GASTROINTESTINAL PROBLEMS IN CHILDREN

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Clinical Entity versus Disease

- Diarrhea is a clinical entity
- Shigellosis as a disease
- Recurrent abdominal pain is a clinical entity
- Lactose intolerance as a disease
List of GI problems

• Diarrhea
• Constipation
• Vomiting
• Abdominal pain
• GI bleeding
• Lactose intolerance
• Others
DIARRHEA
Diarrhea: Epidemiology

- A major health problem in the developing countries
- Morbidity and mortality in underfive children
- Leading to malnutrition
Diarrhea: Etiology

• Direct and indirect causes

  ⇒ **Indirect causes**: Poor hygiene & sanitation, bad feeding practices, low education level, bad houses

• Mostly due to infection of the gut

• Bacteria, virus and parasites

  ⇒ **Bacteria**: *E. coli, Salmonella, V. cholerae, campylobacter, Shigella*

  ⇒ **Virus**: *Rotavirus, Norwalk agent, adenovirus*

  ⇒ **Parasites**: *Giardia lamblia, Entamoeba*
Rotavirus

Entamoeba

Giardia lamblia
Diarrhea: Pathogenesis

- Invasive diarrhea
  ⇒ Shigella
- Secretory diarrhea
  ⇒ Vibrio cholerae
- Mucosal damage
  ⇒ Rotavirus
Osmotic diarrhea

Nutrient

Unabsorbed

Bacterial fermentation

Organic acids

Increased osmotic pressure

Water flux to lumen

Diarrhea
Secretory diarrhea

- Bacteria
  - Toxin
    - Stimulation of c-AMP, c-GMP
      - Stimulation of water/electrolyte secretion
        - Diarrhea
Relative degree of invasiveness of the organisms causing diarrhea

![Diagram showing the relative degree of invasiveness for different organisms causing diarrhea. The organisms are arranged from top to bottom based on their degree of invasiveness: Cholera, Rotavirus, Shigella, and Salmonella. The layers are labeled as Lumen, Mucosa, and Submucosa.](image-url)
Normal villus

Villus atrophy
Villus atrophy
Diarrhea: Pathophysiology

- Diarrhea $\Rightarrow$ Water $\rightarrow$ Dehydration
  - Potassium $\rightarrow$ Hypokalaemia
  - Natrium $\rightarrow$ Hyponatraemia
  - Bicarbonate $\rightarrow$ Acidosis
  - Nutrient $\rightarrow$ Hypoglycemia
Diarrhea: Clinical Manifestation

- Diarrhea: watery, bloody, mucous
- Fever
- Vomiting
- Respiratory symptoms
- Dehydration
- Metabolic acidosis
- Electrolyte imbalance: hyponatraemia, hypokalaemia, hyponatraemia
- Hypoglycemia
- Lactose intolerance
Diarrhea: Degree of dehydration

- No dehydration: no loss of body weight
- Mild dehydration: < 5% lost of body weight
- Moderate dehydration: 6-9% lost of body weight
- Severe dehydration: >10% lost of body weight
Signs of Dehydration

- Irritability, anorexia
- Sunken fontanel
- Sunken eyes
- Dry mouth
- Thirsty
- Fast weak pulse (tachycardia)
- Decreased skin elasticity
- Little urine
Scoring System
Degree of dehydration

<table>
<thead>
<tr>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>General condition</td>
<td>Healthy</td>
<td>Irritability, sleepy, apathy</td>
<td>Delirium, coma or shock</td>
</tr>
<tr>
<td>Skin elasticity</td>
<td>Normal</td>
<td>Decreased</td>
<td>Very decreased</td>
</tr>
<tr>
<td>Eye</td>
<td>Normal</td>
<td>Sunken</td>
<td>Very sunken</td>
</tr>
<tr>
<td>Fontanel</td>
<td>Normal</td>
<td>Sunken</td>
<td>Very sunken</td>
</tr>
<tr>
<td>Mouth</td>
<td>Normal</td>
<td>Dry</td>
<td>Dry &amp; cyanotic</td>
</tr>
<tr>
<td>Pulse</td>
<td>Normal</td>
<td>120-140</td>
<td>&gt; 140</td>
</tr>
</tbody>
</table>

**Amount of score:**
- **0- 2** Mild dehydration
- **3- 6** Moderate dehydration
- **7-12** Severe dehydration

Maurice King, 1974
Diarrhea: Management

• Rehydration (oral or parenteral)
• Nutritional support
• Drugs if needed
• Parental education
CONSTIPATION
Constipation: Epidemiology

- Normal defecation, sign of healthy children
- Too hard, too big, painful, rare
- 3% of pediatrician visit
- 10-15% of pediatric GI visit
- 95% of cases is functional
- Many times the cause is simple
Constipation: Definition

