neomycin is still widely used for EPEC-diarrhoea, but resistance to neomycin from year to year seems to be increasing. EPEC has been found still highly sensitive to nitrofurantoin derivatives (fultrexin, furadantin, urfadyn), gentamycin, minocin, cephalosporin, and colistin (Effek Alamsjah et al., 1974; Suharjono, 1976; Pitono Suparto et al., 1976).

Salmonella sp. and Shigella sp.

The drug of choice for treating salmonella sp. and shigella sp. infections in Indonesia is still chloromycetin followed by ampicillin although resistance to these drugs has been reported (Suharjono et al., 1976; Sunoto et al., 1976). Derivative nitrofurantoin (fultrexin, furadantin, etc.), trimethoprim-sulpha-methoxazole, gentamycin, and kanamycin are still highly effective (Sunoto et al., 1976).

Vibro sp.

For vibrio cholera Eltor and paracho­lera Eltor, tetracyclin is still the drug of choice followed by chloromycetin. Satisfactory result was also found in treating cholera Eltor with trimethoprim-sulpha­methoxazole (Komalarini and Jeni Iswandari, 1975).

2. Viral infection.

For viral infections up to the moment no antiviral therapy has been given because usually viral diarrhea is a self-limiting disease.

3. Anthelminthic drugs.

Several anthelminthic drugs are used for the treatment of intestinal helminthiasis in Indonesia. Usually giving good results. They are tetramisole (Thienpont et al., 1970), pyrantel pamoate (Runizar Rusin, 1976), and mebendazole. For multiple infections, pyrantel pamoate and mebendazole are preferred. Piperazine is also used (Djauhar Ismail et al., 1971, 1976).

4. Anti-fungal drugs.

Since the most common fungal infection as a cause of diarrhea in children is candida sp., nystatin and fungilin have been most commonly used with satisfactory results. No case of resistance has been reported for intestinal candidiasis (Suprihatin et al., 1969; Achmad Surjono et al., 1971).
5. *Anti-amoebic drugs.*

Several trials with anti-amoebic drugs such as mexaform and entobex (Jo Kian Tjay et al., 1969), Intestopan (Pudjiadi et al., 1969), dehydro-emetine and metronidazole (Jo Kian Tjay et al., 1971, 1972, 1974 and tiberal (Pudjiadi et al., 1972; Sunoto et al., 1974) showed good to excellent results. The drug of choice used for amoebiasis in Indonesia up to now is metronidazole with the dose of 50 mg./kg. BW/day for 3-5 days.


Dietetic treatment or refeeding after rehydration period seems to be as important as the rehydration period itself. Many patients suffered repeatedly from gastroenteritis dehydration after rehydration treatment due to ignorance of physicians. This may happen due to the high incidence of lactose and sucrose intolerance during or after the diarrheal episode as mentioned above. For lactose intolerance, several trials with low-lactose milk formula has been tried with good to excellent results (Sunoto et al., 1971; Suharjono et al., 1972, 1974; Sidik et al., 1975; Ismangoen et al., 1975; Pitono Suparto et al., 1975; Bagdadiji et al., 1975).

In fat malabsorption, MCT-milk formula (caprilon and capricid, Nutricia, Holland) has been used effectively in increasing the body weight and stopping the diarrhea (Suhrzono et al., 1976). In breast-fed infants breast feeding is recommended to be continued even though there is lactose intolerance (Abdurachman Sukadi et al., 1975; Suharjono, 1976). Early feeding is also very important in the rapid recovery of the children (Suprapto et al., 1976).

**Prevention of morbidity**

Successful prevention of diarrheal disease in Indonesia will take sometime. As mentioned before it needs improving the socio-enonomic condition, environmental sanitation and personal hygiene. Up till now no vaccin is available which produces a satisfactory immunity. Environmental pollution with microorganisms which may play a role in causing diarrheal disease in children has been investigated by Gracey et al. (1976) in Jakarta. Djohan Kurnia (1973) found in a study area in Ujung Pandang, South Sulawesi that improvements of the environmental sanitation resulted in a decrease of the incidence of diarrhea by 53.4% after one year and by 57% after two years whereas in the control area the decrease was only 12.9% after one year and 23.4% after two years. The incidence of cholera decreased by 53.8% in the 2nd year and 15.4% in the 3rd year of the study. In the control area no decrease was observed in the incidence of cholera during the 3 years of study.

By establishing rooming-in of newborns, Ruskandi Martaatmadja et al. (1976) reduced the frequency of diarrhea amongst newborns from 22.6% to 3.3%. By rooming-in is meant that the
newborn infant stays in the same room with his mother so that no transmission of microorganisms takes place between newborns. The role of aseptic method of the paramedical personnel is also very important in reducing the morbidity and mortality of gastroenteritis (Purnomo Suryantoro et al., 1976). To reduce the microbial contamination on the environmental surfaces of the wards antiseptic drugs can be used (Gracey et al., 1976). Besides, it is well-known and without doubt that breast-feeding may reduce the frequency of diarrhea in infants.

Bell et al. (1974) showed that breast-milk of Indonesian mothers contains enough IgG, IgM, IgA, antibodies against E. coli, staphylococcus, and is only rather low in the lactoferrin content. Therefore, to prevent diarrheal disease, breast feeding should be promoted vigorously.
TABLE 1: Kind of fluid, author/hospital and case fatality rate of pediatric cholera

<table>
<thead>
<tr>
<th>Author/hospital</th>
<th>Cases</th>
<th>Kind of fluid</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dr. Sutomo Hospital Surabaya (1962)</td>
<td>163</td>
<td>Saline + Glucose 5% (2a) or Ringer + Saline + glucose 5% (3a)</td>
<td>29 %</td>
</tr>
<tr>
<td>2. ditto (1965)</td>
<td>160</td>
<td>ditto</td>
<td>46.2%</td>
</tr>
<tr>
<td>3. Lim Hok Nio, Semarang (1961)</td>
<td>14</td>
<td>Ringer-glucose</td>
<td>28.6%</td>
</tr>
<tr>
<td>4. Erwin Suratman et al., Bandung (1965)</td>
<td>60</td>
<td>3a + Glucose solution</td>
<td>16.0%</td>
</tr>
<tr>
<td>5. San Lazaro Hospital Philippines (1961)</td>
<td>7</td>
<td>3 L Saline + 1 L Na-HCO₃ 2%</td>
<td>17.0%</td>
</tr>
<tr>
<td>6. ditto</td>
<td>526</td>
<td>Ringer's lactate</td>
<td>3.2%</td>
</tr>
<tr>
<td>7. Dr. Sutomo Hospital Surabaya (1965)</td>
<td>129</td>
<td>1 L Saline + 1/3 L NaHCO₃ 3.75% + glucose 5%</td>
<td>6.2%</td>
</tr>
<tr>
<td>8. Subagyo Martodipuro et al., Surabaya (1971)</td>
<td>153</td>
<td>Modified PCRS</td>
<td>3.9%</td>
</tr>
<tr>
<td>9. Ruskandi Martaatmadja and Wiyati Donhuijen et al., Bandung (1976)</td>
<td>105</td>
<td>ROSE — System</td>
<td>3.6%</td>
</tr>
<tr>
<td>10. Sutomo Talkah + Rusdi Ismail, Palembang (1976)</td>
<td>156</td>
<td>ROSE — System</td>
<td>3.6%</td>
</tr>
<tr>
<td>11. Nassir Abbas et al., Ujung Pandang (1976)</td>
<td>23</td>
<td>Ringer's lactate</td>
<td>0%</td>
</tr>
<tr>
<td>12. Suharjono et al., Jakarta (1976)</td>
<td>95</td>
<td>Ringer's lactate + COS (ROSE System)</td>
<td>0%</td>
</tr>
<tr>
<td>13. Adnan S.W. + Sutejo Jakarta (1976)</td>
<td>70</td>
<td>Ringer's lactate + COS (ROSE System)</td>
<td>0%</td>
</tr>
<tr>
<td>14. Hendra Santosa et al., Denpasar (1976)</td>
<td>20</td>
<td>ROSE System</td>
<td>0%</td>
</tr>
<tr>
<td>15. Moenginah P.A. et al., Yogjakarta (1976)</td>
<td>7</td>
<td>ROSE System</td>
<td>0%</td>
</tr>
</tbody>
</table>
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