MODULE 1

EPIDEMIOLOGICAL OVERVIEW AND CLINICAL CONCEPTS

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MODULE 1

EPIDEMIOLOGICAL OVERVIEW AND CLINICAL CONCEPTS

This module was developed with the technical and financial participation of the Diarrhoeal Diseases Control Programme of the World Health Organisation (WHO), Regional Bureau for Africa, Brazzaville.

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PRE-REQUISITES

The student must have basic knowledge of the following:

- Methodology of health surveys
- Basic anatomy and the physiology of the digestive tract
- Basic bacteriology and parasitology

LEARNING OBJECTIVES

This module gives an overview of the importance of diarrhoea in the world and in certain countries of the Sahel region. It also provides the scientific information that every intermediate health worker working with diarrhoeal diseases should possess.

The following diagram lays out the learning objectives. **These objectives are based on the tasks that the student will carry out after his studies.** The information provided and practical exercises are designed to facilitate learning.

Describe the importance of diarrhoeal diseases in the world and in his/her country. **1.1** Duration 30 mins.	->	**By means of a health survey, determine the importance of diarrhoeal diseases in a community** **1.2** Duration 4 hrs.	->	**Give a definition of diarrhoea according to its context** **1.3** Duration 30 mins.
Describe the different aetiologies of diarrhoea **1.4** Duration 45 mins.	->	**Summarize the mechanisms at work during diarrhoea from different causes** **1.5** Duration 1 hr.	->	**Distinguish the different clinical signs in the evolution of a diarrhoea episode, and evaluate their effects on the general state of the patient** **1.6** Duration 45 mins.
Explain the interaction between diarrhea and malnutrition **1.7** Duration 30 mins.				

EPIDEMIOLOGICAL OVERVIEW

IMPORTANCE OF THE DIARRHOEAL DISEASES PROBLEM

LEARNING OBJECTIVE: 1.1

Describe the importance of diarrhoeal diseases in the world and in the student's country.

Exercise 1-A
Ask students what they already know about the subject of this objective.

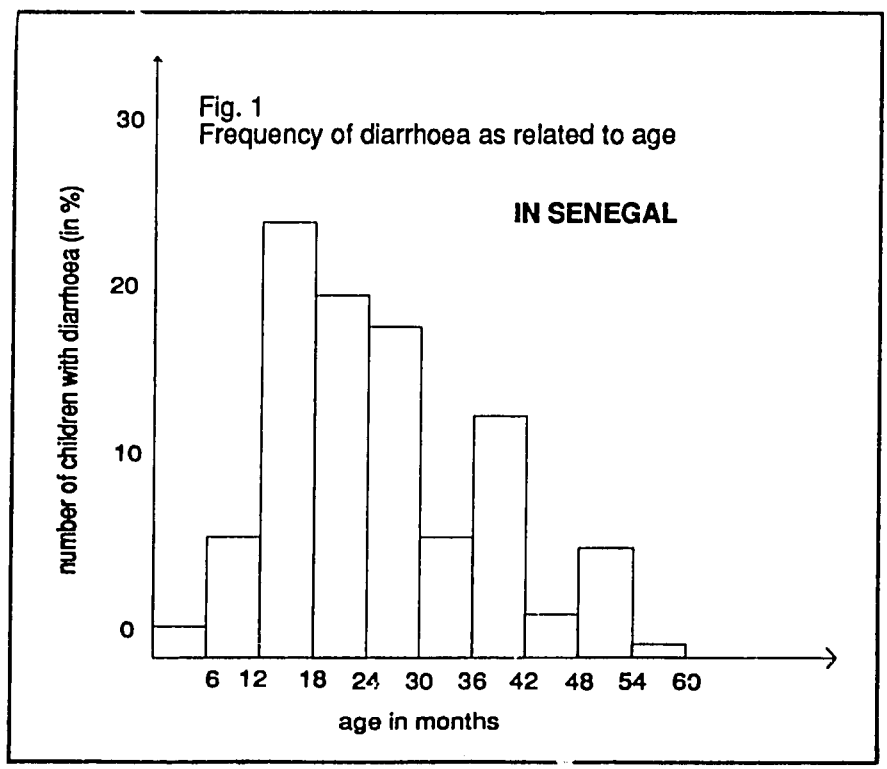
Write down their answers and discuss.

In the world

Diarrhoea occurs frequently and has long been recognized as a principal cause of death in infants and young children. The incidence of diarrhoea has been measured in many places and varies from one to twelve or more episodes per year per child.