- Incapability in evacuating stool completely
- Less frequent bowel movement than usual
- Harder stool than usual
- Fecal mass in abdominal palpation
- With or without encopresis
Defecation: Normal pattern

- In adult, 3 BM/day to 3 BM/week
- Breastfeeding infants have more BM up to 4 months of age
- 1-7 BM in infants (93%)
- At 4 years: 1,2 BM and 96% of them have same BM with adult
- Formed stool
Normal Bowel Movement in Children

<table>
<thead>
<tr>
<th>Age</th>
<th>BM/week (mean+SD)</th>
<th>BM/week (mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 months</td>
<td>5-40</td>
<td>2,9</td>
</tr>
<tr>
<td>BF</td>
<td>5-28</td>
<td>2,0</td>
</tr>
<tr>
<td>Formula</td>
<td>5-28</td>
<td>1,8</td>
</tr>
<tr>
<td>6-12 months</td>
<td>5-28</td>
<td>1,4</td>
</tr>
<tr>
<td>1-3 months</td>
<td>4-21</td>
<td>1,0</td>
</tr>
<tr>
<td>&gt;3 months</td>
<td>3-14</td>
<td></td>
</tr>
</tbody>
</table>
Bowel Movement: Physiology (1)

- Tension of rectum by fecal bulk
- Relaxation reflex of internal AS
- Contraction of external AS → TOILET
- Relaxation of external AS and m. puborektalis
- Contraction of diaphragm, abdominal wall and rectum
- Epithelial sensor: watery, solid, gas
Bowel Movement: Physiology (2)

- Function of colon: stool formation and water salvation/reabsorption
- Feeding/drinking as stimuli for bowel movement (gastrocolic reflex)
- Dietary fiber intake for *stool bulking*
- Less drink
- Increased water loss
- Reduced physical activities
- Stress and change in daily activities
Vicious cycle: Pain-withholding-fecal mass

Hard stool

↓

Anal fissure

↓

Painful defecation

↓

Withholding

Reabsorption

↓

Harder stool

↓

More painful defecation
Vicious cycle: Distention-sensation

Hard & large stool

Chronic stool distention

Ambang rangsang
Sensasi rektum ↓

Kemampuan sensor ↓

Panggilan defekasi (-)
Constipation: Etiology in neonates and infants

- Meconium plug
- Hirschsprung Disease
- Anorectal congenital malformasi
- Chronic idiopathic intestinal pseudo-obstruction syndrome
- Hypotiroid
- Cow’s Milk Allergy
- Metabolic: diabetes insipidus, RTA
- Stool retention
- Dietary changes
Constipation:
Etiology in Todler & 2-4 years children

- Anal fissure
- Toilet refusal
- Cows Milk Allergy
- Short Segment Hirschsprung disease
- Neurologic: central or muscular with hypotoni
- Spinal cord: meningocele, tumor, tethered cord
Constipation:  
Etiology in School Age Children

- Stool retention
- Limited availability of toilet
- Limited capability in recognizing physiologic stimuli
- Preoccupation with other activities
- Tethered cord
Constipation: Etiology in adolescent

- Irritable bowel syndrome
- Spinal cord injury (trauma, accident)
- Diet
- Anoreksia
- Pregnancy
- Laxative abuse
Constipation:
Etiology in children of all ages

- Side effect of drugs
- Dietary changes
- Post-surgery
- History of ano-rectal surgery
- Stool retention and encopresis due to chronic stool distention
- Changes in physical activities, dehydration
- Hypotiroid
Constipation: complications

- Pain: anus or abdomen
- Anal fissure
- Encopresis
- Enuresis
- UTI, ureter obstruction
- Rectal prolaps
- Soliter ulcers
- Stasis syndrome: overgrowth bacteria, maldigestion, fermentation, bile acid dekonjugation, steatorrhea
Constipation: Examinations

- Plain photo of abdomen
- Barium enema
- Rectal biopsy
- Manometry
- Others
Megacolon in Morbus Hirschsprung
Transition area in Morbus Hirschsprung
Functional Constipation: Management

- Disimpaction (stool evacuation)
- Maintenance treatment
  - Dietary intervention
  - Behavioral modification
  - Drugs
  - Follow up
VOMITING
Vomiting

- Common symptom occur in infants and children
- Parental concern
- Mild illness or fatal disease
- Normal or pathologic

- Physiologic gastroesophageal reflux
- Overfeeding
- Excessive crying
Vomiting: Definition

- Vomiting: forceful expulsion of gastrointestinal contents into the esophagus
- GER: the involuntary passage of gastric contents into the esophagus
- Regurgitation: reflux dribbled effortlessly into or out of the mouth
Vomiting: Etiology

- Infection
  - Otitis media
  - Gastroenteritis
  - Urinary tract infection
  - Meningitis

