ACUTE DIARRHOEAL DISEASE
AIMS OF THE LECTURE

- Definitions
- Risk factors
- Pathogenesis and mechanisms
- Consequences of watery diarrhea
- Site / duration of infective diarrhea
- Risk factors for persistent diarrhea
- Principles of ORT
- Composition of ORT
- Advantages/ Limitations of ORT
WHAT IS DIARRHEA?

• Increase in frequency, fluidity & volume of feces, for the age of the child.

• In epidemiological studies:
  The passage of three or more loose or watery stools in a 24-hour period, a loose stool being one that would take the shape of a container.
MAGNITUDE OF THE PROBLEM

- In developing countries
  - 1.3 thousand million episodes
  - 4 million deaths each year in under-fives.
  - Economic burden: occupy 1/3 hosp beds
- 80% of diarrheal deaths occur < 2 yrs of age.
- Is an important cause of under nutrition.
  - Eat less during diarrhea
  - Ability to absorb nutrients is reduced;
  - Nutrient requirements are increased.
DEFINITIONS

1. Acute watery diarrhea

Diarrhea that begins acutely, lasts less than 14 days (most episodes last less than seven days), and involves the passage of frequent loose or watery stools without visible blood. Vomiting and fever may be present.

2. Dysentery

Diarrhea with visible blood in the feces. Important effects of dysentery include anorexia, weight loss, and damage to intestinal mucosa by the invasive bacteria.
RISK FACTORS FOR ACUTE DIARRHEA

• Failure to breast-feed exclusively for 4-6 months.
• Failure to breast-feed until at least one year of age.
• Using infant feeding bottles.
• Storing cooked food at room temperature.
• Drinking water contaminated with fecal bacteria.
• Failing to dispose off infant feces hygienically.
PREDISPOSING HOST FACTORS

• Under nutrition.
• Recent measles (In previous four weeks).
• Immunodeficiency
• Age: First two years of life, maximum at 6-11 months
  Why? Weaning period
  - Declining levels of maternal antibodies.
  - Lack of active immunity in the infant.
  - Infant starts to crawl.
• Seasonal: Rotavirus throughout the year.
  Bacterial in summer & rainy season.
• Epidemics: Vibrio cholera, Shigella.
ENTEROPATHOGENS

• Rotavirus
• Enterotoxigenic Escherichia coli
• Shigella
• Campylobacter jejuni
• Vibrio cholerae
• Salmonella
• Cryptosporidium
PATHOGENESIS OF VIRAL DIARRHEAS

• Replicate within the villous epithelium, causing patchy epithelial cell destruction and villous shortening.
• Normally absorptive villous cells replaced by immature, secretory, crypt-like cells.
• Loss of disaccharidase enzyme - lactose malabsorption
• Recovery occurs when the villi regenerate and the villous epithelium matures E.g. : Rota virus
PATHOGENESIS OF BACTERIAL DIARRHOEAS

Mucosal adhesion:
• Prevents organism being swept away.
• Fimbriae bind to mucosal receptors.
• Results in reduced absorptive capacity.
  E.g.: Enteropathogenic/ Enteroadherent E. Coli.

Secretory toxins:
• Toxins alter epithelial cell function absorption of sodium by the villi is decreased
  increased secretion of chloride in the crypts.
• Recovery occurs when “intoxicated cells” are replaced by healthy cells.
  E.g.: Enterotoxigenic E. coli, V. cholerae, Salmonella.
PATHOGENESIS OF BACTERIAL DIARRHOEAS

Mucosal invasion:

• Direct invasion & destruction of mucosal cells.
• Usually in the colon and distal ileum.
• Invasion micro abscesses & superficial ulcers.
• Toxins cause tissue damage and possibly also mucosal secretion of water and electrolytes.

E.g. : Shigella, enteroinvasive E. coli
• Production of micro-abscesses:

Occurs only when the infecting strain of the Entamoeba histolytica is virulent. In 90% of human infections, the strains are not virulent; in which case there is no mucosal invasion and no symptoms, although amoebic cysts are present in the feces.
FLUID BALANCE IN THE GUT

- Absorption & secretion of water & electrolytes occur throughout intestine.
  - They are simultaneously absorbed by the villi & secreted by the crypts of the mucosa.