The World Health Organisation (WHO) estimates that there are from 744 million to 1 billion episodes of diarrhoea every year in children under five years of age on the five continents. A minimum of five million children die of diarrhoeal disease each year.

The incidence of diarrhoea in relation to age seems to be partly tied to the introduction of weaning foods. The most vulnerable ages are usually between 6 and 60 months.



Diarrhoea is often fatal to very young children and remains a major cause of morbidity and mortality in older children and adults.

In Sahelian Countries

We have chosen Niger and Mali as examples, where surveys of the incidence* and prevalence* of diarrhoeal disease have recently been undertaken.

A. In Niger

According to information gathered by the National Survey on Morbidity and Mortality completed in 1985:

- 25% of children had had a diarrhoea episode during the two weeks prior to the visit of the survey team. From this prevalence one may estimate that each child under five years of age would have from 6 to 7 bouts of diarrhoea per year.
- Approximately 20% of infant deaths are associated with diarrhoea, which constitutes the third cause of infant mortality (estimated at 158 per 1000).
- 28% of children with diarrhoea also suffered from severe malnutrition.
- 0.6% of the cases of diarrhoea had been treated with oral rehydration, although almost 50% of urban mothers and 14% of rural mothers had heard about ORT.

B. In Mali

Study of health facility records and some surveys resulted in the findings below on morbidity and mortality due to diarrhoeal diseases:

- In the district of Bamako, between 1980-82, between 1980-82, 24% of the consultations at four MCH centers were related to diarrhoeal diseases.
- During 1981 in the district of Kolokani, 28% of all consultations were for a diarrhoea problem, with approximately 3% mortality, of which 6% were from 0 to 10 years of age.
- In 1982, in the pediatric ward of the Gabriel Touré Central Hospital, 26% of all inpatients were diagnosed as suffering from diarrhoea and dehydration, and approximately 27% of deaths were diarrhoea-associated.
- The survey done by the National School of Medicine and Pharmacy in May 1985 in the region of Bandiagara (189,654 inh.), shows that gastro-enteritis was the second highest cause of death in infants 0-11 months, second to febrile convulsions.
- The survey on diarrhoeal diseases done in September 1983 by the National Institute of Public Health Research, in the district of Bamako, shows that 24% of the children under five years of age had an episode of diarrhoea during the 15 days prior to the survey.

* **incidence = new cases in a given period**
* **prevalence = total number of old and new cases in a given period.**

ASSESSMENT OF THE IMPORTANCE OF DIARRHOEAL DISEASES IN A COMMUNITY

LEARNING OBJECTIVE: 1.2

By means of a health survey, determine the importance of diarrhoeal diseases in a community.

At the community level, each health worker should have accurate information about the importance of diarrhoeal diseases. This can help to:

- make families aware of the problem
- increase the awareness of government authorities
- organise activities to control diarrhoeal diseases
- evaluate the impact of a program, knowing that any action should be evaluated on the basis of an initial study of the situation and a subsequent study long enough after the start of activities for them to have had an effect.

An assessment of the situation should include:

- the percentage of cases of diarrhoea in children under five years of age compared to the total number of children under five seen in outpatient health services.

- the percentage of deaths associated with diarrhoea compared to the total number of deaths recorded by the same services.

- the percentage of children under five years of age hospitalized for diarrhoeal disease compared to the entire number of children under five years of age hospitalized.

- the annual number of diarrhoea episodes per child under five years of age as identified by their families
- the percentage of cases of diarrhoea treated by ORT (children under five years of age)
- the percentage of mothers who have heard of or use ORT

EXERCISE I-B: Divide students into three groups:

- one group will collect data on diarrhoeal diseases at the hospital (pediatric ward)
- one group at the local dispensary
- one group in a local neighborhood

How to proceed:
The group at the hospital will collect data on:

- The percentage of children under five years of age hospitalized for diarrhoeal disease during the past trimestre compared to the total number of hospitalized children under five.
- The percentage of diarrhoea cases having severe dehydration
- The percentage of diarrhoea cases with an associated illness and/or malnutrition
- The percentage of deaths associated with diarhoea compared to the total number of recorded deaths
- The percentage of cases of diarrhoea treated with ORT
- The percentage of cases of diarrhoea treated with IV.
- The average number of days of hospitalization for diarrhoeal cases.
- The average number of ORS packets used for diarrhoeal cases.