- Drug and toxin

- Metabolic diseases

- Intestinal obstruction
  - Pyloric stenosis
  - Malrotation
  - Intussusception

- Non-obstructive GI disease
  - Gastroesophageal reflux
  - Appendicitis
  - Gastritis
Vomiting in Children

- Long list of etiology
- Life-threatening causes of vomiting
- Approach based on:
  - age groups
  - presence of intestinal obstruction
  - presence of extra-gastrointestinal symptoms
- Other important things, vomiting appearance, severity of disease in general, other gastrointestinal symptoms
Vomiting: Etiology in neonates aged 0-2 weeks

- Normal variation (*spitting up*)
- Gastroesophageal reflux
- Intestinal obstruction (congenital)
- Necroticans enterocolitis (NEC)
- Infection (sepsis, meningitis)
Red flags for organic cause of vomiting in neonate (1)

- History of hydramnion
- Persistent vomiting
- Bile vomiting
- *Drowsiness*, unwanted to suck
- Abdominal distention
- Failure to Thrive
Red flags for organic cause of vomiting in neonate (2)

- Dehydration
- Fever
- Delay in meconium excretion
- Peristaltic wave in the abdomen (right to left)
- Palpable mass: meconium ileus, enlarge kidney, gut duplication, urine bladder
- Bulging fontanel
Vomiting: Etiology in children aged 2 weeks -12 months

• Normal variation
• Gastroesophageal reflux
• Intestinal obstruction (especially HPS, intussusceptions, incarcerate hernia)
• Gastroenteritis
• Infection: sepsis, meningitis, UTI, otitis media, pertussis
• Drug overdose: aspirin, theophylline
Vomiting: Etiology in children >12 months

- Intestinal obstruction (incarcerate hernia, intussusceptions)
- Gastroenteritis, gastroesophageal reflux, appendicitis
- Infection: meningitis, UTI, URTI
- Metabolic ketoacidosis
- Toxin/drug: aspirin, theophylline, iron, lead
Vomiting: complications

- Mallory-Weiss syndrome
- Gastric aspiration
- Failure to Thrive
- Water and electrolytes imbalance
Vomiting: management

- Based on the etiology
- Correction of water and electrolytes imbalance
- Metoclopramide
- Domperidone
- Cisapride
- Bethanechol
- Ondasetron
ABDOMINAL PAIN
Abdominal Pain

• Acute abdominal pain
• Chronic abdominal pain
Acute Abdominal Pain

• Diagnostic challenge
• Differential diagnosis is broad
• Requires careful and detailed observations, often repeated several times
• Searching for clues to the diagnosis
• Require immediate surgical intervention
• Localization of pain
Acute Abdominal Pain

- History
- Physical examination
- General examination
- Abdominal examination
- Rectal & pelvic examination
- Laboratory test
- Radiography: PFA, CT, USG
Acute Abdominal Pain

Medical conditions (1)

- Gastroenteritis
- Constipation
- UTI
- Urolithiasis
- Ovarian torsion and cyst
- Ectopic pregnancy
Acute Abdominal Pain

Medical conditions (2)

• Pelvic inflammatory disease
• Acute cholecystitis
• Biliary colic
• Ulcer disease
• Pancreatitis
• Inflammatory Bowel Disease
• Henoch-Schonlein Purpura
Acute Abdominal Pain

Surgical conditions (2)

• Appendicitis
• Intussusception
• Malrotation with volvulus
• Incarcerated inguinal hernia
• Testicular torsion
• Foreign body ingestion
Chronic Abdominal Pain

- Organic and non-organic
- Mostly (95%) functional (non-organic)
- Costly diagnostic test
- Frustration for patients, parents and doctors
Epidemiology

- 10-15% of school-aged children
- 2-4% of pediatric visits
- Apley (1958): 5% organic
- 75% of adolescent; 13-15% have pain on a weekly basis, with 21% severe enough to affect activity (Hyams et al, 1996)
- At present: 33% organic and 67% functional
Organic Causes of Chronic Abdominal Pain

- Constipation
- Inflammatory bowel diseases (IBD)
- Lactose intolerance
- Helicobacter pylori infection
- Peptic ulcer disease
- Infestation/Infection
- Gynecologic condition
- Physical and sexual abuse
Functional pediatric disorders  
(Rome II criteria)

Abdominal pain

⇒ Functional dyspepsia
⇒ Irritable bowel syndrome
⇒ Functional abdominal pain
⇒ Abdominal migraine
## Functional GI Disorders