- Change in this two-directional flow more fluid enters large intestine. If this exceeds colonic absorptive capacity, diarrhea occurs.

![Image of mucosa](image)

Water

Electrolytes

Normally fluid absorption >> fluid secretion
MECHANISMS OF DIARRHEA

- Osmotic diarrhea
- Secretory diarrhea
- Inflammatory diarrhea
OSMOTIC DIARRHEA

• Small bowel mucosa is a porous epithelium; water and salts move across it rapidly to maintain osmotic balance.

• Diarrhea occurs when a poorly absorbed, osmotically active substance is present in the gut.

• If substance is isotonic, the water and solute will simply pass through the gut unabsorbed, causing diarrhea. E.g.; magnesium sulfate, lactose.

• If it is a hypertonic solution, water will move from the ECF into the gut lumen until osmolality is equalized - volume of stool & dehydration.
OSMOTIC DIARHOEA

Features:

- Stooling stops on fasting.
- Stool pH acidic.
- Reducing substance positive.

E.g.. Rota virus diarrhea.

Disaccharide malabsorption.

- Monosaccharide malabsorption.
  Lactulose ingestion.
  Treatment :
  - Remove offending agent from diet.
SECRETORY DIARRHOEA

ACTIVE SECRETION

- Caused by the abnormal secretion (water and salt) into the small bowel.
- Occurs when
  
  Sodium absorption by the villi is impaired.
  
  Chloride secretion in crypts continues/increased.
- Mediators .. Cyclic A.M.P of Cholera
  
  .. Cyclic G.M.P of E.T.E.C
SECRETORY DIARRHOEA

Features:

- Stooling continues on fasting.
- Stool pH alkaline.
- Reducing substance – Negative.

Treatment:

- Treat underlying cause.
- Correct fluid & electrolyte deficits.
- Limited role for antibiotics.
CONSEQUENCES OF WATERY DIARRHOEA

1. Dehydration
   .. Isotonic dehydration: commonest
     - Net losses of water & sodium are in proportion.
   .. Hypernatremic dehydration
     - Net loss of water in excess of sodium.
     - Severe thirst out of proportion to the dehydration.
   .. Hyponatremic dehydration
     - Replacement with fluids of low salt concentration
     - Rare, usually iatrogenic
CONSEQUENCES OF WATERY DIARRHOEA

2. **Metabolic acidosis**
   Causes: Loss of bicarbonate in the stool.
   Poor renal blood flow, production of lactic acid.
   Low bicarb, arterial pH < 7.10, deep/rapid breathing.

3. **Potassium depletion**
   Due to large fecal losses (esp. in infants)
   Signs: Muscular weakness, Paralytic ileus.
RECAP OF IMPORTANT POINTS

• Diarrhea is an important cause of malnutrition and death in children below 2 yrs.
• Acute uncomplicated watery diarrhea settles in 7 -14 days
• Normally H2O absorbed by villi >> secreted by crypt cells
• Secretory diarrhea occurs when Na⁺ absorption by the villi is impaired, while Cl⁻ secretion in crypts continues
• Osmotic diarrhea occurs when a poorly absorbed, osmotically active substance is present in the gut
• Dehydration, acidosis and hypokalemia are complications
3. Inflammatory diarrhea

   A. Infective – Shigellosis, Amoebiasis.
   B. Non infective – Ulcerative colitis.

How to diagnose?

   A. Fever.
   B. Blood in stool. Increased fecal leucocytes.
   C. Abdominal pain, cramps, tenesmus.
MANAGEMENT OF DYSENTERY

- **Antibiotics**: Depends on local sensitivity pattern
  - Nalidixic acid, Norflox, Cefixime
  - Given for 5 days.

- **Fluids**:
  - Oral replacement enough, unless vomiting present.

- **Feeding**:
  - Continue breast-feeding
  - Give energy & nutrient-rich foods six times a day.
  - One extra meal a day for two weeks follow-up.
MORE ON INFECTIVE DIARRHEA......

<table>
<thead>
<tr>
<th></th>
<th>SITE</th>
<th>DURATION</th>
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<tbody>
<tr>
<td>1.</td>
<td>Cholera</td>
<td>Small Bowel</td>
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<tr>
<td>2.</td>
<td>Shigella</td>
<td>Large Bowel</td>
</tr>
<tr>
<td>3.</td>
<td>Rota Virus</td>
<td>Small Bowel</td>
</tr>
<tr>
<td>4.</td>
<td>ETEC</td>
<td>Small Bowel</td>
</tr>
<tr>
<td>5.</td>
<td>EIEC</td>
<td>Large Bowel</td>
</tr>
<tr>
<td>6.</td>
<td>Salmonella</td>
<td>Small &amp; Large Bowel</td>
</tr>
<tr>
<td>7.</td>
<td>Giardia</td>
<td>Small Bowel</td>
</tr>
<tr>
<td>8.</td>
<td>Amoebiasis</td>
<td>Large Bowel</td>
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</table>
• **Persistent Diarrhea**
  An episode of diarrheal of presumed infectious etiology that begins acutely and lasts for more than 14 days.

• **Chronic diarrhea**
  Diarrhea that is recurrent/lasting more than 14 days, is due to non-infectious cause & associated with malabsorption. E.g. Celiac disease
PERSISTENT DIARRHEA

RISK FACTORS

- Infants below 6 months
- Malnourished infants
- Multiple antibiotics
- Multiple physicians
- Not breast fed
- Repeated diarrhea
- Enteropathogenic E. coli infection
ORAL REHYDRATION THERAPY

What is it?

Administration of fluid & electrolytes orally to treat or prevent dehydration.

Why?

– Correction of water & electrolyte deficit is possible orally
– Reduce mortality
– Cheap, easy and scientific
STORY OF ORAL REHYDRATION THERAPY

• Developed in the late 1960’s
• Life saver in cholera epidemic in east India in 70’s
• In the last 40 yrs, has saved more lives than any other medical invention.
• In 1980: 5 million deaths < 5 yrs from diarrhea
• In 2000: Only 1.8 million deaths !!!

The problem today: low ORS usage by health workers
SCIENTIFIC BASIS OF ORT

- Absorption of H2O/Na/K/HCO3 near normal in diarrhea
- Glucose coupled sodium absorption promotes water absorption across intestinal mucosa
- Maximal absorption, when Na to glucose ratio is 1.0
- Potassium absorption occurs by passive diffusion
- Water/electrolyte losses in diarrhea can be effectively corrected by ORT
### COMPOSITION OF CURRENT ORS

<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>Gm</th>
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<tbody>
<tr>
<td>K Cl</td>
<td>1.5</td>
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<tr>
<td>Glucose</td>
<td>13.5</td>
</tr>
<tr>
<td>Na Cl</td>
<td>2.6</td>
</tr>
<tr>
<td>Trisodium citrate</td>
<td>2.9</td>
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**TOTAL** 20.5

<table>
<thead>
<tr>
<th>OSMOLARITY</th>
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<tbody>
<tr>
<td>Na</td>
<td>75</td>
</tr>
<tr>
<td>Cl</td>
<td>65</td>
</tr>
<tr>
<td>Glucose</td>
<td>75</td>
</tr>
<tr>
<td>K</td>
<td>20</td>
</tr>
<tr>
<td>Citrate</td>
<td>10</td>
</tr>
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</table>

**TOTAL** 245
DIARRHEA MANAGEMENT IN IMNCI

• Assessment of dehydration
• Mixing of ORS and details of administration
• Treatment of diarrhea at home (Plan A)
• Treating some dehydration in clinic (Plan B)
• Treating severe dehydration in an emergency (Plan C)
• Management of dysentery
• Diet in acute diarrhea
RICE BASED ORS

- Rice powder when digested releases twice the amount of glucose than in ORS. This is enough to support the absorption of water & electrolytes in ORS.
- Protein in rice adds to this effect by release & absorption of amino acids.
- Osmotic activity of rice-ORS (220 mOsm/l) is lower than that of blood or other tissues (290 mOsm/l).
- Calories in rice may help prevent malnutrition.
- Trials show lower rate of stool volume in cholera.

More studies needed in non-cholera diarrhea.
ADVANTAGES OF ORT

• Low cost

• Eliminates need for IV line placement

• Treatment can be done/continued at home

• Safe and few side effects
LIMITATIONS OF ORT USE

• Difficult when mental status is altered
  (aspiration)

• Difficult when there is paralytic ileus

• Severe dehydration

• High failure rate if stool output remains excessive

• Difficult in severe/persistent vomiting, when ORS
ASSESSMENT OF A CHILD WITH DIARRHOEA

HISTORY
• Acute watery D
• Dysentery
• Persistent D.
• Watery, large, frequent
• Vomiting - 6-8hrs
• Urine
• Nature of fluids
• Feeding before illness

PHYSICAL EXAM.
• Signs of Dehydration
• Nutritional Status of child
• Pneumonia,
  Otitis Media
• Other infections
ASSESSMENT OF A CHILD WITH DIARRHOEA

NO DEHYDRATION

LOOK AT
• Condition
• Eyes
• Tears
• Mouth & Tongue
• Thirst

FEEL
Skin Pinch

• Well Alert
• Normal
• Present
• Moist
• Drinks Normally Not Thirsty

• Goes back quickly
ASSESSMENT OF A CHILD WITH DIARRHOEA (CONT)
SOME DEHYDRATION

Look at
• Condition
• Eyes
• Tears
• Mouth & Tongue
• Thirst

Feel
• Skin Pinch

Two of following signs
Restless, Irritable
Sunken
Absent
Dry
Thirsty, Drinks eagerly

Goes back slowly
ASSESSMENT OF A CHILD WITH DIARRHOEA (CONT) SEVERE DEHYDRATION

LOOK AT

- Condition: Lethargic or unconscious, floppy
- Eyes: Very sunken & dry
- Tears: Absent
- Mouth & Tongue: Very dry
- Thirst: Drinks poorly or not able to drink

FEEL

Skin Pinch: Goes back very slowly
MANAGEMENT

• No Dehydration

• Some Dehydration

• Severe Dehydration

• PLAN - A

• PLAN - B

• PLAN – C
## ORS FOR PREVENTION OF DEHYDRATION (PLAN-A)

<table>
<thead>
<tr>
<th>Age</th>
<th>Amt. of ORS after each loose stool</th>
<th>Amt of ORS to provide for use at home</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;24 months</td>
<td>50-100 ml</td>
<td>500 ml /day</td>
</tr>
<tr>
<td>2-10 years</td>
<td>100-200 ml</td>
<td>1000 ml /day</td>
</tr>
<tr>
<td>10 years/more</td>
<td>As much as wanted</td>
<td>2000 ml /day</td>
</tr>
</tbody>
</table>
TREATMENT PLAN B
(FOR SOME DEHYDRATION)

• Rehydration Therapy-75 ml/Kg ORS in 1st 4 hours
• Maintenance Therapy
• Provision of Normal daily fluid requirements
## TREATMENT PLAN C
SEVERE DEHYDRATION : IV FLUID THERAPY
RINGER LACTATE/N.SALINE

<table>
<thead>
<tr>
<th>Age</th>
<th>First-30 ml/kg</th>
<th>Then 70 ml / kg</th>
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</thead>
<tbody>
<tr>
<td>&lt;12 months</td>
<td>1 hour</td>
<td>5 hours</td>
</tr>
<tr>
<td>Older children</td>
<td>30 minutes</td>
<td>2 1/2 hours</td>
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</table>
NUTRITIONAL MANAGEMENT OF ACUTE DIARRHOEA

Diarrhea Worsens Nutritional status

a) Decreased food intake –
   Anorexia /
   Maternal food withholding

b) Intestinal malabsorption –
   Macronutrients & Some micronutrients
RECOMMENDATIONS

• Continue Feeding
• Continue Breast Feeding even during rehydration
• Animal milk need not be diluted
• Enrich staple foods – fats & oil /sugar
• High fiber content foods–avoided
• Routine lactose free feeds-not needed
• During recovery-125% intake
RECAP ......

- Persistent diarrhea lasts > 14 days. Infants < 6 months, malnourished and not breast fed are at high risk.
- High fever, blood in stool & abdominal cramps suggest dysentery
- ORT is life saving in diarrheal dehydration.
- Principle of ORT is that glucose coupled sodium transport promotes water absorption across intestinal mucosa
- Total osmolarity of current ORS is only 245 mOsm/L
- Advantages of ORT are more than the limitations.