The group going to the dispensary should:

- Calculate the percentage of cases of diarrhoea compared to the total number of recorded patients:
  A. during a month of the dry season
  B. during a month of the rainy season
- Calculate the percentage of diarrhoea cases sent to a hospital compared to the total number of cases of diarrhoeal disease
- Calculate the percentage of patients seen for diarrhoea out of the total number of children from 0 to 5 years seen for one dry season month and one rainy season month.
- Calculate the percentage of cases of children under five with diarhoea treated with anti-diarrhoeal drugs (out of total under-fives diarrhoea cases).

- Percentage of cases of children under five treated with
  1. ORT
  2. Naso-gastric tube
  3. IV

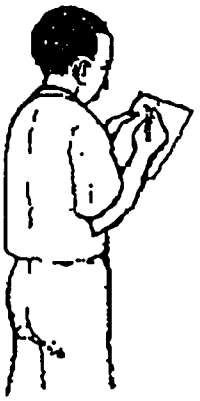
  (out of total under-fives diarrhoea cases)

The group going to the neighborhood should:

- Meet with ten mothers who have children between 0 and 5 years of age
- Ask them what the three principal causes of illness are for children under five years of age
- Ask if the child has had a bout of diarrhoea in the past two weeks. (Calculate the average number of bouts of diarrhoea per child per year based on the data collected)
- Ask what the mother did to treat the diarhoea
- Ask if the mothe has had children that have died after having diarrhoea
- Ask if she knows about ORT
- Ask if she has ever used ORT

Discuss:

- What is the importance of diarrhoea compared to other illnesses?
- Do people perceive diarrhoea to be an important problem?
- What do you think about what mothers do to treat diarrhoea?



EXAMPLE OF A FORM FOR COLLECTING INFORMATION TO SHOW THE PREVALENCE OF DIFFERENT ILLNESSES IN HEALTH FACILITIES

Butawa Health Area, July 1982					
Problem treated or service provided	Government Health Centre	Provate Clinic	Dr. Sati	Community Health Worker	TOTAL
Problems					
Fever	卌 卌 卌 卌	卌 卌 卌 卌 卌 卌	/	卌	56
Acute respriratory infection	卌 卌 /	卌 卌	卌 /		27
Gastroenteritis	卌 //	卌 ////	卌		21
Dysentery	卌 ////	卌 /			15
Malaria	卌	卌 卌	卌 ///		23
Skin Disease	卌 卌	卌 卌 卌	卌 //	卌 卌 /	43
Measles	卌 卌	卌	///	/	19
Diarrhoea	////	///		卌 卌 ////	21
Cough	///	卌		卌 卌	18
Wound/Trauma	卌 卌 /	卌 //		卌 卌	28

Notice that this form is for a single month. You can add up the monthly figures to get a total for the year.

Clinical Concepts

A DEFINITION OF DIARRHOEA

LEARNING OBJECTIVE: 1.3

Give a definition of diarrhoea according to its context

Exercise 1-C

Ask students what they already know about the subject of this objective.
Write down their answers and discuss.

It is difficult to define diarrhoea precisely, since the frequency, consistency and volume of stools depend to a large extent on diet, and consequently vary from one culture to another. Generally one can define diarrhoea as the defecation of liquid or watery stools. These watery stools are usually discharged at least three times a day. However, it is the consistency rather than the frequency of the stools which is the most important factor.

Frequent discharge of formed stools should not be considered as diarrhoea. Breast-fed children often have soft, pasty stools which should not be confused with diarrhoea either.

It is best to determine what each society calls diarrhoea. In most cases mothers know when their child is suffering from diarrhoea and can provide useful definition which is applicable to the local situation.

Diarrhoea can be acute, lasting several hours or several days, or chronic,lasting more than 14 days.

Diarrhoea is called mild or benign if it causes a loss of fluid less than 5 ml per kg and per hour.

Diarrhoeas causing loss of fluid more than 5 ml per kg and per hour are called serious diarrhoea.

AETIOLOGIES

LEARNING OBJECTIVE 1.4

Describe different aetiologies of diarrhoea.

Exercise 1-D

Ask students what they already know about the subject of this objective.
Write down their answers and discuss.

The onset of diarrhoea may be linked to an excess or other alimentary imbalance, or to the accidental ingestion of toxic substances already present in food, but most diarrhoeas are infectious, sometimes extra-digestive tract, but generally intestinal.

It is generally difficult to isolate the cause of diarrhoea. In all cases, the essential point is that any aetiology of diarrhoea may cause dehydration.

The majority of episodes of acute diarrhoea in infants are due to enteral infection, but before accepting this aetiology it is necessary to mention the other possible causes of diarrhoea.

Diarrhoeal disease due to excess or alimentary imbalance will be easily revealed during the initial interview with (or concerning) the patient.

Forms beginning with an acute attack due to an alimentary intolerance are often difficult to detect at the onset.

Certain exceptional causes should not be ignored: strangulated lateral hernia, congenital megacolon, etc.

It is also prudent to look for parenteral infections: measles, suppurative middle ear disease, nasopharyngitis, meningitis, urinary infection, etc. which are frequently accompanied by diarrhoea, and which may bring on acute dehydration.
Enteral infections causing diarrhoea may be bacterial or viral.

Diarrhoea caused by **Escherichia coli.**

E. Coli remains the most commonly found germ in our countries, causing 6-10% of all cases.

The clinical picture varies widely: though often benign, it can be very severe in very young children, marked by a sudden attack of vomiting, explosive diarrhoea, and rapid dehydration.

Diarrhoea caused by **Salmonella**: This form of diarrhoea represents 0,1 to 6% of all acute diarrhoea.

It may appear in a seemingly harmless form. After an incubation period of 12 to 72 hours, there is an onset of diarrhoea, vomiting, fever and occasional dehydration which evolves towards restored health within several days.

It may also cause a high fever, abdominal pains, presence of blood, pus or mucus in the stools.

Sometimes, in young children it takes a form resembling septicaemia, especially in those children with sickle cell anaemia.

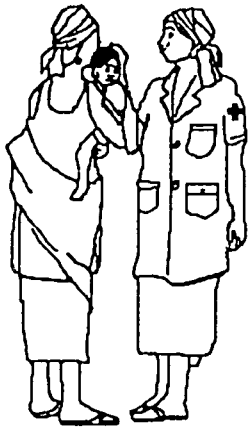
Diarrhoea from **Shigella**: The most common mild forms present a liquid stool without markedly affecting the general state of health. The acute forms cause a dysenteric syndrome with sudden onset, high fever, vomiting, abdominal pains which may be accompanied by tenesmus, bloody stools containing mucus or pus.

Acute viral diarrhoea: **Rota-virus** diarrhoeal disease most commonly attacks young children from 6 months to 3 years of age. Clinically, it is characterized by a sudden, febrile gastro-enteritis which presents the following signs:

- diarrhoea with from four to six stools, liquid, not very foetid, little mucus
- almost constant vomiting
- fever higher than 38° C.
- severe dehydration
- extra-digestive manifestations are quite often observed: maculopapular rash and especially a respiratory infection consistent with a viral aetiology.
- benign asymptomatic forms are frequently found in breast-fed newborns.

Parasitic diarrhoea: Certain parasites may provoke acute diarrhoea, which begins abruptly and only lasts a few days, as in acute forms of **intestinal amoebiasis, giardia**, and **balantidiosis**. However, the majority of parasitic diarrhoeal diseases are chronic, which by definition means diarrhoea which lasts more than 14 days or which reappears after an initial, acute onset. This happens in symptomatic cases of **strongyloidiasis** and **trichocephalosis** as well as in numerous cases of **amoebiasis** and **giardiasis**.

To the list of common pathogenic agents causing diarrhoea must be added **Campylobacter jejuni** and **Vibrio cholerae**. It is important to stress that in children under two years old (the age group in which occurs a large majority of diarrhoea-related dealths) the principal agents are those that cause watery diarrhoea - **E. Coli** and **Rotaviris**. Pathogenic agents causing dysentery (Chigella, Campylobacter jejuni) are relatively rare. This explains why oral rehydration therapy must be the treatment of choice for this age group (except for new-borns, where the common risk of generalised infection must be considered).



EXERCISE 1-E

A. Make a list of quetions to ask a mother to establish whether her child suffers from:
   - Acute watery diarrhoea
   - Dysentery
   - Chronic diarrhoea

B. Simulate a consultation where the health worker is questioning a mother in order to try to identify the type of diarrhoea which the child presents.

PATHOPHYSIOLOGY OF DIARRHOEA

LEARNING OBJECTIVE 1.5

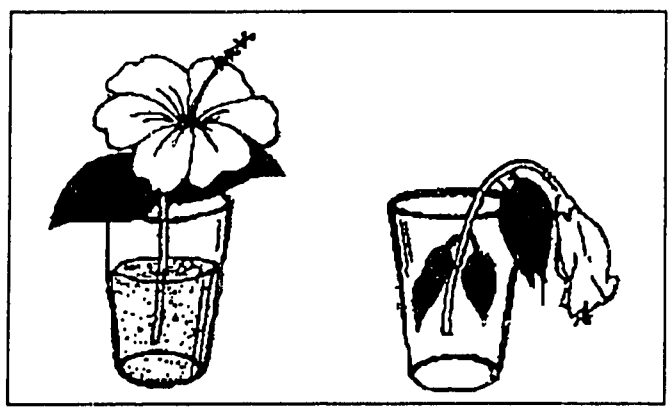
Summarize the mechanisms at work during diarrhoea from different causes

EXERCISE 1-F

Ask students what they already know about the subject of this objective.
Write down their answers and discuss them together.

Reminder: Water is a nutrient essential to life itself. It is present in all tissues of the organism and is a solvent for some nutritive substances such as certain electrolytes and vitamins.

The percentage of the body made up of water varies according to different stages of growth. It diminishes during the first year of life and will be about 60 to 65% by adulthood.



Pathophysiologically, diarrhoea constitutes an alteration of the enterosystemic water cycle. In normal circumstances, the intestine is the site of an intensive recycling of water coming from salivary, gastric, biliary, pancreatic and intestinal secretions. 99.5% of this water is reabsorbed into the intestine following the absorption of sodium. (Fig.2) It is known that the secretion and absorption of water through the intestinal epithelium follow passively those of electrolytes and in particular, those of sodium.

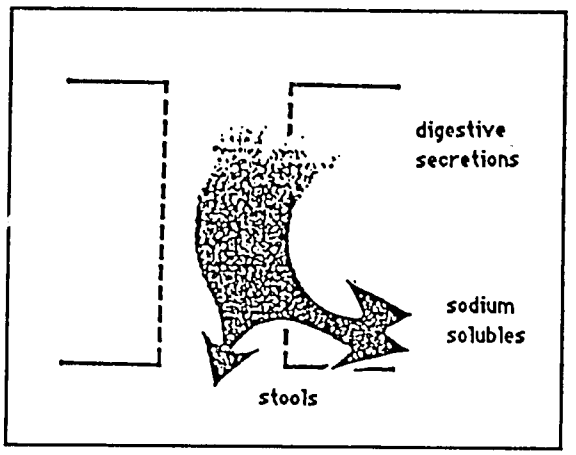


FIG. 2: The enterosytemic cycle of water showing the active reabsorption of Na.

The quantitative importance of this enterosystemic cycle cannot be precisely stated because of uncertainty about the circulation of water through the intestinal wall (epithelium). It is probable, however, that the volume of water recycled through the intestine each day would be several times the total volume of water in the body, (20-40 liters in an adult.)

It is, therefore, easy to understand that by even slightly altering this enterosystemic water cycle, acute diarrhoea could rapidly provoke serious dehydration.

It is well-established that acute diarrhoea in children is mostly of infectious origin: either bacterial, viral or protozoan.

Schematically, two mechanisms are involved in the pathogenesis of diarrhea:
increase in intestinal secretions and/or decrease in intestinal reabsorption. These two mechanisms are represented in Figure 3.

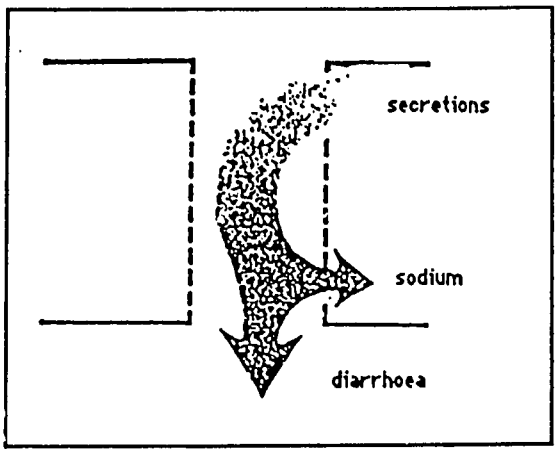
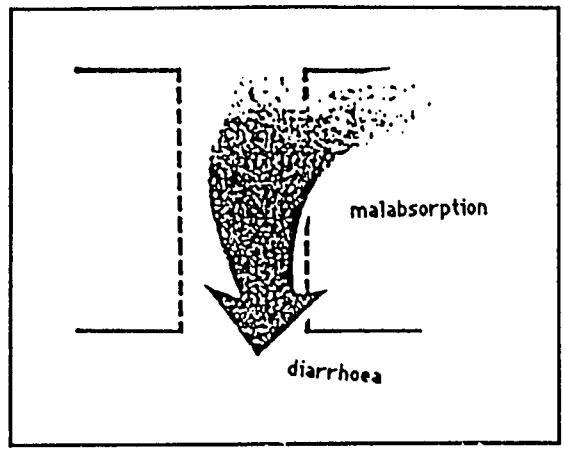


Fig. 3: Diarrhoea due to secretion



Diarrhoea due to malabsorption

If the quantities of fluid secreted into the intestine increase dramatically, they may exceed the reabsorptive capacity of the intestine. There is then an increase in the loss of fluid through the stools, which is called diarrhoea.

On the other hand intestinal secretions may be unchanged, but there is diminished capacity to reabsorb. The result is the same: increase of fluids lost through stools, or diarrhoea.

Some infectious agents provoke diarrhoea by stimulating intestinal secretions through toxins, of which the best known are the cholera toxin, the LT and ST toxins of E.Coli (enterotoxin genes), or through the secretory mediators released by Entamoeba histolytica.

Other infectious agents diminish the reabsorptive capacity of the intestine. This is the case with the rotavirus. It destroys the cells at the top of the intestinal villi which are especially responsible for reabsorption.

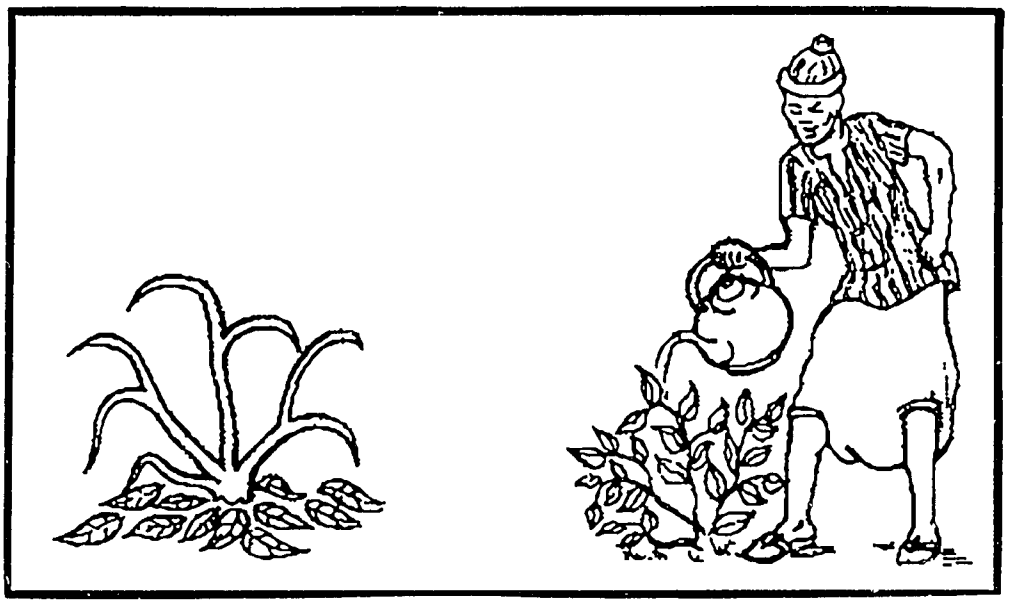
Other bacteria cause diarrhoea by penetrating the epithelium, most frequently at the colon. In this case, the clinical picture is most often one of dysentery, (Shigella species) that is to say, a diarrhoea with loss of blood and mucus in the stools.

As we have seen, acute diarrhoea causes a loss of water and electrolytes by disturbing the enterosystemic cycle of fluids. If these fluids are not replaced rapidly, it will cause dehydration and death.

Until 25 years ago the only effective way of compensating for this loss of fluid was to replace fluids and electrolytes lost through stools with fluids and electrolytes injected intravenously.

Treatment of dehydration due to diarrhoea was revolutionised in the 1960s by successive discoveries which perfected a rehydration solution that was inexpensive and could be administered orally.

The first of these discoveries showed that glucose could stimulate the movement of sodium through the mucous membrane of the intestine.



In fact it showed molecules, within the cells of the mucous membrane of the intestine, carrying linked molecules of glucose and sodium from the intestinal lumen toward the centre of the cell. As we noted above, water passively follows the absorption of sodium. Therefore the mechanism of the absorption of sodium is also a mechanism for the absorption of water.

The second discovery was that this absorptive mechanism of glucose and of sodium linked with glucose worked perfectly during an acute bout of diarrhea, even one due to the cholera vibrio.

From this discovery it was demonstrated that fluid and electrolyte losses due to acute diarrhoea could be efficiently replaced by a solution of electrolytes and a chemical compound of sugar which could be administered orally.

For optimal absorption of the water and electrolytes administered orally, it was demonstrated that certain criteria needed to be met:

1. The solution must be iso-osmotic to plasma.

2. The concentration of the carrier (the glucose) must be between 20 and 30 g/litre to obtain maximum absorption of the sodium and water. (A higher concentration could induce osmotic diarrhoea, and a lower concentration would result in less than optimal absorption of water and electrolytes.)

3. The closer the concentration of sodium in the solution is to the concentration of sodium in plasma, the greater is the net absorption of sodium. A sodium concentration of 90 mmol/l in the solution induces an optimal absorption of water and sodium to correct the deficit of sodium and water in dehydration.

4. The losses of potassium due to acute diarrhoea can be particularly disastrous in young children, especially if they are malnourished. Potassium is absorbed passively depending on the degree of concentration (a higher degree of potassium concentration in the intestine than that found in the plasma, will elicit a net absorption.)

   A potassium concentration of 20 mmol/l in oral rehydration solution is well tolerated and very adequate in replacing losses.

5. Bicarbonate, which is necessary to correct acidosis, is actively absorbed independently of glucose. Basic recommended concentrations of bicarbonate to correct acidosis due to losses are from 30 to 48 mmol/l.

Acetate and trisodic citrate are acceptable replacements for bicarbonate and are easier to integrate into ORS preparations in packet or tablet form. This permits some reduction in costs and a longer conservation period.

The oral rehydration solution recommended by the WHO responds perfectly to all the criteria. (See chart of WHO oral rehydration solution. Module 2.) It is now generally agreed that this solution optimally corrects losses of water and electrolytes as observed in infants, children and adults dehydrated by diarrhoeal diseases (including cholera).

LEARNING OBJECTIVE 1.6

Distinguish the different clinical signs in the development of diarrhoea and evaluate their effect on the general state of the patient.

EXERCISE 1-G

Ask students what they already know about the subject of this objective.
Write down their answers and discuss them together.

Symptomatology varies considerably according to the intensity of the diarrhoea and its associated signs.

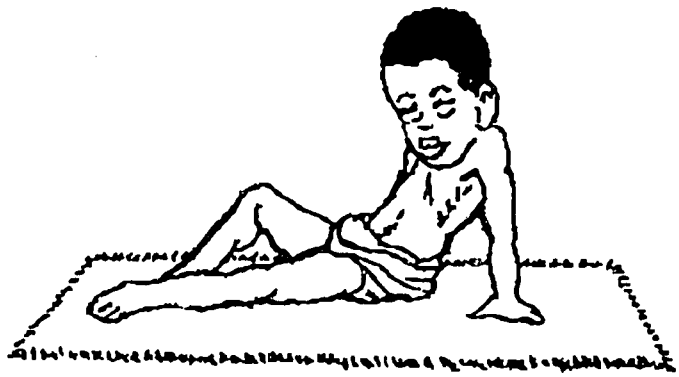
It is necessary to treat the patient at the first sign of a liquid stool.

Diarrhoeal stools are essentially characterized by their high water content. It is important to note the number of stools, from several stools a day in moderate forms of diarrhoea, to several dozen in more severe forms, and to describe their appearance, which may vary from stools that are simply loose to the discharge of barely fecal liquid stools.

The appearance of the stools is an important indicator and enables one to identify:

- the choleric syndrome: profuse diarrhoea, watery, like rice-water, which points to an enterotoxinogenic bacteria
- the dysenteriform syndrome: viscous, bloody-mucous stools, sometimes mucopurulent and accompanied by violent abdominal pains and tenesmus, all of which suggest the presence of an enterobacterial invasion.

The occurrence of any type of diarrhoea in an infant or child may rapidly lead to a state of dehydration, which must be quickly corrected.



The best way to evaluate acute dehydration is to calculate the weight loss due to loss of fluid when a previous weight is known. This underlines the importance of regularly weighing infants.

A weight loss of less than 5% might not be clinically detectable.

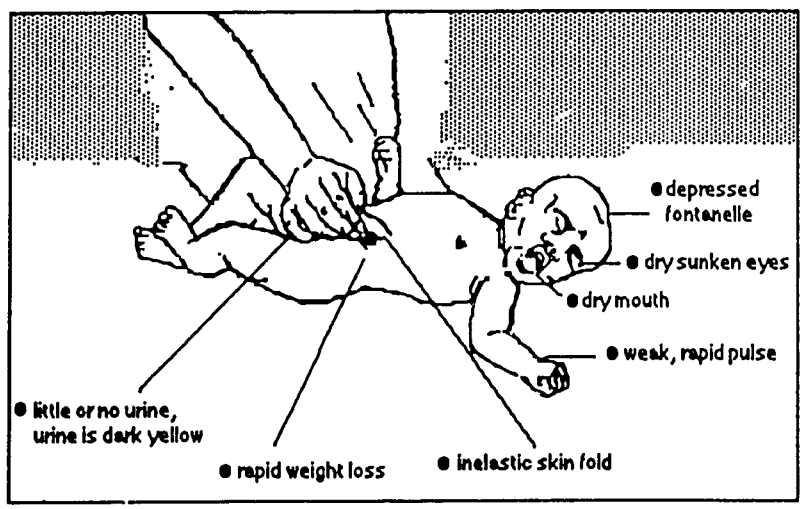
Dehydration corresponding to a weight loss of 5 to 10% of body weight is always clinically observable and requires prompt rehydration procedures.

If the weight loss is equal to or more than 15%, the patient is usually in a coma and treatment requires urgent intensive care. All acute dehydration in children can be life-threatening and is, therefore, an emergency.

The signs of acute dehydration are easily recognized:

- irritability
- inelastic skin fold
- depressed fontanel
- rapid pulse
- oliguria
- hypotension
- sunken eyes
- tearless eyes

The intensity and combinations of these different signs help establish the varying degrees of dehydration, (see Module 2).



LEARNING OBJECTIVE 1.7

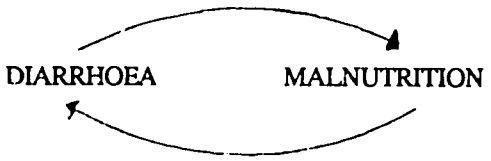
Explain the interaction between diarrhoeal disease and malnutrition.

EXERCISE 1-H

Ask students what they already know about the subject of this objective.
Write down their answers and discuss them together.

The two-way interconnection between diarrhoeal disease and malnutrition is well-known today.

Malnutrition increases the length and severity of diarrhoea episodes, and diarrhoea has a negative effect on nutritional status. Thus a vicious cycle begins which can be represented by this diagramme:



The negative effects of diarrhoea on the nutritional status of the child are the result of at least four factors:

- reduced food consumption
- reduced absorption of nutrients
- loss of water/fluid, electrolytes and nutrients
- altered rate of metabolism

1. Reduced food consumption

This can be due to several causes including: anorexia, vomiting, dehydration, fever, or traditional customs like fasting imposed by the mother. Several studies have shown that a diarrhoeal ailment alone could reduce food consumption by 20 to 50%; its effect could last several days after the diarrhoea episode, particularly when the pathogenic agent is a rotavirus.

2. Reduced absorption of Nutrients

Reduced absorption of nutrients may be due to the adhesion of bacteria to the mucous membrane, the release of toxins, or the simple destruction of cells. The absorption of fats, carbohydrates, amino acids and of some vitamins is affected. This state of diminished absorption can continue for several weeks. However, in spite of this malabsorption, feeding children with diarrhoea is to be encouraged because there is a significant absorption of all nutrients even in an acute diarrhoea episode.

3. Loss of fluids, electrolytes and nutrients

Hypersecretion, which characterizes diarrhoea, leads to a deficit in water, sodium, potassium, chlorine and probably a number of trace elements. The structural changes of the intestinal mucous membrane cause a loss of protein. This is partly responsible for the severe, protein-caloric malnutrition which may occur after a diarrhoea episode.

4. Altered rate of metabolism

Any infection disturbs the normal endocrine and metabolic functions. Catabolism (the utilisation of energy for the organism's functioning) increases and exceeds the rate of anabolism (building tissue). Generally, the extent of nutrient losses due to catabolism is proportional to the severity and length of the fever.

The impact of diarrhoea on children's physical development is immediate and can be seen in weight loss and arrested growth. There is no doubt that diarrhoea is a predominant cause of malnutrition.

On the other hand, it does not necessarily follow that malnutrition leads to an increased rate of diarrhoea, or that supplementary feeding programs can reduce the incidence of diarrhoea. It has been proven, however, that malnutritionpredisposes the patient to more severe and more lethal bouts of diarrhoea and that supplementary feeding programs can reduce the severity and mortality from diarrhoea.

MODULE 1

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