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Symptoms</th>
<th>Pain</th>
<th>General symptoms</th>
<th>Bowel movements</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAP</td>
<td>12 weeks</td>
<td>Nearly continuous</td>
<td>No characteristic of other FGID</td>
<td>No relation</td>
</tr>
<tr>
<td>IBS</td>
<td>12 weeks</td>
<td>Relieved by defecation</td>
<td>Bloating, cramping</td>
<td>Abnormal frequency or form, + mucus</td>
</tr>
<tr>
<td>Functional dyspepsia</td>
<td>12 weeks</td>
<td>Upper abdomen</td>
<td>Heartburn, early satiety, bloating</td>
<td>No relation</td>
</tr>
<tr>
<td>Abdominal migraine</td>
<td>3 or more episodes of 2 hours or longer</td>
<td>Paroxysmal midline</td>
<td>Symptom-free interval, unilateral headache, aura, photophobia, family history</td>
<td>No relation</td>
</tr>
</tbody>
</table>
HISTORY

- Thorough and detailed history
- Patient first, then parents
- One finger, not entire hand, is used to localized an area of pain
- Quality, intensity, duration, and timing of pain
Findings Suggestive of Organic Etiology in a Child with RAP (1)

- Patient age < 5 years
- Constitutional symptoms: fever, weight loss or growth deceleration, joint symptoms
- Emesis, particularly if bile- or blood-stained
- Pain that awakens the child from sleep
- Pain well localized away from the umbilicus
- Referred pain to the back, shoulders, or extremities
Findings Suggestive of Organic Etiology in a Child with RAP (2)

- Dysuria, hematuria, or flank pain
- Family medical history of IBD, PUD, etc
- Perianal disease (tags, fissures, fistulas)
- Occult or gross blood in the stool
- Abnormal screening laboratory studies (elevated ESR, WBC, hypoalbuminemia, anemia)
Algorithm for the initial management of RAP

1. History and Physical
   - Functional GI diagnosis (Rome criteria)
   - Reassurance
   - Education
   - Therapy (optional)

2. Red flags?
   - No
     - Optional
   - Yes
     - Laboratory
     - Radiology
     - Endoscopy

3. Positive
   - Organic disease
   - Therapy
GASTROINTESTINAL BLEEDING
Gastrointestinal Bleeding

- Parent: the presence of blood in stool or vomitus is an indication of severe disease
- Uncommon event in infants and children: consulted to specialist
- Seriously ill versus trivial bleeding
DEFINITIONS

- **Melena** is the passage of black, tarry stools
- **Hematochezia** is the passage of bright or dark red blood per rectum
- **Hematemesis** is the passage of vomited material that is black (“coffee grounds”) or contains frank blood
Present illness

- Source of bleeding
- Magnitude of bleeding
- Duration of bleeding
- Associated gastrointestinal symptoms (vomiting, diarrhea, pain)
- Associated systemic symptoms (fever, rash, joint pain)
Review of systems

- Gastrointestinal disorders
- Liver diseases
- Bleeding diatheses
- Anesthesia reactions
- Medications (NSAID, warfarin, hepatotoxins)
FAMILY HISTORY

- Gastrointestinal disorders (polyps, ulcers, colitis)
- Liver diseases
- Bleeding diatheses
- Anesthesia reactions
SUBSTANCES THAT COMMONLY COLOR EMESIS OR STOOLS

RED
• Candies
• Fruit punch
• Beefs
• Laxatives
• Phenytoin
• Rifampicin

BLACK
• Bismuth
• Activated charcoal
• Iron
• Spinach
• Blueberries
• Licorice
PHYSICAL EXAMINATIONS

SKIN

• pallor, jaundice, ecchymoses, abnormal blood vessels, hydration

HEAD, EYES, EARS, NOSE, THROAT

• Nasopharyngeal injection, oozing
• Tonsillar enlargement, bleeding
PHYSICAL EXAMINATIONS

CARDIOVASCULAR
- Heart rate, lying and sitting
- Pulse pressure, lying and sitting
- Gallop rhythm
- Capillary filling

ABDOMEN
- Organomegaly
- Tenderness
PHYSICAL EXAMINATIONS

PERINEUM
• Fissure
• Fistula
• Induration

RECTUM
• Gross blood
• Melena
• Tenderness
LABORATORY STUDIES

SIGNS OF SHOCK – SYSTEMIC OR LIVER DISEASE ABSENT

- Complete blood count
- Erythrocyte sedimentation rate
- BUN
- Prothrombin time
- Partial thromboplastin time
- Guaiac stool, emesis
LABORATORY STUDIES

SIGNS OF SHOCK – SYSTEMIC OR LIVER DISEASE PRESENT

- CBC, ESR, BUN, PT, PTT, guaiac stool, emesis
- Blood typing and crossmatch
- SGOT, SGPT, γ-GT
- Creatinine, albumin, total protein
IMAGING STUDIES

Upper GI series
• Dysphagia, odynophagia, drooling

Barium enema
• Suspected intussusception
• Stricture found at endoscopy

Abdominal ultrasound
• Suspected portal hypertension
IMAGING STUDIES

Meckel’s scan
• