FACTORS AFFECTING THE USE OF ORAL REHYDRATION THERAPY IN THE HOME MANAGEMENT OF DIARRHOEAL DISEASE

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DECLARATION

It is hereby declared that this work is original unless otherwise acknowledged. It has never been submitted in part or in whole to any other examining body.

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CERTIFICATION

This is to certify that this research was carried out by Dr. Johnson Okechukwu Amaizu at Plateau State Specialist Hospital, Jos, under our supervision, between June and November 2003.

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DEDICATION

This work is dedicated to the memory of my late senior brother, Jesse, who saw me through the University, and to all the subjects who participated in this study.

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ABBREVIATIONS

ADH	-	Antidiuretic Hormone
AIDS	-	Acquired Immune Deficiency Syndrome
Cl	-	Centilitre
Cl^-	-	Chloride
ECF	-	Extra-cellular Fluid
E.Coli	-	Escherichia Coli
ECWA	-	Evangelical Church of West Africa
ESR	-	Erythrocyte Sedimentation rate
E/U/C	-	Electrolytes, Urea and Creatinine
EWA	-	Expected Weight for Age
FBC	-	Full Blood Count
GM	-	Gramme
$\geq$	-	Greater than or equal to
HCO_3^-	-	Bicarbonate
HIV	-	Human Immunodeficiency Virus
IV	-	Intravenous
K	-	Potassium
Kg	-	Kilogramme
L	-	Litre
Meq/L	-	Milliequivalent per litre
Ml	-	Millilitre
Mmol/L	-	Millimole per litre
Mosmol/L	-	Milliosmolality/Litre
N	-	Number (Frequency)
Na	-	Sodium
ORS	-	Oral Rehydration Salt
ORT	-	Oral Rehydration Therapy
%	-	Percent
P	-	Predictive Value
SD	-	Standard Deviation
SSS	-	Salt Sugar Solution
UNICEF	-	United Nations International Children Education Fund
WAZ	-	Weight for Age Z-Score
WHZ	-	Weight for Height Z-Score
WHO	-	World Health Organisation

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SUMMARY

Aim: To identify the factors affecting the use of oral rehydration therapy in the home-management of diarrhoeal disease.

Study period: The study was carried out between June and Number,2003.

Study design: Four hundred (400) consecutive children aged less than five years who presented with diarrhoea at Plateau State Specialist Hospital, Jos were seen and examined. Their mothers were interviewed. Their demographic data, duration of diarrhoea, level of dehydration and nutritional status were obtained. The usage rate of oral rehydration therapy (ORT) at home before presentation and mother's knowledge of mixing and administration of oral rehydration solutions were assessed. The factors relating to the correct use of ORT were analysed.

Results: Diarrhoeal disease was more prevalent in the second half of infancy. A total of 237 (59.3%) patients had no dehydration, 150 (37.5%) had some dehydration, and 13 (3.3%) had severe dehydration. Malnutrition was present in 70 (17.5%) patients. The usage rate of ORT was 39%, oral rehydration salt (ORS) was 34%, and salt sugar solution (SSS) was 5%. There was a significant association between use of ORT and the degree of dehydration. There was no relationship between use of ORT and mothers' educational status or parity. Of the 20 mothers who used SSS, only 10 (50%) prepared it correctly. Of the 136 mothers who used ORS, only 18 (12.5%) prepared it correctly. The rest prepared hypertonic solutions. There was no association between the ability to prepare ORT correctly and mothers' educational status. The average volume of the correctly prepared and incorrectly prepared ORT administered in 24 hours were 600ml and 300ml respectively, and they were low. There was no

relationship between the administrative skill of the mothers and their parity or educational status.

Conclusion: These findings showed that mothers were lacking in their knowledge of the work, the reconstitution and administration of oral rehydration solutions. The value of ORT in the home-management of diarrhoeal disease is therefore limited. There is a need to intensify effort at teaching mothers the correct way to prepare and administer ORT at home so that its full impact and benefits will be realized.

INTRODUCTION

Diarrhoeal disease is a major health problem and one of the leading causes of childhood morbidity and mortality particularly in the developing countries[1]. It is estimated that 1.4 billion episodes of diarrhoea occur annually in children under the age of five years resulting in about four to five million deaths[1,2]. Currently in Nigeria, diarrhoeal disease ranks among the first three causes of hospital admission and deaths among children under five years of age, accounting for about 25% of deaths in these children [3]. A National household survey on control of diarrhoeal disease conducted in the country in 1993, showed an incidence rate of acute watery diarrhoea of 4.9 episodes per child per year. Annually in Nigeria, there are approximately 200,000 deaths from acute watery diarrhoea. This translates to approximately 500 deaths daily or no less than one death every three minutes[3].

Diarrhoeal infections inhibit the body's ability to absorb salts and water. Fluid is lost faster than it can be replaced thus leading to dehydration - the major contributor to mortality. Fortunately, dehydration can be prevented by the use of oral rehydration therapy (ORT), which simply means increased fluid intake and continued feeding instituted at the onset of diarrhoea[3]. Oral rehydration therapy is a simple, inexpensive and effective therapy based on the discovery that glucose greatly increases the capacity to absorb salt and water[4]. The benefits of ORT are clear. It is cheap. The materials are readily available in most homes. It does not require expert knowledge or manpower. It avoids most of the complications associated with the intravenous therapy. The mother is involved in the medical management of her child.

ORT campaigns are concentrating on teaching mothers to forestall dehydration by using household remedies at the onset of diarrhoea since effective early interventions can reduce complications and subsequently will result in fewer office or emergency room visits, hospitalizations and deaths. The major components of the ORT campaigns in Nigeria are [5, 6]:

1. Recognition of diarrhoea by parents as a potential cause of death.
2. Prompt institution of management with salt-sugar solution and other home-based fluids.
3. Continuation of breast feeding and other feeds during and after diarrhoea.
4. Prompt recognition of simple clinical indicators of failure of home-management, such as the signs of dehydration, as an indication for seeking expert help.

Due to the high impact of diarrhoea on health, several countries have initiated a programme on control of diarrhoeal disease (NPCDD) to help co-ordinate management of diarrhoea at all levels throughout the country[5,7]. Its goals were to reduce the incidence of diarrhoea and prevent complications through oral rehydration therapy using oral rehydration salt. The programme also emphasizes on the prevention of diarrhoea by using interventions that are cost effective and easy to incorporate in the primary health care programmes. These interventions include improved nutrition through promotion of breastfeeding and proper weaning practices; adequate supply and use of safe drinking water; good personal, domestic and environmental hygiene; immunization, especially against measles; female

education; improvement in socioeconomic status; safe faeces disposal and the provision of vitamin A.

Similarly, oral rehydration therapy has been recognized and inco-orporated as a strategy for child survival and development revolution (CSDR) in any country with a high incidence of diarrhoeal disease[7]. These are programmes aimed at curtailing the high rate of infant morbidity and mortality in these countries. At the world summit for children in 1990, over 150 countries under-took to attain 80% access to and usage of oral rehydration therapy by 1995 with a view to achieving a reduction of 50% in mortality attributable to diarrhoea by 2000[5,7]. This was to be achieved through health education of the public and establishment of health care facilities especially for oral rehydration salts.

The programme since its establishment, has shown both success and failure in its efforts to achieve its objectives. Case studies all over the world show positive trends in diarrhoea management[8]. ORT is now given to the majority of children with diarrhoea resulting in a significant reduction in the mortality rate due to diarrhoea. Nonetheless, several workers have found that less than half of women who knew about ORT actually use it when their children have diarrhoea[8,9]. It is estimated that world wide, oral rehydration is currently used by 23% of those who can benefit from the treatment, usually being given only for maintenance or to correct mild dehydration[9].

There is a need for continuing education for healthcare providers and caretakers to become familiar with the benefits and applicability of ORT, so that in the long term, oral rehydration solutions would become more widely used both in

the clinic and at home, and this would greatly reduce cost, and the rate of hospitalization and mortality attributable to diarrhoeal disease[9].

Statement of the problem

Diarrhoeal disease is one of the leading causes of childhood morbidity and mortality, particularly in the developing countries. It has been shown that oral rehydration therapy is a very important and efficient tool in combating this scourge [9]. Though, the level of awareness of ORT has been increasing, studies carried out both within and outside the country indicate a low usage rate of ORT (SSS and ORS) in the management of diarrhoeal disease, both at home and in the clinic[9,10]. Similarly, serious harmful errors in mixing the ingredients and administration of the solution have commonly been reported[10,11]. These have limited the potential benefits derivable from this innovation. There is a need to find out the factors affecting the knowledge, use rate and correct use of salt-sugar solution in the home-management of diarrhoeal disease. These were the motivation for this study.

Aim of the study

To identify the factors affecting the use of oral rehydration therapy in the home-management of diarrhoeal disease in children.

Specific objectives

To determine

1. The clinical presentation (Level of dehydration and Nutritional status) of diarrhoeal diseases in children presenting at Plateau State Specialist Hospital, Jos.
2. The use rate of oral rehydration solutions (salt sugar solution and oral rehydration salt solution) at home before presentation.
3. Errors regarding their use.
4. The level of mother's awareness and knowledge of salt sugar solution.

Rationale for the study

Most of the studies on the knowledge and use of ORT so far reported were done in rural areas among the illiterates. It is pertinent to carry out a study in a relatively urban and literate environment to identify the factors affecting the use of oral rehydration therapy in the home-management of diarrhoeal disease. This will help to know the level of impact the ORT campaigns has achieved so far, and assist in redesigning the programme to a more efficient and effective intervention strategy.

Assumptions

For the purpose of this study, the following assumptions were made.

1. Mothers should be aware that diarrhoeal disease is a great killer disease of childhood, and that it chiefly does so by causing electrolyte and fluid loss.

2. Oral rehydration therapy (SSS and other recommended home fluids) is adequate and effective to be used in the home-management of diarrhoeal disease.
3. They should initiate the use of salt-sugar solution as a first line remedy to prevent dehydration at the onset of diarrhoeal disease.
4. They should be able to prepare and administer this solution correctly at home.
5. When signs of dehydration develops, the mother should be able to recognize this, and the child should be taken to a health care facility for management which may include the use of oral rehydration salt (ORS) solution.

CHAPTER TWO
LITERATURE REVIEW

Definition: Diarrhoea is the passage of three or more loose or watery stools in 24 hours [12]. It is the passage of watery stools more frequently than normal for the age of the child [12,13]. The newborn may have frequent stools about five times a day; this is not diarrhoea.

Clinical types of diarrhoea [13]

a) Acute watery diarrhoea (AWD): It lasts for less than two weeks. The stools do not contain blood. It is associated with vomiting, anorexia and sometimes fever. It has a risk of dehydration and circulatory collapse, and it occurs frequently in infants.

b) Acute dysentery (Bloody diarrhoea) (5 to 10% of all acute episodes): The stools are small quantities and contain mucus and blood and/or pus. It is associated with tenesmus, anorexia and weight loss. It occurs more frequently in older children. Common organisms are *Shigella, Campylobacter jejuni* and *Entameba histolytica*.

c) Persistent diarrhoea: It lasts for two weeks or more. Weight loss and malnutrition are common. Dehydration may occur when stools are bulky.

   Other forms of classification of diarrhoea [12]:

   i. Secretory or Osmotic (malabsorptive) diarrhoea. These are used when the stool output continues or ceases respectively in the fasting patient.

ii. Organic or functional diarrhoea. These are used when there is an identifiable cause or not.

Aetiology:- Several studies have shown that in many parts of the world, 30 to 40 percent of episodes of acute diarrhoeal diseases in children are caused by viruses, 20 to 30 percent are caused by bacteria or parasites, but no aetiologic agent can be identified in about 20 to 40 percent of cases [14,15]. The table below shows the different causative agents.

Table 2.1 Pathogens that cause infectious diarrhoea in children [14,15]

Viruses	Bacteria			**Parasites**
Rotavirus	Toxigenic:	Cytotoxic:	Invasive:	
Norwalk virus	Vibrio cholerae	Clostridium deficile	Shigella species	Giardia lamblia
Enteric adenovirus (Enteroviruses)	Enterotoxigenic E. coli	Shigella species	Salmonella species	Entamoeba histolytica
Astrovirus (Coronaviruses)	Shigella species	Enteropathogenic E.coli	Yersinia enterocolitica	Cryptosporidium species
Calcivirus	Yersinia enterocolitica	Staphylococci	Campylobacter jejuni	Strongyloides stercoralis
Cocksackie virus	Klebsiella		Vibrio Parahaemolytic-us	
	Pseudomonas aeruginosa			
	Baccilus cereus			

Epidemiology

Acute diarrhoea occurs frequently in children between the ages of six months and three years[15]. Diarrhoea in infants below six months is usually associated with early introduction of infant formula feeds, which are prepared under unhygienic conditions[16].

Many studies report that the incidence of diarrhoeal disease is especially high after weaning is initiated, and is related to the decline in breastfeeding, poor weaning foods and the popularity of bottle feeding among mothers[16,17]. Rowland and McCollum reported that there is particularly high incidence of diarrhoeal disease between 7 and 18 months with a peak at nine months of age[2,17]. Snyder and Merson showed that the median incidence of diarrhoeal disease was three to six episodes per year, the highest incidence being during the second half of infancy[18]. Similarly, Black found that the prevalence of diarrhoea was highest during the second six months of life and declined with increasing age thereafter[15,18] . The declining incidence of food borne illness with increasing age is explained by the probable acquisition of immunity from repeated exposure to the pathogens [15, 18] .

Contaminated weaning foods account for a substantial proportion of diarrhoeal diseases among infants and young children especially in developing countries. Up to 70% of diarrhoeal episodes could be due to pathogens transmitted through food [19] .

The sources of food contamination are numerous, such as night soil, polluted water, flies, pests, unclean utensils and pots, baby bottles, teats, dirty hands and

polluted environment caused by lack of sanitation, animal droppings, dust and dirt. The washing of hands after defecation or changing infants' napkins and prior to the preparation of food is frequently neglected or ignored. Contamination of weaning food with faecal matter has been reported[15,19]. Water used for the preparation of food itself is a source of pathogenic agents especially in rural areas where the water is very often contaminated.

Known environmental predisposing factors include poor sanitation, lack of pipe borne water, overcrowding especially in the urban slums, and malnutrition. In some parts of the world, there is a seasonal variation in the prevalence of diarrhoea[20]. Epidemic diarrhoea in children usually occurs in Nigeria during the dry season[20]. This is probably due to easy contamination of food and water by dust containing viral particles. In temperate climates however, the incidence of rotavirus diarrhoea is highest in the winter[20].

Pathogenesis of infectious diarrhoea

Most diarrhoeal diseases is non inflammatory and primarily affect the small intestine [20]. Over ten litres of fluid per day are secreted and absorbed by the normal adult gut. In the small intestine, fluid secretion occurs by the extrusion of chloride ion from the cells of the villous crypts. This extrusion is mediated by cyclic adenosine monophosphate (cAMP). Absorption of fluid occurs at the cells of the villous tip[20].

A. Bacteria: Bacterial agents may cause diarrhoea by several mechanisms with some pathogens acting by more than one mechanism.

Secretory diarrhoea: - The mechanisms include:

(i) Toxigenic bacteria elaborate enterotoxins that bind to specific receptors on the small bowel mucosa and induce the production of excess cyclic adenosine monophosphate (cAMP) by stimulating the action of adenosine cyclase. This inhibits influx of sodium chloride and water into villous cells and gives rise to the active secretion of sodium and water by the crypt cells. The damaged cells are shed after a few days. This partly explains the self limiting actions of the toxins. The glucose-stimulated sodium absorption of the gut is however not affected. Characteristically, the stool is watery, with no blood or mucus.

(ii) Cytotoxic pathogens produce the cytotoxins that generate inflammatory reactions and cause cell damage (ulceration), primarily in the colon[21].

(iii) Other bacteria may invade the cell (mucosa), elicit an acute inflammation and damage the mucosal lining of the small and large intestine which results in the clinical picture of dysentery.[21].

B. **The Viruses** invade and lyse the absorptive villous tip mucosal cells of the small intestinal epithelium, causing decreased absorption, outpouring of fluid and depletion of brush border disaccharidases with consequent carbohydrate malabsorption[21].

C. Protozoa. Method of disease production: (i) *Giardia lamblia:* It attaches to the mucosa leading to malabsorption (ii) *Entamoeba histolytica:* It invades the mucosal cells of the colon causing inflammation and ulceration.

Osmotic diarrhoea: Results from osmotically active substances present in gut lumen and which are not absorbed. Isotonic solutions give diarrhoea but no dehydration, while hypertonic solution leads to diarrhoea and dehydration [21].

The balance between fluid secretion and absorption is upset in secretory diarrhoea and the resultant loss of water and electrolytes in the stool can be rapid and massive (60 to 120 mEq/L) and in severe cases, approaches the serum concentration[21].

In osmotic diarrhoea, damage to the intestinal microvillous membrane leads to malabsorption of luminal solute, with osmotic loss of free water into gut lumen. The stool sodium concentration is usually low (30 to 40mEq/L). Stool losses of both bicarbonate and potassium occur in both secretory and malabsorptive diarrhoea.

In many cases, the resultant effect is loss of fluid and electrolytes from the extracellular and later the intracellular compartments leading to dehydration. This clinical state known as dehydration begins to manifest when fluid loss is equivalent to three to five percent of body weight. The marked reduction of body fluid may lead to shock, decreased renal blood flow and oliguria. These changes may be quite rapid, leading to death or irreversible sequelae, especially on the brain.

Degree of dehydration

An assessment of the degree of dehydration is of importance in the evaluation of a child with diarrhoeal disease. Dehydration may be classified as none, some or severe based on clinical signs that correspond to water deficit expressed as percentage of the body weight[22].

1. No dehydration (at less than 3%, 10 to 20ml /kg body weight loss of fluid):- No physical sign of dehydration is present, but the child may have a history of increased thirst and mild oliguria.
2. Some dehydration (at 3 to 9%, 30 to 90ml/kg body weight loss of fluid):- Some physical signs of dehydration are present, and the child may show behavioural signs such as listlessness or irritability.
3. Severe dehydration (at $\geq$ 10%, $\geq$100ml/kg body weight loss of fluid):- The child may demonstrate one or more signs of impending or overt shock.

Table 2.2. Assessment of the diarrhoea patient for dehydration [23,24].

1	Loot at			
	Condition	Well, alert	Restless, irritable	Lethargic or comatose
	Eyes	Normal	Sunken	Very sunken and dry
	Fontanelle	Normal	Depressed	Very depressed
	Tears	Present	Absent	Absent
	Mouth and Tongue	Moist	Dry	Very dry
	Thirst	Drinks normally	Thirsty, drinks eagerly	*Drinks poorly or not able to drink*
2	Feel			
	Skin pinch	Goes back quickly	Goes back slowly	Goes back very slowly
3	Decide	The patient has no sign of dehydration	If the patient has two or more signs including at least one *sign* there is some dehydration	If the patient has two or more signs including at least one *sign* there is severe dehydration

Other *signs* for severe dehydration include low blood pressure, cold extremities cyanosis, grunting and tachypnea.

The skin pinch may be less useful in-patients with marasmus or kwashiokor or obese patients. Tears are a relevant sign only for infants and young children.

Table 2.3. Types of dehydration (based on serum sodium concentration) [21,24]

	Isotonic	Hypotonic	Hypertonic
Temperature	Cold	Cold	Cold or hot
Skin tugor	Poor	Very poor	Doughy and thick
Feel	Dry	Clammy	Dry
Mucous membrane	Dry	Pale but moist	Parched
Eyeball	Sunken	Sunken	Sunken
Fontanelle	Sunken	Sunken	Sunken
Activity	Lethargic	Very lethargic	Irritable
ECF	Decreased	Severely decreased	Decreased
Serum sodium	Maintained	Decreased	Increased

1. Isotonic (isonatraemic) dehydration: Water and sodium losses occur in the same proportion as in the normal ECF. The characteristic features include: hypovolaemia, normal serum sodium (130-150mmol/L) and normal serum osmolality (275-295mosmol /L)
2. Hypertonic/hypernatraemic dehydration: In this condition more water than sodium is lost. This may be caused by the ingestion of hypertonic

fluids such as sodium and glucose. The characteristic features include hypovolaemia, high sodium concentration (>150mmol /L), high serum osmolity (>295mosmol /L) and intense thirst.

3. Hypotonic dehydration: This results when sodium losses are higher than water loss or water is re-absorbed but sodium loss continues. This may be caused by intake of large quantities of water (water intoxication, syndrome of inappropriate ADH secretion) or infusion of plain dextrose in water (electrolyte free).

Capillary refill time: Capillary refill time has been shown to correlate well with the degree of dehydration in young children [25]. The time required for capillaries to refill is measured by applying pressure to the fingernail bed until blanching occurs then releasing the pressure and timing the capillary refill.

Table 2.4. Capillary refill time[25]

Capillary refill time (seconds)	Dehydration (%)	Water deficit (ml per kg)
<1.5	<5	< 50
1.5 to 3.0	5 to 10	50 to 100
>3	>10	>100

Electrolytes disturbances in diarrhoeal disease[24,26]

These include:

(i) Metabolic (Base-deficit) acidosis: Large amount of bicarbonate may be lost in the stools. Kidneys compensate but if its function is impaired usually with increasing hypovolaemia, base deficit and acidosis develop rapidly. Characteristic features are serum bicarbonate less than 10mmol/L, deep rapid breathing, increased arterial pH resulting from compensatory respiratory alkalosis and increased vomiting.

(ii) Hypokalaemia: The characteristics include general muscle weakness and paralytic ileus

(iii) Hypoglycaemia: In some cases, life threatening hypoglycaemia may accompany diarrhoea[26].

Diarrhoea as a cause and effect of malnutrition [26, 27]

Several studies have shown that diarrhoeal illness impair weight as well as height gains with the greatest effect being seen with recurrent or prolonged illness[27].

The pathophysiology of how diarrhoea leads to malnutrition includes [27]

(a) Decreased food intake: Local beliefs and tradition may lead to intentional restriction of food for hours or days. Anorexia may lead to partial or total rejection of food, or fluids including breast milk.

(b) Metabolic and nutritional responses: There is increased catabolism which results in significant loss of bodily nutrients, muscle and fat.

(c) Mucosal alterations causes anatomic and functional alterations leading to malabsorption.

(d) Reduced digestion and absorption of nutrients (protein, fat and carbohydrate).

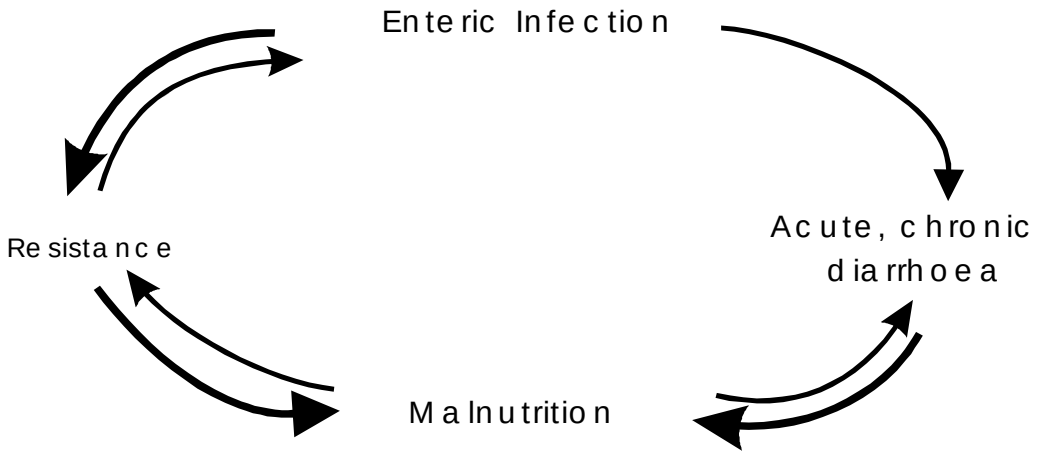
(e) Increased secretion with loss of bodily fluids. These mechanisms lead to loss of nutrients, nitrogen, vitamins, electrolytes, albumin leading to oedema, anaemia, reduced immune status and consequently recurrent infections.

(f) Altered immune response as with HIV infection.

(g) Impaired growth and development.

The summation of metabolic and nutritional alterations lead to progressive deterioration of nutritional status and severe malnutrition. Malnutrition in turn impairs resistance. In addition, enteric infection itself is suggested to be a cause of decreased resistance, and impaired resistance aggravates malnutrition by interfering with the amplification phenomenon. This contributes to persistence of the agent, concurrent infection, and chronicity of disease.

Figure 2.1



Diarrhoea -Malnutrition cycle. The width of the arrows indicate the strength of the association [27].

The evaluation of patients with acute diarrhoea

Clinical presentation: The differential diagnosis of acute diarrhoea can be divided into the clinical (or diarrhoea) syndromes of non-inflammatory and inflammatory types of diarrhoea [29]. Non-inflammatory secretory diarrhoea is associated with cramping, bloating, periumbilical pain and large volume watery stool. Fever and other constitutional symptoms are minimal or absent. In contrast, inflammatory diarrhoea or dysentery is associated with mucosal invasion and commonly accompanied by fever, other constitutional symptoms, lower abdominal pain, faecal urgency and tenesmus. Stools are usually numerous, small volume and often bloody or mucoid. Causes of non-inflammatory diarrhoea include the viruses and toxigenic bacteria. These organisms do not invade the mucosa but induce a secretory watery diarrhoea, thus haematochezia and faecal leucocytes are typically

absent [29]. Approximately half of patients with enteric diseases will present with non-specific symptoms that are not helpful in determining the diagnostic possibilities.

Table 2.5. Pathogenesis influences clinical syndrome

Clues to aetiologic diagnosis [29,30].

Characteristic pathogenesis	**Predominant feature**	**Clinical syndrome**	**Characteristic aetiologies**
	Vomiting	Gastroenteritis (Stomach)	Staphylococcal food poisoning, Rotavirus, Norwalk virus
Enterotoxin production. Adhere to mucosal surface → fluid into the gut.	Watery diarrhoea. Large volume stools, few in number, no faecal leucocytes.	Enteritis (small bowel)	Viruses. Tox. E. coli. Shigella, Staphylococcus aureus, Clostridium welchi, Vibrio cholera
Mucosal invasion → Mucosal inflammation, ulceration and death of cells.	Numerous small volume stools containing blood and/or mucus and many leucoytes	Dysentery (colon)	Shigella, invasive E. coli, Salmonella, Campylobacter, Staphylococcus aureus, Entamoeba histolytica, Giardia.
Submucosal invasion → Inflammation	Constitutional, vomiting, watery diarrhoea ± blood, few faecal leucocytes	Systemic diarrhoea	Salmonella, Viruses

Travel history, recent food and drug ingestion and sexual practices are important when considering causes of diarrhoea. Foodborne diarrhoea can be

noninflammatory due to bacterial toxins, or inflammatory following the ingestion of invasive pathogens. Food poisoning should be suspected when outbreaks of diarrhoea occur in companions. A specific bacterial toxin may be suggested by the clinical setting. Staphylococcal toxin causes the abrupt onset of nausea and vomiting two to seven hours following the consumption of contaminated meat, poultry, or mixed salads. Abdominal cramps and diarrhoea also occur. In toxicity with clostridium perfringes, onset of symptoms is delayed for 8 to 14 hours after consumption of contaminated meats. Vomiting is frequent, and the main features include abdominal cramps and watery diarrhoea that persist for 24 hours.

Medications may precipitate diarrhoeas. Diarrhoea associated with recent antibiotic use suggests the possibility of antibiotic-associated (Pseudomembranous) colitis. Symptoms usually include noninflammatory watery diarrhoea that appears at any time up to six weeks following antibiotic therapy. Antibiotic use facilitates the overgrowth of clostridium deficile, which produces a toxin damaging the mucosa [29,30].

Laboratory evaluation: The presence of faecal leucocytes suggests colonic mucosal invasion [30]. Because most acute diarrhoeal illnesses are self-limited and caused by viruses, stool bacterial cultures should be used judiciously. Cultures are reserved for the following cases: patients who have occult blood or are positive for faecal leucocytes, febrile patients, those requiring admission to hospital, and those who have diarrhoea for more than one week.

Proctoscopy/sigmoidoscopy is useful in the diagnosis of antibiotic associated colitis, amoebic colitis and ulcerative colitis.

Evaluation of patients with chronic diarrhoea

Patients who report having diarrhoea for more than four weeks should be evaluated for chronic diarrhoeal diseases, since most infectious enteritides and other causes of acute diarrhoea generally resolve spontaneously within this period [31]. The keys to making the proper diagnosis include an accurate history and appropriate laboratory studies.

Some chronic diarrhoeal diseases have specific characteristics. Certain criteria suggest the presence of an organic disorder, and these include: a shorter duration (usually less than three months), predorminantly nocturnal diarrhoea, continual rather than intermittent diarrhoea, a sudden onset, weight loss, a high erthrocyte sedimentation rate, anaemia and a low albumin level [32]. In the absence of these, a diagnosis of functional diarrhoea is sometimes made [32].

In giardiasis, the diarrhoea is often associated with upper abdominal cramps and “frothy” stool. Amoebic diarrhoea can be either watery or bloody and can last many years. Suggestive of steatorrhea is a history of weight loss, greasy or bulky stools that are difficult to flush and a bad odour. The presence of steatorrhea is determined by a 72- hour collection of stool fat [32]. The diarrhoea of carbohydrate malabsorption (disaccharidase deficiency) can be intermittent and is usually accompanied by symptoms of bloating, flatus, and cramping. This type of diarrhoea can be primary or secondary to viral enteritis, which damages the small intestinal mucosa, or to antibiotic therapy, which alters colonic bacteria.

Before the evaluation, the patient should follow a lactose-free diet for several days, since diarrhoea that continues after an acute episode is often due to secondary lactase deficiency [32]. Lactase deficiency is the likely diagnosis when symptoms relate to milk ingestion.

A step-wise approach to the laboratory tests is advocated, beginning with stool examination for ova and parasite, and progressing to radiological investigations.

Table 2.6 Diarrhoea syndromes classified by duration of symptoms [32,33].

	Duration	Differential diagnosis	Workup
Acute diarrhoea	< 2 weeks	Enteric infection likely	Faecal leucocytes, stool culture
Subacute diarrhoea	2 weeks to 2 months	Lactose intolerance, Giardiasis, Bacterial overgrowth, Cryptosporidiosis, Bacterial enteric infection	Alteration in diet, stool microscopy, serology, stool culture
Chronic diarrhoea	> 2 months	Giardiasis, amoebiasis, inflammatory bowel disease (irritable bowel syndrome, malabsorption syndrome (steatorrhea), carbohydrate malabsorption, AIDS, medications, previous surgery (short bowel syndrome), endocrine causes, paradoxical diarrhoea, idiopathic (functional) diarrhoea. Less common: Faecal incontinence, food allergy, epidemic chronic diarrhoea.	Endoscopy stool microscopy, serology FBC, ESR, E/U/C, plain abdominal X-ray, Barium studies.

MANAGEMENT

Replacement of the lost fluid and electrolytes is the mainstay of therapy, usually through oral rehydration therapy and intravenous fluid therapy.

ORAL REHYDRATION THERAPY

The major advance in the treatment of diarrhoeal disease has been the development of oral rehydration therapy (ORT).

Historical Background:- In 1930, Stevens in the West Indies and London gave water and salt solutes to his diarrhoeal patients to drink [34]. This method of treatment was not pursued because there was a conviction, which persisted for almost another century that cholera destroys the gut wall and would prevent rehydration by mouth [34]. While oral therapy for diarrhoea has been used by traditional cultures for centuries, the origin of modern oral rehydration therapy date to the 1940s, when Harrison at John Hopkins and Darrow at Yale began using an oral electrolyte solution that approximated the ion losses in the stool, with glucose added because of its protein-sparing effect [34]. In the 1950s and 1960s, several investigators independently described that water absorption in the proximal small bowel of laboratory animals was mediated by an active process of sodium transport that was coupled in an obligatory fashion to the co-transport of glucose or other substrates such as D-hexoses, amino acids, dipeptides, tripeptides, in an approximately equimolar ratio[35,36].

In the presence of glucose, there is increased sodium and chloride uptake by active transport. Water follows by passive transport. The finding that this co-

transport mechanism also mediates water absorption in the human gut and is preserved in patients with diarrhoea of all aetiology led to the formulation of a sodium and glucose-based oral rehydration solution [35-37]. Field testing of these solutions was performed initially in rural Bangladesh, and was later first used on a large scale during an epidemic of cholera affecting refugees fleeing into India during the Bangladesh war of independence in 1971 [36]. When supplies and personnel for administering intravenous therapy were scanty, the use of ORT reduced the mortality from 30% to 3%[3,38]. It was shown that over 80% of moderately and severely dehydrated patients who would normally receive intravenous therapy, were sufficiently rehydrated by ORT.

Subsequently, in 1975, the WHO and UNICEF agreed to promote a single oral rehydration solution (WHO-ORS) to treat dehydrating diarrhoea in children and adults of all ages[33,38].

Formulation of oral rehydration salt (ORS): The formulation of oral rehydration solution should be nearly isotonic, contain an appropriate amount and mixture of electrolytes to replace what is lost and the balance between sodium and glucose should be appropriate to enhance the absorption mechanism [39]. A complete ORS should also provide some potassium and some alkali to correct any metabolic acidosis that may be coexisting.

The composition of the diarrhoeal stool depends on the infecting organism [39].

Table 2.7 Composition by electrolytes of diarrhoeal stools.

	Na	K	Cl	HCO_3 (mmol /L)
Cholera	88	30	86	32
Rotavirus	37	38	22	6
ETEC	53	37	24	18

The WHO-ORS was formulated along the line of the choleraeic stool

Table 2.8: Composition by weight of WHO Oral Rehydration Salt (ORS) [20,39]

(Quantities shown for the preparation of one litre of ORS solution)

Ingredient	grams
Sodium chloride	3.5
Trisoduim citrate dehydrate,	2.9
OR Sodium citrate dehydrate	2.5
Potassium chloride	1.5
Glucose anhydrous	20, or sugar (sucrose) 40gms

The dry ingredients are distributed in packets for reconstitution with water. More recently trisoduim citrate has replaced bicarbonate as the base to prolong the packet shelf life. When dissolved in the recommended amount of water it gives a solution which is effective for the treatment of dehydrated children .

Table 2.9: Molar concentration of components of ORS solution [20,39]

Component	Mmol/Litre of water
Sodium	90
Potassium	20
Chloride	80
Citrate	10 (or Bicarbonate –30)
Glucose	111(2%)

The salt-sugar solution (SSS): In developing countries, where the majority of the people are poor and live in rural areas, the value of ORS is limited. The mothers are not familiar with the litre measure and the use of WHO-ORS would mean dependence on commercially produced sachets with the attendant problem of scarcity, cost and delay in therapy. Therefore, a regime can be developed that is available to the mother in the home; she can then give guided help to the child. This led to the development of salt-sugar solution, the sucrose in it being broken down to glucose in the gut.

In the 1980s, health workers had taught mothers various methods of preparing this simple solution. One well known formula is " a one three-finger pinch of salt (exactly up to the first crease of index finger) or a quarter teaspoon of salt and two four -finger scoops of sugar or four cubes of sugar, dissolved in one beer bottle of water [10,40]. Due to the inherent errors, a group of Nigerian paediatricians and the UNICEF has produced a standard formula for home made salt-sugar solution, which can easily be prepared, and it consist of [10,40].

1 beer bottle or 2 soft drink bottles of water	-	600ml
1 level teaspoon (3ml) of salt	-	1.8 to 2.4g
10 level teaspoon or 5 cubes of sugar	-	25g

It is important that the teaspoon is leveled down to the edge. This solution contains 45 to 70mmol/L of sodium and 83 to 111mmol/L of glucose. One of the main objectives of the ORT programme in Nigeria is to ensure that every mother is taught how to prepare the salt-sugar solution correctly at home. She should taste it before giving it to her child. The correct solution should not be too salty, but should taste like coconut water. The mother should give the child slowly with a cup and teaspoon, and solutions must be discarded after one day.

Strategy for ORT: ORT simply means increased fluid intake plus continued feeding [3,41].

The implementation of ORT strategy in Nigeria involves the following components [20, 41]:

- Prevention of dehydration through promotion of use of locally appropriate home available or home-prepared solutions
- Treatment of dehydration due to diarrhoea by the use of oral rehydration salts provided throughout the health care infrastructure
- The promotion of continued feeding during and after diarrhoea.
- And selective use of intravenous fluids and antibiotics.

Prevention of dehydration

ORT campaigns are concentrating on teaching mothers to forestall dehydration by using household remedies at onset of diarrhoea, since effective early interventions can reduce complications and subsequently will result in fewer office or emergency room visits, hospitalizations and deaths. As soon as

the diarrhoea starts the child should be given extra fluids in the form of breast milk, ordinary water or other recommended home fluids such as light pap, fruit juice, salted rice water, salt-sugar solution, cereal-based solutions and traditional soups. The mother should make a standard salt-sugar solution and give the child slowly with a cup and a teaspoon.

Fluid requirement [23, 41]: Drink should be given every time a watery stool is passed. One-quarter to a half of a large cup for a child under the age of two years, and a half to one large cup for older children.

Table 2.10: Fluid requirements

Age	Amount of solution after each loose stool
Less than 2 years	50 to 100ml
1 to 9 years	100 to 200ml
10 years or more	As much as wanted

Treatment of dehydration

Oral rehydration salt solution can be used in the hospital or clinic for the treatment of most children with dehydration due to acute diarrhoea. Ideally an oral rehydration therapy unit should be established in every health institution. On admission, the degree of dehydration is assessed and the amount of ORS solution required for rehydration is determined (50 to 100ml/kg body weight).

Table 2.11 shows how much ORS (in milliliter) to give. This is a guideline only for rehydration within 4 to 6 hours [20, 41].

	Age / weight				
Degree of dehydration	2-4 months 3 to 5kg	5-9months 6to 8kg	10-12months 12 to 14kg	13-14months 12 to 14kg	Above 2 years Above 15kg
Mild	200	400	800	800	1000
Moderate	400	600	1000	1000	1200
Severe and conscious	600	800	1200	1400	1600
Severe and unconscious	IV therapy 70ml/ kg within hours, followed by ORS (maintenance)				

For maintenance ORS (to prevent dehydration recurring) give after each watery stool 100ml.

The mother is given a measured amount of the solution in the cup and she is asked to give it to the child slowly by spoon. The solution may be given by nasogastric tube, if the child is unable to take sufficient amount by mouth. Most children are rehydrated within four to six hours [41].

For patients in shock, give intravenous fluid immediately to replace fluid deficit. Use Ringer's lactate or, if not available, normal saline. For patients aged one year and older give 100ml/kg body weight of the fluid intravenously in three hours, as follows [23, 41]:

- 30ml/kg as rapidly as possible (within 30 minutes): then
- 70ml/kg in the next 2½ hours

For patients less than one year, give 100ml/ kg intravenously in six hours as follows:

- 30ml/kg in the first hour; then
- 70ml/kg in the next five hours

Monitor the patient very frequently. After the initial 30ml/kg have been given, if still in shock continue to give the intravenous fluid rapidly.

Reassess the patient after three hours (infants after six hours):

- If there are signs of severe dehydration, repeat the intravenous therapy given.
- If there are signs of some dehydration, continue as indicated with ORS.
- If there are no sign of dehydration, go on to the maintenance phase of rehydration.

Other fluids that can be used in place of Ringer's lacate include:

- Half-strength Darrow's solutions or Half strength saline diluted with 5% dextrose in water.
- One-fifth normal saline is used in cases of hypernatraemic/hypertonic dehydration.
- Potassium replacement can commence when the patient starts making adequate (0.5 to 1ml/kg) urine.

ORS can be started to supplement intravenous fluids as soon as the child starts taking fluids orally.

Maintenance phase: This begins following rehydration in the child with clinical signs of dehydration or begins immediately in the child without clinically apparent dehydration. An oral rehydration solution with a lower sodium concentration (40 to 60mEq/L) should be used during this phase. If a solution with a high sodium

concentration (75 to 90mEq/L) is used, it should be alternated with liquids that are low in solutes (i.e. breast milk, formula or water). Additional oral rehydration solution should be given to replace stool losses approximately 10ml/kg body weight or one-half to one cup of solution for each diarrhoeal stool[23, 41].

WHO-ORS has been studied extensively and it has been found to be safe and effective in children of all ages (including neonates) with diarrhoea of all aetiology, dehydration of all degrees of severity up to the point of shock and electrolyte disturbances, including both hyponatraemia and hypernatraemia [39, 41]. In controlled clinical trials, oral rehydration therapy was found to be more rapid than intravenous therapy in correcting dehydration and acidosis[42]. ORT was also safer with none of the complication associated with intravenous therapy[42].

Limitations of ORT

1. Patients with bloody diarrhoea may have a bacteria or parasite infection requiring treatment with an antimicrobial agent.
2. Patients in shock or near shock should be treated initially with intravenous solutions. Also, patients with intestinal ileus should not be given oral fluids until bowel sounds are audible.
3. Intractable vomiting: Greater than 90% of patients with vomiting can be successfully rehydrated or maintained with oral fluids when small volumes of ORS (5 to10ml) are administered every one to two minutes with a gradual increase in the amount consumed.
4. High stool output: Stool output greater than 10ml /kg/hour is associated with a lower rate of success of oral rehydration. However, no patient should be

denied ORT simply because of a high purging rate, since most patients will respond well when administered adequate replacement fluid.

5. Monosaccharide malabsorption: The presence of glucose or reducing substances in the stools, accompanied by a dramatic increase in stool output with the administration of ORS, is an indication of glucose malabsorption. The incidence is one to eight percent among some populations [39,43]. Malabsorption of lactose, sucrose and maltose can also occur because of deficiencies of their respective enzymes or starvation associated with the lack of enzyme induction.

Nonetheless, ORT is often the optimal method for the treatment of acute diarrhoea. Its ability to be administered at home promotes earlier treatment and prevention of dehydration, as well as active involvement of the parents in the medical care of their children. The use of ORS with early feeding is not only safer, but also more efficacious than intravenous therapy in the treatment of acute diarrhoea.

Cereal-based ORS formulations

A perceived weakness of the glucose-based ORS is its inability to reduce the duration of illness or volume of stool output and may slightly increase the stool volume [43]. The continued diarrhoea compromises the value of oral rehydration in the mind of the user, who expects treatment to decrease liquid stools and vomiting.

Several studies have shown that cereal-based solutions are equally effective in restoring volume losses, can substantially reduce losses of intestinal fluids (diarrhoea and vomiting), and may also shorten the duration of illness [44,45]. The table below shows the composition of an effective cereal based ORS, as well as that of glucose-based solution recommended by the WHO [45,46].

TABLE 2.12: Composition of Oral-Rehydration Solution (g/L)

Component	Glucose-based	Cereal-based
Glucose	20.0	0.0
Rice	0.0	50 to 80
Sodium Chloride	3.5	3.5
Trisodium citrate	2.9	2.9
Potassium Chloride	1.5	1.5

Sufficient rice powder should be added to make a thick but drinkable solution when cooked for two to three minutes. The addition of sodium bicarbonate and potassium chloride is not critical to the success of the cereal-based oral rehydration solutions.

The dominant component in the cereals is starch from rice, corn, wheat, potato, maize, sorghum, millet or plantain. Since the organic substrates are polymeric (starch and protein), a much larger quantity or substrate may be used than in the glucose-based solution, without increased osmolality. When these molecules are digested at the intestinal brush border, more glucose and amino acid monomers are presented for co-transport with sodium and water than can be provided by glucose-based solutions without a dangerous increase in osmolality.

A second advantage of the cereal-based solutions is that they can be prepared from ingredients that are readily available in virtually every home. However, the solutions require time and effort to prepare, and they can be contaminated if left unrefrigerated. A home-made cereal-based solution can be prepared by mixing one-half cup dry, precooked baby rice cereal with two cups of water and one-quarter level teaspoon of salt. This should produce an oral rehydration solution containing about 60g of rice per litre and 50mEq of sodium per

litre [45]. The resulting mixture should be thick, but pourable and drinkable, and it should not taste salty.

At present, no cereal-based solution is commercially available. Infalyte, a commercial oral rehydration solution, is prepared from refined rice syrup and contains only 30g of glucose and short glucose polymers per litre. In one controlled clinical trial, infalyte was found to reduce stool volume only during the first six hours of therapy [46].

Table 2.13. Composition by electrolytes of other fluids used as oral rehydration solutions[46].

Other Fluids	Na	K (mmol/L)
Infalyte	50	20
Pedialyte	(45) 30	20
Coca-cola	0.4	1.0 to 13
Pepsi cola	6.5	0.77
7-up	4.6	0.10
Apple Juice	1.7	26

Dietary management of acute diarrhoea

Although dehydration is the most serious direct effect of diarrhoea, adverse nutritional consequences also can occur when nutritional management is not appropriate. The long-term effects of repeated gastrointestinal tract infections include growth failure and malnutrition and possibly impaired cognitive development.

Reduced oral intake versus continued feeding: Two opposing approaches to the nutritional management of acute diarrhoea have been recommended [47]. One approach favours reducing oral intake during illness to avoid diarrhoea that occurs because of intestinal malabsorption, while the other approach favours continued feeding to avoid the nutritional consequences of fasting. The first approach, the tradition of “gut-rest”, still in wide practice, probably evolved from the observation that stool output was reduced in patients who fasted. However, no controlled clinical trial have demonstrated the efficacy of this approach. Rather, studies have shown that fasting in children not only has a negative impact on nutritional status but also actually prolongs the course of diarrhoea [45,47]. The fasting child loses approximately one percent of lean body mass per day. Fasting can reduce enterocyte renewal. The gut mucosa may suffer atrophy. Furthermore, the injured gut requires luminal foodstuff for rapid repair.

There has been no adverse effect of early or continuous feeding. Several studies have provided strong evidence for the recommendation that full-strength, lactose free formulae can be safely introduced immediately after rehydration therapy and that such therapy can improve nutritional outcome as well as reduce stool output and the duration of diarrhoea [39, 47].

Because diarrhoeal disease can cause transient lactase deficiency, the use of milk is of special concern. Continued breastfeeding should be encouraged, because human milk appears to diminish the duration and severity of diarrhoea. Non-human milk may be given in a dilute form initially [47]. Older children receiving semisolid or solid foods should continue to receive their usual diet during diarrhoea.

Recommended foods include starches (e.g. Irish potatoes, noodles, crackers and banana), cereals (e.g. rice, wheat and oat), and soup, yoghurt, vegetables and fresh fruits. Foods high in simple sugars (e.g. soft drinks, undiluted apple juice and pre-sweetened cereals) and fats should be avoided because of their tendency to exacerbate diarrhoea by osmotic effects and to delay gastric emptying respectively [47].

Antidiarrhoeal and antimicrobial agents

Since viral agents are the predominant cause of acute diarrhoea, antimicrobial agents play only a limited role in case management. Neither antibiotics nor non-specific antidiarrhoeal agents are usually indicated for acute diarrhoea. Antibiotics should be considered when dysentery or a high fever is present, when watery diarrhoea lasts for greater than five days, or when stool cultures, microscopy or epidemic setting indicate an agent for which specific treatment is required [48].

Antimotility agents and adsorbents generally are not recommended for use in young children. The use of opiates, kaolin and other antidiarrhoeal mixture, which either inhibit peristalsis or solidify the stool, gives false impression of recovery. The copious secretion of water by enterocytes and the production of diarrhoeal stool is a physiological response of the body in an attempt to eliminate the causative organism and toxins from the gut. The drugs inhibit this process and the course of the disease may be prolonged. Metoclopromide (plasil) and chlorpromazine are usually given as antiemetic. These drugs can produce abnormal extrapyramidal signs (abnormal movements of the limbs and oculogyric crises) in some children.

Promethazine causes drowsiness and prevents the child from taking enough fluids by mouth. Loperamide is only indicated in cases of chronic diarrhoea of all aetiology [48]. Unacceptable side effects such as opiate-induced ileus (abdominal distension), nausea and drowsiness can occur. In addition, reliance on antidiarrhoeal agents shifts the therapeutic focus away from appropriate fluid, electrolyte, and nutritional therapy. This can interfere with oral therapy and unnecessarily add to the economic of the illness [39,48].

Table 2.14 Antibacterial agents for specific bacterial and parasitic pathogens [48].

Agent	Therapy
Viruses	Supportive measures
Shigella	**Ampicillin, cotrimoxazole,**
Invasive E. coli	**chloramphenicol**
Toxigenic E. coli	As with Shigella
Salmonella	Supportive measures
	Supportive measures
	Severe- Ampicillin, cotrimoxazole,
Yersinia enterocolitica	Chloramphenicol,
	Supportive measures
Campylobacter jejuni	Severe-erythromycin
	Supportive measures
Cholera	Severe- erythromycin
Entamoeba histolytica	Tetracycline, erythromycin
Giardia lamblia	Metronidazole
Clostridium deficile	Metronidazole
Acute diarrhoea in	Metronidazole
immunocompromised	
host or child < 3 months	
Bacteremia or enteric	Ampicillin, Amoxil, Cotrimoxazole
fever	Ampicillin, chloramphenicol, cotrimoxazole

Interventions for Control of Diarrhoeal Diseases

As a result of the high impact of diarrhoea on health, several countries have initiated a programme on control of diarrhoeal diseases (NPCDD) to help coordinate management of diarrhoea at all levels throughout the country. Its goals

were to reduce the incidence of diarrhoea and prevent complications through oral rehydration therapy. The programme also emphasizes on the prevention of diarrhoea by using interventions that are cost-effective and easy to incorporate in the primary health care programmes. These interventions are implemented more or less simultaneously, with ORT being the cornerstone of the programme. The important measures include; improved nutrition through promotion of breastfeeding and proper weaning practices, adequate supply of safe drinking water, safe faeces disposal, good personal, domestic and environmental hygiene, immunization especially against measles, female education, improvement in socioeconomic status and provision of vitamin A. Efforts are being made to complement these preventive measures with the development of enteric vaccines that could confer long lasting prevention [20,48].

Child survival strategy

Similarly, oral rehydration therapy has been recognized and incorporated as a strategy for child survival and development revolution (CSDR) in any country with a high incidence of diarrhoeal disease. These are measures aimed at curtailing the high rate of infant morbidity and mortality in these countries. Other components of the child survival strategy include growth monitoring, breast-feeding, immunization, food supplementation, female education, family planning, improvement in socioeconomic status, prompt and adequate treatment of common diseases and ailments and health education.

At the world summit for children in 1990, over 150 countries under-took to attain 80% access to and usage of oral rehydration therapy by 1995 with a view to achieving a reduction of 50% in mortality attributable to diarrhoea by 2000 [5,49]. This was to be achieved through health education of the public and establishment of health care facilities especially for oral redydration salts. It is essential that health workers and caretakers are acquainted with the common causes of diarrhoea in children and the applicability of ORT. Every mother in Nigeria should know how to prepare and give the standard salt-sugar solution at home. She should also be able to recognize the simple signs of dehydration, and take the child to a health facility when home remedies fail.

Evaluation of the programmes

Efforts are continually being made by the WHO/UNICEF to evaluate the success rate of these programmes (NPCDD and CSDR) with a view to improving upon them. The reasons for these studies which are mostly based on ORT are [10]:

1. To measure the full impact of the National control of diarrhoeal disease programme.
2. Experience with ORT can provide useful guidance for child survival programmes.
3. To evaluate the ORT formula and assess the impact of the promotional effort on the people.

4. To assess the reproducibility of the recommended methods and determine the accuracy and variability of the compositions of solutions prepared by mothers.
5. In monitoring progress towards the goals established by the world summit for children.

In studies focusing on ORT use, three aspects of knowledge have been most often examined: knowledge of the use per se, knowledge of mixing and administration instructions for salt-sugar solution (SSS) or ORS packets, and knowledge of dehydration and the benefits of using ORT [49]. There are many factors besides knowledge that influence a mother's choice of treatment for diarrhoea in a child [49.] These include the relative availability and cost of various treatments, access to medical services of all kinds, the difficulty in making use of specific treatment and beliefs concerning their relative efficacy.

Population-based data show positive trends in the management of diarrhoea in most parts of the world. ORT is now given to the majority of children with diarrhoea resulting in a significant reduction in the mortality rate due to diarrhoea. More children continue to be fed when suffering from diarrhoea. Nonetheless, several workers have found that less than half of women who know about ORT actually use it when their children have diarrhoea [5,50]. Antidiarrhoeal drugs have continued to be used inappropriately in children.

The few reports in Nigeria show that the use of SSS is low, ranging between 11% and 18% [50]. In a survey carried out by Yakubu *et al* in a rural area near Zaria, they found that 82% of the mothers interviewed were aware of SSS, only 14% could

actually prepare the mixture correctly [50]. The common sources of error were too much water (61%), salt (10%), sugar (10%) and too little water (38%), salt (8%) and sugar (41%). Further findings include the use rate of SSS (23%), ORS (14%). Maternal education did not influence the use rates of ORT nor the preference for home treatment.

Their findings corroborated those of Ekanem *et al* who reported a low use rate of ORT, and a small proportion of women who could prepare the SSS correctly [51]. Just like Yakubu *et al*, Ekanem *et al* were not able to identify the determinants of the low ORT usage at home, nor the equally low prescription rate of ORT by health care providers.

Babaniyi *et al* in their study in Suleja, Nigeria found that 44% of mothers gave SSS to their children with diarrhoea at home[52]. Only half of the mothers prepared the solution correctly. Among the mothers who prepared SSS incorrectly, 72% added the incorrect amount of sugar and 63% added the incorrect amount of salt, water was added incorrectly by 35% of mothers. Too much salt/sugar resulted from using 5ml teaspoon instead of the recommended 3ml teaspoon. Too little water could have resulted from ignorance on the proper amount of water. The implications of these mistakes are that a substantial number of the prepared solutions were too concentrated in either sugar, salt, or both. Similar evaluations of home-made salt-sugar solution have indicated that the finding in Suleja is within normal for Nigeria[10,53]. Salt type, sugar and moisture content, spoon size and leveling technique were all possible causes of their error. A previous study indicated that

there are over 12 types of teaspoons in Nigerian homes and that they vary in volume from 1.8 to 5ml[10].

Other findings from Babaniyi's study included: The drug use rate at home was 53.5%. Mothers treated at home significantly more often when the diarrhoea was perceived as severe. Children with "severe" diarrhoea were given SSS at home, and were referred for treatment to a health facility or traditional healer, more often than those with non-severe diarrhoea. Most children received SSS six to nine times daily and were given one to nine teaspoons of it each time. Among all children with diarrhoea, 24% received correctly prepared SSS. Twelve percent received correctly prepared SSS in adequate quantity. This observed low success rate of SSS use may have contributed to the poor SSS acceptability, and of its limited role in home-management of diarrhoea in Nigeria. Twenty-two percent of children with diarrhoea were given increased amounts of fluid while 56% received the same amount of fluids and 22% received less fluid than they received before the onset of the illness. Mothers seem to have accepted the simple message that children need to drink more during episodes of diarrhoea.

Nwoye *et al*, in a study in Nsukka, near Enugu, evaluated the homemade solutions prepared by 40 illiterate mothers, after training them on how to reconstitute SSS [53]. They found that 60% of them made accurately composed solutions. All the rest made hypertonic solutions. Salt type, spoon size, the number of spoonfuls and leveling technique were all possible causes of their error. Nwoye *et al* were able to identify nine different makes of metal teaspoons of varying weights, sizes, and volumes commonly available in the local markets. The plastic

spoons were extremely variable, and were not used in the study. Mothers could probably confuse the 5ml teaspoon for the recommended 3ml teaspoon. Quite remarkably, not a single mother prepared a solution hypotonic or hyponatraemic. The tendency to err only on the side of greater rather than lower salt concentration may be culture based or simply due to maternal instinct.

In a survey carried out by the Federal Ministry of Health in 1989, it was estimated that each child had 4.3 episodes of diarrhoea a year [54]. Of those children who had diarrhoea in the previous two weeks (16.7% of children surveyed), 35% received SSS, 47% of caretakers interviewed did nothing for the treatment of diarrhoea, and 18% sought non-SSS treatment. Twenty-seven percent of the cases received an increased amount of fluid during the episode, while 64.5% got at least the same amount of fluid as before the diarrhoea started. The review found that progress had been made in implementing effective case management at health facilities, but that there was a high degree of inappropriate use of drugs.

In a household survey done in Plateau state, in 1992, to find out how mothers managed their children at home, the incidence of diarrhoea was 4.8 episodes per child per year [54]. Among the children who had diarrhoea in the preceding 24hours, nearly all children had been given fluids while they had diarrhoea – Kunu was the most common, followed by water, SSS and ORS. Salt sugar solution (SSS) was given to 11.4% of the children with diarrhoea in the preceding 24hours. Almost half of the mothers who said they had given their child SSS were able to prepare SSS correctly in front of the interviewer. The most common mistakes were the use of too little water or too much salt or both. The implication of these mistakes may be that

many mothers prepare SSS that is too concentrated in either sugar, or salt, or both. ORS use rate was 1.5%, mainly on the advise of a doctor, health worker or drug seller. Two-thirds of the caretakers who had used ORS solution in the previous 24hours were able to prepare it correctly. Four caretakers prepared it incorrectly; two mothers used 600ml of water for 1 litre ORS sachets. Another mistake was not using the whole packet of ORS and not making sure the powder was completely dissolved. The average amount of SSS that had been given to children in the previous 24hours was quite low, ranging from 50ml to 1200ml (average of 353ml in 24hours – a little more than 1½ tea cup). Only 21.9% of the children with diarrhoea were given more fluids than they received before the diarrhoea began; 50.2% got the same amount and 27.9% got less. Nearly all breast-fed children (98.1%) continued to be breast-fed, and nearly all children (72.3%) being fed semi-solid or solid foods continued to be given foods while they had diarrhoea. Drugs were given to 75.1% of the children who had diarrhoea.

In a study in Enugu, 97% of mothers were aware of oral rehydration therapy (ORT) and 80% had ever used salt sugar solution[55]. About 23% of the mothers could not describe the correct reconstitution of SSS and only 28.4% would give sufficient quantities of SSS to avert dehydration. Over a third of mothers practiced withdrawal of certain foods and fluid restriction during diarrhoea. Among the mothers who could not prepare SSS correctly, the common errors include low quantities of sugar (34.9%), smaller measures of water (14.8%) and abnormally high quantities of salt (50.3%). Awareness and use of ORT increased with age, social class and level of education. Women in the lower social classes tended to

give inadequate quantities of SSS (perceiving it as a drug) compared to their counterparts in the upper social classes. Educated mothers had a better understanding of the management of childhood diarrhoea than their less educated counterparts. Another revelation was that most of the mothers did not appreciate the role of SSS in replacement of fluid lost during diarrhoea. SSS was perceived as a drug and hence used sparingly. The implication of this practice are that firstly, mothers get easily discouraged from using SSS and secondly, a lot more children get severely dehydrated. It was believed by mothers that a lot of fluids in the diet further increased the volume of diarrhoea and minimal food intake was believed to help in reducing the burden of intestinal work, which in turn, reduced the frequency of bowel motions.

In a study done at Odukpani, near Calabar, Nigeria, Edet found that the fluid intake of under-five children with diarrhoea was low [56]. The SSS use rate was 35.4%. The average amount of SSS given within the previous 24hours was 368ml with a range between 40ml and 840ml. The ORS use rate was 49.2%. The average amount of ORS given to children within the previous 24hours was 274ml with a range between 59ml and 900ml. Less than half of the children continued breastfeeding.

Community studies in other developing countries reflect a similar pattern. Ahmed *et al* in their study in a Sudanese rural community found that ORS use rate was very low (2.1 to 4.3%) [57]. Although awareness about ORS was high (100%), only 25% prepared and used it correctly. Also, they did not know how to administer it. Forty-five percent of illiterate mothers stopped breastfeeding and other feeds

during diarrhoea compared to 30% of literate mothers. Educated mothers had a better home-management of diarrhoea than their illiterate counterparts.

Household surveys in 35 developing countries in 1990-92 showed a low ORS use rate ranging from 0.8% to 56%, while correct ORS preparation was less than 30% in 7 countries (range 5.9 to 30%)[57].

Barros *et al* in their study in North-East Brazil found that ORT was administered to 25.8% of the 57 children (ORS-11.1%, SSS-14.7%)[58]. Although 95% of the caretakers knew about rehydration solutions, only 18% prepared them correctly, the most common error being the use of insufficient water. Among ORS users, 44% used less than 800ml of water for a packet that should have been diluted in 1 litre of water. On average, the intake of ORS was 354ml in 24hours. Children who were given a rehydration solution whose sodium concentration was less than 120mmol/L ingested a significantly greater amount (average intake 301ml) than those who were offered solutions whose sodium concentration were too high (average 218ml).

In India, 42.7% of mothers knew about ORS packets and 25.9% had ever used them [59]. ORS use rates in children who suffered from diarrhoea during previous two weeks varied from 8.3% in Rajasthan to 50.1% in West Bengal. Exposure to electronic mass media had a significant impact on mothers' awareness of ORS packets.

In another survey, 69% of the mothers interviewed were aware of oral rehydration therapy, but only 66% among them had ever used it [60]. Sixty percent of doctors advised and prescribed ORS preparation not conforming to WHO

formulation, 44% of medical practitioners were not sure of the exact method of dilution and preparation of the commercially available preparations. The study recommended that ORS preparations not conforming to WHO formulation be withdrawn from the market. The study revealed that there is more to be done towards realizing the total success of oral rehydration therapy.

Overall, these studies have indicated that the programme (NPCDD and CSDR) since its establishment has shown both success and failure in its efforts to achieve its objective. More work still need to be done by all stakeholders and health care providers towards realising the total success of the programmes.

CHAPTER THREE

MATERIALS AND METHODS

Location of the study

Jos is the capital of Plateau State. It is situated in the middle belt of Nigeria, which occupies the geographical centre of the country. Jos is an urban town undergoing rapid expansion and industrialization with an influx of people from all over the country in search of jobs. The original inhabitants are Biroms and Jarawa, but with influx of more people into the state, Jos now consists of all tribes in the country [61]. The population of Jos according to the 1991 population census was 622,873[62].

The main occupation of the indigenous population is farming and mining of tin. However, with urbanization and influx of people into the state, it has witnessed an explosion of job opportunities, both professional, semi-skilled and unskilled. The town is mostly unplanned and slums are found in some parts especially Angwar Rogo, Nasarawa, Kabong and Tudun wada.

Jos town has the Jos university Teaching Hospital, the Plateau State Specialist Hospital, ECWA (Evangel) Hospital, Our Lady of Apostles (OLA) Hospital, and many private clinics and hospitals. It also has many functioning primary health care centres located close to the reach of the people that serve their health care needs.

The source of drinking water is mainly pipe borne water and well. The toilet systems are water system, pit-latrine and surface.

Study area

The study was carried out at the paediatric unit of the Plateau State Specialist Hospital, Jos. The hospital is a state -owned General Hospital and was established in 1918 as a hospital for European miners. It was later expanded to take care of senior government officials before being turned into a General Hospital. It is still undergoing modification, and has a bed capacity of 135 beds. It attends to patients in the low and middle socio-economic class. It also serves as a referral centre for many primary and secondary health institutions in and around Plateau State. In addition, it serves as a centre for training of resident doctors in family medicine of the National Postgraduate Medical College of Nigeria.

The paediatric unit has a diarrhoea treatment unit, a special care baby unit, an emergency paediatric unit, a lying-in ward and a paediatric out-patient clinic.

Approval for the study was obtained from both the faculty of General Medical Practice, National Postgraduate Medical College of Nigeria and the ethical committee of the hospital (appendices I and II).

Study period: **The study took place between June and November, 2003**

Sample size: This was calculated from the prevalence rate of use of oral Rehydration Therapy obtained from studies done within the Country[63]. The sample size was calculated from the formula[63]:

$$N = \frac{P\,(1-P)z^2}{E^2}$$

Where P= Best estimate of use rate of ORT from previous studies (ie 44%).

Z= Constant from z table at 95% confidence level (ie 1.96)

E= Range of sampling error tolerated (5%)

Thus $N = \frac{0.44 \times 0.56 \times (1.96)^2}{(0.05)^2} = 378$

The minimum sample size needed was 378. A sample size of 400 was chosen to compensate for possible missing data.

Study design

This is a descriptive prospective study, and involved all consecutive patients aged less than five years who presented with diarrhoea at the time of the study. Diarrhoea was defined as the passage of three or more loose or watery stools in 24 hours. Information was obtained from both the mothers of the children and by physical examination of the patients. The mothers were interviewed to know whether they were the suitable candidates for inclusion in the study.

All patients who satisfied the inclusion criteria were recruited consecutively over the period of study. This method was simple, cheap and avoided any bias. A

random selection of patients was not possible since the size of the population was not large enough, the patients were relatively few in number and their list was not available before the study.

Inclusion criteria: Mothers of children aged less than five years presenting with diarrhoea at Plateau State Specialist Hospital, Jos during the period of study.

Exclusion criteria: (i) Mothers with children who had visited or consulted another health care facility or health care professional on the index episode of diarrhoea and had ORS or salt sugar solution (SSS) prescribed for them.

(ii) Mothers with children who were coming for a second or more consultation on diarrhoeal disease at this hospital during the period of the study. Subjects were recruited and interviewed only once on their first visit.

(iii) Children accompanied or brought by their fathers, house-helps or temporary caretakers like grandmothers, neighbours, family friends or relations.

After due explanation of the purpose of the study, a written consent (appendix III) was obtained from the mother of the child to be included in the study. Each patient was seen and examined by the author at presentation. Most patients were seen either at the out-patient clinic or the emergency paediatric unit.

Collection of data.

Data for this study was collected using a standardized format containing the relevant information needed (appendix IV). The data included basic demography of the child and mother, duration and nature of the diarrhoea, associated symptoms, nutritional history during the illness and treatment history which included drugs and special fluids like ORT given to the child. Physical examination was

conducted on the children to assess the state of dehydration and the nutritional status.

Knowledge and use of ORT: In order to assess the mother's knowledge of ORT usage, each mother was asked to specify whether she used any form of ORT at home during the index episode of diarrhoea before coming to the hospital. If she had used any, she was asked to describe and demonstrate before the examiner how she prepared it. She was also asked whether the child accepted the fluid when she offered it, and if accepted, she was asked to estimate how much quantity of the fluid she gave the child in 24 hours. This was estimated by calculating how many teaspoonful (3ml, 5ml), tablespoonful (10ml), teacupful (200ml), soft drink bottle (25cl, 29cl, 35cl, 50cl) or beer bottle (60cl) of the fluid and the frequency of administration in a day. Each of the mothers, whether she had used ORT or not, was asked whether she knew how to prepare salt-sugar solution (SSS). If she answered yes, she was asked to describe and demonstrate it before the examiner. Several sizes of the metal teaspoons (3ml, 5ml), tablespoon, Fanta and Coca-cola bottles (25cl, 35cl, 50cl, 1litre), Pepsi and 7up bottles 30cl each and beer bottle (60cl) were made available. Also a bowl, salt and sugar (granulated and cubes), plain water and funnel were made available.

The original Fanta and Coca-cola bottles (29cl) which were in use at the inception of the ORT programme have been withdrawn from circulation, and in it's place, 25cl and 35cl bottles are being produced. As a result of this confusion, correct preparation of SSS was recorded if the mother mixed one level teaspoon

(3ml) salt plus 10 level teaspoon (30ml) of sugar (or five cubes) with any two of these soft drink bottles (25cl, 29cl 30cl, 35cl) or one beer bottle (60cl) of water. The range of the volume of water allowed was 500 to 700ml. Correct preparation of the ORS was recorded if the mother mixed the standard ORS with one liter of water. The mothers were further asked if they knew the work of the ORT in the child's body.

Figure 3.1

Some of the materials used in the study. At the foreground are the teaspoons (3ml and 5ml), and tablespoon (10ml).

Figure 3.2

The 3ml and 5ml metal teaspoons available in most Nigeria homes. The 3ml teaspoon is the recommended one for use in e reconstitution of salt sugar solution.

Physical examination was conducted on the child to determine the level of dehydration. This was assessed using the information contained on table 2.3. Nutritional status of the child was determined from the height and weight measurements.

The height was taken with a stadiometre positioned against a wall on a flat surface. The patient stood erect with the back against it, looking straight, with both feet brought close together and to the wall, without any cap, head tie, shoes or slippers. The height was measured to the nearest centimeter. For the infant who could not stand, the length was measured with a measuring stick positioned on a table, the child lay supine against it, looking straight, the legs brought close together and straightened.

Patients were weighed in kilogrammes using the infant weighing scale (RGZ-20) which had a capacity for 20kg. Patients were weighed wearing light clothing without shoes or slippers.

Nutritional status

Nutritional status was determined using the modified Wellcome classification[64]. This was based on the ratio of the weight of the patient to the expected weight for age expressed as percentages. The expected weight for age was determined from the formula [65]:

(1) $\frac{N + 9}{2}$, where N = age of the child in months

(2) 2n + 8, where n = age of the child in years.

The modified Wellcome classification is classified as wellnourished, under nutrition, Kwashiokor, Marasmus and Marasmic Kwashiokor depending on the ratio of the real weight to the expected weight for age (EWA) expressed as percentages, and the presence of oedema.

Table 3.1: The modified Wellcome classification[64].

Well-nourished	Under nourished	Kwashiokor	Marasmus	Marasmic Kwashiokor
> 80% EWA	60-80%	60-80%	<60%	<60%
No pedal oedema	No pedal oedema	Pedal oedema present	No pedal oedema	Pedal oedema present

Nutritional status was also assessed using the WHO weight for age Z score and weight for height Z score. Z-score of less than – 2SD was regarded as malnutrition, while Z-score less than -3SD was regarded as severe malnutrition.

Therapy

At the end of the interview, each mother was instructed on the role or value of ORT in the management of diarrhoea, the correct preparation of both SSS and ORS, and the proper way of administration of the fluid. Salt-sugar solution was encouraged to be used at home by the mothers at the onset of diarrhoea, because the materials are readily available in any home (including rural areas), at any time of the day or night, and it is not costly. In contrast, ORS could only be obtained at a cost from the chemist shop or health care facility mainly in urban areas. According to the National Programme on Control of Diarrhoeal Disease, ORS is designed to be used in the health care facilities for the treatment of some dehydration due to diarrhoea, and also for maintenance of hydration (after rehydration).

Statistical method: Data were analysed using the computer EPI-INFO version 6.0 statistical programme[65]. Chi-square (x^2) test was used to determine the significance of difference between the means.

CHAPTER FOUR
RESULTS

4.1 Characteristic of the subjects in the study

A total of 400 children with diarrhoea were seen, examined, and their mothers were interviewed.

Table 4.1: Age distribution of the mothers

Age (years)	Frequency (N=400)	Percentage
< 20	4	1.00
20-24	88	22.00
25-29	146	36.50
30-34	100	25.00
35-39	40	10.00
40-44	19	4.75
45-49	3	0.75

Mothers in the age range of 20 to 35 years constituted the majority of the respondents.

Table 4.2: The parity of the mothers

Parity	Frequency	Percentage
1	119	29.75
2	89	22.25
3	69	17.25
4	57	14.25
≥5	65	16.25

Mothers with one or two children constituted more than 50% of the respondents. The number decreased sharply with increasing parity.

Table 4.3: Educational status of the mothers.

Number of completed years of education	Frequency	Percentage
0	20	5.00
6	101	25.25
9	23	5.75
12	156	39.00
13+	101	25.00

Mothers with at least 12 years of education constituted about two-third of the subjects, while those without any formal education constituted only 5%. The median number of years of education was 12 years. There was a high literacy rate among the mothers.

4.2 Characteristics of the children with diarrhoeal disease

Table 4.4: Age distribution of the patients.

Age group (months)	*Male* (N=230)	Female (N=170)	Total	Percentage
<12	130	93	233	55.75
12-23	74	58	132	33.00
24-35	14	13	27	6.75
36-47	8	5	13	3.25
48-59	4	1	5	1.25

The children who were less than 2 years old constituted about 90% of the patients. The incidence of diarrhoea decreased sharply after this age. Males constituted 57.5% while females were 42.5%, giving a male to female ratio of 1.4:1. The mean ages of the males and females were both 12.5 months. There was no significant difference between the two sexes (Chi-square=0.7; P=0.3).

Table 4.5: Duration of the diarrhoea at presentation

Duration (days)	Frequency	Percentage
≤1	14	3.50
2	119	29.75
3	104	26.00
4	60	15.00
5-7	69	17.00
8-13	8	2.00
≥14	26	6.50

About 50% of the patients presented by the 3rd day of the illness. The number decreased after this day. The mean and median duration at presentation were 4 days and 3 days respectively. About 93% presented with acute diarrhoea (duration < 14 days), while 6.5% presented with persistent diarrhoea (duration ≥ 14 days).

A total of 375 (93.8%) of the patients presented with non-bloody diarrhoea, while 25 (6.2%) presented with bloody diarrhoea. There was no association between age and development of persistent diarrhoea (Chi-square=3.4; P=0.9). There was also no association between age and development of bloody diarrhoea (Chi-square=11.6; P=0.2).

A total of 84(21%) of the patients presented with diarrhoea alone, 76 (19%) had associated vomiting, 88 (22%) had associated fever, while 152 (38%) had both vomiting and fever.

4.3 Degree of dehydration

A total of 150 (37.5%) of the patients presented with some dehydration, 13 (3.3%) had severe dehydration and 237 (59.3%) had no dehydration.

Table 4.6: Degree of dehydration in relation to age

Age group (months)	None (%) N=237	Some (%) N=150	Severe (%) N=13	Total
<12	128 (57.0)	86 (39.0)	9 (4.0)	228
12-23	81 (61.4)	48 (36.4)	3 (2.3)	132
24-35	16 (59.3)	11 (40.7)	0 (0)	27
36-47	8 (61.5)	4 (30.8)	1 (7.7)	13
48-59	4 (80.0)	1 (20.0)	0 (0)	5

Just like the incidence of diarrhoea, most of the cases of some and severe dehydration were seen in the age group 6 to 23 months. The mean ages of the patients with none, some and severe dehydration were 12 months, 12 months and

11 months respectively. There was no association between age and development of dehydration (Chi-square=17.8; P=0.4).

Table 4.7: Degree of dehydration in relation to duration of the diarrhoea.

Duration (days)	None (%) N=237	Some (%) N=150	Severe (%) N=13	Total
<7	191 (58.4)	126 (38.5)	10 (3.1)	327
7-13	30 (63.8)	15 (31.9)	2 (4.3)	47
≥ 14	16 (61.5)	9 (34.6)	1 (3.8)	26

The mean duration at presentation for the patients with none, some, and severe dehydration were 3 days, 3 days and 4 days respectively. There was no significant relationship between duration of the diarrhoea and development of dehydration (Chi-square=0.12; P=0.9).

4.4 Level of malnutrition

Malnutrition (underweight) was found in 70 (17.5%) patients. Wasting (WHO-WHZ) was found in 16 (4%) patients. Other findings were Kwashiokor (2%), Marasmus (0.8%) and Marasmic Kwashiokor (0.25%).

Table 4.8: Level of malnutrition in relation to age

Age group (months)	Malnourished (%) N=70	Well-nourished (%) N=330	Total
<12	35 (15.7)	188 (84.3)	223
12-23	24 (18.0)	108 (82)	132
24-35	8 (29.6)	19 (70.4)	27

36-47	2 (15.4)	11 (84.6)	13
48-59	1(20.0)	4 (80.0)	5

Most of the malnourished patients (84%) were below two years of age. Their mean age was 12 months. There was no significant association between age and malnutrition (Chi-square=12.4; P=0.2)

Table 4.9: Malnutrition in relation to duration of the diarrhoea.

Duration (days)	Malnourished (%) N=70	Well-nourished (%) N=330	Total (400)
<7	57 (17.4)	270 (82.6)	327
7-13	8(17.0)	39 (8.3)	47
≥ 14	5(19.2)	21(80.8)	26

The median duration at presentation of the malnourished patients was 4 days. There was no significant association between the duration of the diarrhoea and development of malnutrition (Chi-square=0.08; P=0.9).

Table 4.10: Malnutrition in relation to the degree of dehydration

Dehydration	Malnourished (%) N=70	Well-nourished (%) N=330	Total N=400
None	38 (16)	199 (84)	237
Some	29 (29)	121 (71)	150
Severe	3 (23)	10 (77)	13

There was no significant association between malnutrition and development of dehydration (Chi-square=10; P=0.8).

Feeding during diarrhoea: All the mothers (400) continued giving the child's normal feeds during the period of the diarrhoea.

4.5 Usage of oral rehydration therapy

A total of 156 (39%) mothers gave oral rehydration therapy (ORT) to their children that had diarrhoea, before coming to the hospital. Of these, 136 (34%) gave oral rehydration salt (ORS) solution, while 20 (5%) gave salt sugar solution (SSS). Mothers used ORS more often than salt sugar solution (Chi-square=5.9; P = 0.01).

Table 4.11: Usage of ORT in relation to age of the child.

Age group	Used ORT (ORS + SSS) N=156 (%)	Non-use (%) N=244	Total
<12	87 (39.0)	136 (61.0)	223
12-23	52 (39.4)	80 (60.6)	132
24-35	13 (48.0)	14 (30.8)	27
36-47	3 (30.8)	10 (69.2)	13
48-59	1 (20.0)	4 (80.0)	5

The mean ages of those that were given ORT and those not given were both 12 months. There was no significant relationship between use of ORT and age of the child (Chi-square=1.7; P=0.4).

Table 4.12: Usage of ORT in relation to degree of dehydration

Dehydration	Used ORT (ORS, SSS) N=150	Percent	Non-use N=244	Percent	Total 400
None	81	34.2	15.6	65.8	237
Some	65	43.3	85	56.7	150
Severe	10	76.9	3	23.1	13

There was a significant association between the use of ORT and dehydration (Chi-square=24.8; P< 0.01). Oral rehydration therapy was given more

frequently to those with some and severe dehydration than those with no dehydration.

Table 4.13: Usage of ORT in relation to mothers' educational status

Education (years)	Used ORT	Percent	Non-use	Percent	Total
0	5	25.0	15	75.0	20
6	42	41.6	59	58.4	101
9	4	18.2	18	81.8	22
12	58	37.2	98	62.8	156
13+	47	46.5	54	53.5	101

The median years of education of those that used ORT and those that did not use were both 12 years. There was no significant association between use of ORT and mothers' educational status (Chi-square=15.8; P=0.1).

Mothers used ORS (34%) significantly more than SSS (5%) (Chi-square=5.9; P=0.01). The reasons they gave for preferring ORS to SSS were:

Table 4.14: Reasons for preferring ORS to SSS.

	Frequency
Don't know how to prepare SSS	84
ORS is quicker / easier to prepare	22
More effective / better than SSS	16
More hygienic than SSS	7
ORS is the same as SSS	4
Don't have salt and sugar at home	3
	136

Most of the mothers used ORS because they don't know how to prepare SSS.

4.6 Preparation of ORS / SSS and sources of error

Of the 156 mothers who used either ORS or SSS, only 28 (18%) prepared it correctly, while 128 (82%) did not.

Of the 20 mothers who used SSS, only 10 (50%) prepared it correctly, and 10 did not. Sources of error were the addition of too much salt/sugar (50%) and too little water (50%). The source of the too much salt/sugar was in using full 3ml teaspoon (1), 5ml teaspoon (2), more than 1 teaspoon (1) and tablespoon (1). The source of the too little water was in using less than 2 mineral bottles (25 or 35cl).

Among the 136 mothers who used ORS, only 18 (12.5%) prepared it correctly, while 118 (87.5%) did not. Their source of error was in using too little water (100%). They had used 1 mineral bottle (25 or 35cl) (45), 2 mineral bottles (24), 1 beer bottle (27) and small swan bottle (75cl) (8) to mix one ORS (1litre)

sachet. Other sources of error was in using ½ ORS to mix 1 mineral bottle, 2 mineral bottles, 1 beer bottle or ¾ small swan bottle. No mother used too much water.

Table 4.15: Correct preparation of ORT in relation to mothers' educational status.

Education (years)	Correctly prepared (N=28)	Incorrectly prepared (N=128)	Total (156)
0	2	3	5
6	3	36	39
9	0	4	4
12	10	46	56
13+	13	39	52

The median years of education of the mothers who prepared ORT correctly and those that did not were both 12 years. There was no significant relationship between the ability to prepare ORS/SSS correctly and mothers' educational status (Chi-square=10.7; P=0.1).

4.7 Acceptance rate of ORT

Of all the ORT (156) prepared and given, 73% (114) were accepted by the children, while 27% (42) were not accepted.

Among the correctly prepared ORT, 100% (10) of the SSS were accepted, while 66.7% (12) of the ORS were accepted by the children, giving an average rate of 78%.

Among the incorrectly prepared ORT, 72% were accepted while 28% were not. There was no significant difference in acceptance between the correctly prepared and incorrectly prepared ORT (Chi-square=0.2; P = 0.8).

Table 4.16: Acceptance rate of ORT in relation to age

Age (months)	Accepted *N=114*	Not accepted N=42	Total 156
<12	70	20	90
12-23	33	17	50
24-35	5	5	10
36-47	5	1	6

The mean ages of those that accepted ORT and those that did not were both 12 months. There was no significant relationship between acceptance of ORT and the child's age (Chi-square=0.1; P=0.7). There was also no relationship between acceptance of ORT and the degree of dehydration (Chi-square=2.6; P=0.2).

Table 4.17: Acceptance rate of ORT in relation to the degree of dehydration.

Dehydration	Accepted (%) N=114	Not accepted (%) N=42	Total 156
None	63 (77.8)	18 (22.2)	81
Some	46 (70.8)	19 (29.2)	65
Severe	5(50.0)	5 (50.0)	10

4.8 Administrative skill of the mothers who used ORT

Table 4.18: Amount of fluid administered in 24 hours

Quantity in ml	Correctly prepared *N=28*	Incorrectly prepared N=97	Total 125
< 100	6	21	27
100-150	12	38	50
251-500	1	15	16
501-1000	7	21	28
> 1000	2	2	4

The range of the volume of fluid administered was 20ml to 4.5litres. The average volume was 324ml. Among the correctly prepared ORT, the range of the volume of fluid was 45ml to 4.5 litres. The average amount was 600ml. Among the incorrectly prepared ORT, the range was 20ml to 2 litres. The average amount given in 24 hours was 300ml. The children received the correctly prepared ORT more than the incorrectly prepared one (Chi-square=8.6; P<0.01).

Table 4.19: Mean volume of ORT in relation to mothers' education.

Education (years)	*Frequency*	Mean volume of fluid (ml)
0	4	105
6	33	450
9	4	267
12	46	229
13+	38	359

There was no significant association between the mean volume of ORT given in 24 hours and mothers' educational status (Chi-square=7.6; P = 0.1)

Table 4.20: Mean volume of ORT in relation to age of the child

Age group	Frequency	Mean volume (ml)
<12	76	262
11-23	38	350
24-35	8	320
36-37	3	470

There was no significant association between the age of the child and mean volume of ORT given in 24hours (Chi-square=4.6; P=0.2).

Table 4.21: Mean volume of ORT in relation to degree of dehydration

Dehydration	Frequency	Mean volume (ml)
None	67	271
Some	50	298
Severe	8	927

There was no significant relationship between the degree of dehydration and the mean volume of ORT (Chi-square=4.5; P=0.1).

Table 4.22: Frequency of administration of ORT

Frequency in 24 hours	Number	Percentage
2-4 times	18	11.5
5-6 times	7	4.5
On demand	94	60.3
After vomiting or diarrhoea	13	8.3
Don't know	24	15.4

Most of the women (60.3%) gave the ORT on demand, while only 13 (8.3%) gave after vomiting or diarrhoea.

Table 4.23: Quantity of ORT given at a time

Quantity	Frequency	Percentage
1-3 teaspoons	12	7.6
4-6 teaspoons	8	5.2
2-5 tablespoons	8	5.2
Small sips from a cup	27	17.3
As much as child could take	27	17.3
Don't know	74	47.4

Most of the women did not know how much of the ORT to give at any given time.

4.9 Knowledge of Salt-Sugar Solution

Among all the mothers, six (1.5%) had not heard of salt sugar solution (SSS) 219(54.7%) had heard but did not know how to prepare it, and 175(43.7%) claimed they knew how to prepare it.

Table 4.24: Correct preparation of SSS in relation to mothers' education (in years)

Measure used	0	6	9	12	13+	Total
2 Mineral bottles (25cl)	1	10	3	16	7	37
2 Mineral bottles (30cl)	-	-	-	1	1	2
2 Mineral bottles (35cl)	-	2	-	2	3	7
1 beer bottle (60cl)	28	-	1	2	11	42
						81

Of the 175 women who claimed they knew how to prepare SSS, 81 (46%) were able to describe and demonstrate the reconstitution of salt-sugar solution (SSS) correctly, while 94(54%) prepared it wrongly. There was no association between the ability to prepare SSS correctly and mothers' educational status (Chi-square=7.6; P=0.1).

Table 4.25: Shows the sources of error in relation to the mothers' educational status.

(A)Too much salt	0	1-6	7-9	10-12	13 +	Total	%
1full teaspoon (3ml)	-	-	-	3	1	4	4.2
1 level teaspoon (5ml)	-	3	1	7	12	23	24.5
> 1 teaspoon (3 or 5ml)	1	12	2	13	9	37	39.4
1-2 table spoon	-	1	-	4	3	8	8.5
						72	76
(B) Too little water I mineral bottle (25cl or 35cl)	1	4	-	4	2	11	11.8
(C) Too little sugar	1	2	-	5	1	9	9.6
(D) Too much sugar	-	4	1	11	14	30	32

The sources of error were too much salt (76%), too much sugar (32%), too little water (11.8%) and too little sugar (9.6%). Most women prepared concentrated (hypertonic) solutions.

Table 4.26: Knowledge of the work of ORT

	Frequency	Percentage
Replaces lost fluid/salt	112	28
Gives strength	112	28
Cures diarrhoea	60	15
Don't know	116	29

Only 28% knew that ORT replaces lost fluid and salt. There was no association between the knowledge of the work of ORT and mothers' educational status (Chi-square=8.1; P=0.08).

CHAPTER FIVE

DISCUSSION

In this study mothers with at least 12 years of education constituted about 64% of the respondents while those without any formal education constituted only 5%. There was a high literacy rate among the mothers. The implication is that it reflects the general trend in the whole Jos Town or that only the literate group sought orthodox medical care for their children that had diarrhoea. This is in keeping with the observation of Barros *et al* in their study which found that children under one year of age and those whose mothers were more literate were frequently taken for health care for their diarrhoea [58]. However, in a study at Ilorin, it was found that children of mothers with secondary education had a significantly higher risk of diarrhoea when compared with children of illiterates[66]. This may be related to the fact that bottle feeding and infant formula feeding were significantly more common in children of mothers with secondary education than children of mothers with no education.

Mothers who were less than 20 years old constituted only 1% of the respondents, while those in the age group 20 to 29 years constituted about 59%. Most of the mothers had to wait until they were 20 years old and above before having their first issue. This may be related to the fact that most of them had 12 or more years of education.

The highest number of children with diarrhoeal disease was seen in the age group 6 to 12 months accounting for 41% of all cases. Together with those in the age group of 12 to 18 months they made up about two third of all the patients. This is in keeping with the findings from previous studies, where the highest prevalence of diarrhoea was found in the second six months of life[18,20]. Snyder and Merson showed that the highest incidence of diarrhoeal disease was during the second half of infancy. Similarly, Black found that the prevalence of diarrhoea was highest during the second six months of life and declined with increasing age thereafter[18,20]. This high incidence of diarrhoea after weaning is initiated, is related to the decline in breast-feeding, poor weaning foods, and the popularity of bottle-feeding among mothers.

About 7% of the patients presented with persistent diarrhoea. Sixty five percent (65%) of these were below the age of 18 months. The peak age of persistent diarrhoea in this study was nine months. This is consistent with the findings from other developing countries, where the proportion of episodes lasting longer than 14days ranged from 3% to 23%, with a median value of about 10% [67]. In Nairobi, Kenya, 5.4% children presented with diarrhoea of more than 14 days duration[67]. About 63% of these were less than 12 months old. The peak age for persistent diarrhoea was nine months with no sex difference.

Malnutrition was found in 17.5% of the patients that presented with diarrhoea in this study. Seventy five percent of the cases of malnutrition were found in those aged 6months to 2 years. This is similar to the result from other studies [41]. In Nairobi, 18.5% of the children with diarrhoea had malnutrition[67]. Most of these were less than 2 years old. In this study, malnutrition was not significantly associated with persistent diarrhoea compared with the observations from other studies which found malnutrition as a risk factor for persistent diarrhoea and vice versa [67-69]. Manunebo *et al* in a study in rural

Zaire demonstrated a higher incidence of diarrhoea among malnourished children[68]. Mahalanabis *et al* in their study in Bangladesh showed that protein-energy malnutrition was a risk factor for increased duration of acute diarrhoea and persistent diarrhoea[69]. The duration and severity of diarrhoeal illness were greatest among infants and young children with malnutrition and impaired immune status.

About 60% of the patients presented with no dehydration, 37% had some dehydration, while 3.3% had severe dehydration with signs of shock requiring an initial intravenous fluid therapy. In the study at Enugu, severe dehydration was found in 5.2%, while in Nairobi, Kenya, severe dehydration was present in 12.5% [20,67]. In Gondar, Ethiopia, 38.1% of the children presented with no dehydration, 61.3% had some dehydration, while 0.6% had severe dehydration[41]. The majority of the children in this study presented with no dehydration. This suggests that (1) the disease was not severe, (2) the mothers being literate tended to seek early treatment for their children with diarrhoea and (3) most of the mothers had continued breast feeding and other feeds, and had given their children increased fluids during the diarrhoea. Data reported from health facilities in 14 countries have shown a median decrease in admission rate and a three-fold reduction in the percentage of diarrhoea cases receiving intravenous fluids when ORT was introduced [1,4].

In this study, there was no association between the duration of diarrhoea, malnutrition and development of dehydration. In Gondar, Ethiopia, malnourished children had a 4 fold higher risk of developing dehydration than well-nourished children [41]. Children who were malnourished had more episodes of dehydration particularly moderate and severe forms. The presence of antecedent malnutrition was a predictor of moderate to severe dehydration in acute diarrhoeal disease in Ethiopia [41,70]. Also, in this study, one hundred percent (100%) of the mothers continued breast feeding and other feeds during the period of diarrhoea. Similarly, in a previous study in Plateau State and Suleja, nearly all the mothers continued breast-feeding and other feeds during the diarrhoea [52,54]. However, in a Sudanese rural community, 45% of illiterate mothers stopped breast feeding and other feeds during diarrhoea compared to 30% of literate mothers [57]. Educated mothers had a better attitude and understanding of the management of diarrhoeal disease at home.

The use rate of oral rehydration therapy in this study was 39%, those who used ORS was 34%, and SSS was 5%. The majority of the mothers used ORS instead of the traditional SSS. This is in contrast to the result obtained from rural communities where the majority of the mothers used SSS. In Suleja, Nigeria, the use rate of SSS was 43.5% [52]. In a rural community near Zaria, the use rate of ORT was 37%, SSS was 23%, while ORS was 14%[50]. In a household survey in Plateau State, the use rate of SSS was 11.4%, while ORS was 1.5% [54]. The reasons given by the mothers for preferring ORS to SSS in this study were (i) they were not sure how to prepare SSS (ii) ORS was quicker to get and prepare (iii) ORS was more hygienic and effective than SSS. However, the underlying reason could be that since these mothers were mostly literate and resided in the city, they could easily afford to procure ORS from the so many chemist shops located close to their reach, unlike in rural areas where the mothers are mostly illiterate and poor and the ORS are not easily accessible. Although the present study was selective in that it focused on those who made use of the health care facility for their children that had

diarrhoea. There were probably more mothers who did not come to the hospital, and did not do anything for the diarrhoea or treated with native medications. In a study in Suleja, 52% of the mothers had used health facilities, while 32% did nothing for their diarrhoea [52]. In Plateau State, 47% of the caretakers did nothing for the treatment of diarrhoea, and 18% sought non-SSS treatment [54].

Among mothers (20) who used SSS, 10 (50%) prepared it correctly, 5 (25%) added too much salt/sugar, while 5 (25%) added too little water. This is similar to the findings obtained from Plateau State and Suleja where about half and 45.3% respectively of the mothers who had used SSS at home prepared it wrongly [52,54]. Their main source of error was the addition of too much salt or too little water. This resulted from the use of 5ml teaspoon and tablespoon instead of the recommended 3ml teaspoon. There was a confusion among the mothers on the exact size of spoon to use as there are several sizes of teaspoons available in the market. Among the mothers who used ORS, only 18 (14%) prepared it correctly, the rest added too little water. Most of them mistook the standard ORS as being the same as SSS in preparation and had used between 250mls and 750mls of water for its preparation. In a Sudanese rural community, only 25% prepared and used ORS correctly [57]. In North-east Brazil, among ORS users, 44% used less than 800ml for a sachet that should have been diluted in one litre of water [58]. Clearly, confusion had arisen among the public because the initial ORS of 600ml had been withdrawn, and in its place the standard ORS requiring one litre of water for its preparation has been introduced to the market.

The average volume of the correctly prepared ORT and incorrectly prepared ORT given in 24hours were 600ml and 300ml respectively. The average volume of all the prepared ORT administered to the children in 24 hours was 324ml. The volume given was inadequate compared to the WHO recommendation of ORS 110ml/kg body weight/day [41]. This is generally true for most developing countries. The volume of ORT given is too little to have any effect on the dehydration caused by diarrhoea. The children in this study received more of the correctly prepared ORT than the incorrectly prepared ORT. This is also true in most studies[52,58]. In Odukpani, southeastern Nigeria, the average amount of fluid given to children was 368ml for SSS and 274ml for ORS [56]. In a previous study in Plateau State, the average amount of SSS fluid given in 24hours was quite low, ranging from 50ml to 1200ml (the average intake of SSS was 353ml in 24hours) [54]. In Northeast Brazil, on average the intake of ORS was 354ml over 24hours [58]. Children who were given a hydration solution whose sodium concentration was less than 120mmol/L ingested a significantly greater amount (average intake 301ml) than those who were offered solutions whose sodium concentration were too high (average 218ml). Children who were offered over concentrated solutions drank significantly less volume than children who were given mixtures with the correct sodium content. This diminishes the risk of hypernatraemia among children taking rehydrating solutions with too high sodium content, and could be one explanation as to why there have been few report of an increased incidence of hypernatraemia in countries where ORT programmes have been established, despite the documented evidence of problems in making up the solution [58].

In this study, most of the mothers did not know when to give or how much of the fluid to give at any given time. Only few gave the fluid after vomiting or diarrhoea. The

implications were that (i) too little of the fluid are bound to be given, and this will not have any effect on the dehydration caused by the diarrhoea (ii) Too much of the fluid can be given to the child who accepted, and since most of the solution prepared are hypertonic, there is real danger of both circulatory overload and electrolyte imbalance. One of the mothers gave a child 4.5litres of correctly prepared solution in 24hours. Two mothers gave 1.5litre and 2litres respectively of a hypertonic solution to their children in 24hours. These findings are similar to those obtained from other developing countries [52,58]. In Suleja, 43.5% women gave SSS at home, 18.5% gave correctly prepared SSS, while 11.7% gave the correctly prepared SSS in adequate quantity. Most children (48%) received SSS 6 to 9 times in 24hours and were given 1 to 9 teaspoons of it each time.

Among the 175 mothers who claimed they knew how to prepare salt-sugar solution, only 81 (46%) could actually prepare it, while 94 (54%) could not. Sources of error were the addition of too much salt (76%), too much sugar (32%), too little sugar (9%) and too little water (11%). These findings are similar to those obtained from other studies. In Northeast Brazil, 95% of the caretakers knew about rehydrating solutions, only 18% prepared them correctly, the most common error being the use of insufficient water [58]. In Suleja, Nigeria, among the mothers who prepared SSS incorrectly, 73% added the incorrect amount of sugar, 63% added the incorrect amount of salt, water was added incorrectly by 35% of the mothers [52]. As in all studies in the developing countries there is a tendency by mothers to prepare a hypertonic solution, and not a hypotonic one [53].

The main source of error in the reconstitution of salt sugar solution by the mothers in this study was the addition of too much salt/sugar. The mothers used 5ml teaspoon (24.5%) and tablespoon (8.5%) instead of the recommended 3ml teaspoon in preparing the mixture. Others added more than one teaspoon (3ml, 5ml) of salt. There was a confusion among the mothers on the exact type of spoon to use as there are several sizes or types of teaspoon (both metal and plastic) available in the market [53].

In this study, only 28% of the mothers knew that ORT replaces lost fluid and salt. The majority did not know the actual work of the ORT in the child's body. This could explain why the mothers gave very small amount of the ORT to their children who had diarrhoea. They were cautious not to give too much (or overdose) of the fluid, believing it to be a drug, and so an overdose could be dangerous. Many others gave I to 6 teaspoons of the fluid 3 to 4 times daily as they would other medications.

5.2 CONCLUSIONS

1. There is lack of sufficient knowledge among the mothers on the correct preparation and administration of ORT (ORS and SSS) in the home-management of diarrhoeal disease. The mothers had confused the standard ORS with SSS as being the same, and had used the same volume of water in its preparation. The implication could be that health care providers are not doing enough in transmitting this message of ORT to the mothers. Most of the messages they receive on ORT are deficient. They are silent on a number of issues such as the exact size of the soft drink bottle, teaspoon, the quantity of fluid the

mother can administer at any given time and what she can use in the home to measure this amount of fluid. The initial Coca-cola and Fanta bottles (29cl) that were in use at the inception of the ORT programme has been withdrawn and in its place we now have so many sizes (25cl, 35cl, 50cl and 1litre). The mothers are confused on which of these sizes of bottle to be used.

2. There is also confusion among both caregivers and caretakers on the appropriate volume of water to use in preparing the standard ORS. The initial ORS (600ml) which was in use at the inception of the programme has been withdrawn and in its place the standard WHO-ORS requiring 1 litre of water for its preparation is being produced and marketed. However, many people are not fully aware of this, and so continue to use the same amount of water for SSS in preparing the WHO-ORS.

5.3 RECOMMENDATIONS

1. There is a need for the government to re-define the National strategy on control of diarrhoeal disease, and make it clearer to all. (i) Such a message should be specific on the correct size of teaspoon (3ml or 5ml), the exact size of soft drink bottle (25cl, 30cl or 35cl) to be used in the preparation of ORT at home. The message should also be clear-cut on the amount of fluid the mother could administer at any given time, the frequency of administration and the volume in 24 hours, using a measure that is available in the home. (ii) Since mothers in the urban areas find it more convenient to use ORS rather than SSS at home, every mother should be taught on how to reconstitute and administer the standard WHO-ORS at home.

(iii) Every health worker or caretaker should know the type of ORT (ORS or SSS) to use at any point in time whether at home or in the clinics when there is none, some or severe dehydration

2. Health care providers and family physicians should learn to use more of ORT (ORS) in the treatment of some and severe dehydration in the health care facilities instead of the current practice of widespread use of intravenous fluid for every case of dehydration from diarrhoea. By so doing, the mothers will be taught the appropriate way to reconstitute and use the fluid, and when they see the effectiveness of ORT in correcting dehydration, they will be encouraged to try it at home when next their children had diarrhoea.

3. Every family physician and care provider should use every contact with the mothers to help and teach them the correct use of oral rehydration therapy in the home-management of diarrhoeal disease. These teachings should always be accompanied with practical demonstrations showing the recommended teaspoon (3ml) to be used in the reconstitution of salt-sugar solution.

There is more to be done by the governments and health care providers in helping to rectify the pitfalls in the use of WHO-ORS and salt sugar solution at home so that ORT will become more useful in the fight against the dreaded consequences of diarrhoeal disease which is still a leading cause of morbidity and mortality in children in developing countries.

Further research is needed:

(1) To identify the determinants to a correct use of ORT at home and in the clinics.

(2) To confirm the value of cereal-based ORS in the management of diarrhoea. Cereal-based ORS, in view of its potentials of not only correcting dehydration, reducing the volume of the diarrhoea, and providing nutrition to the patient, could be the all-important ‘medicine’ or breakthrough needed for the effective management of diarrhoeal diseases.

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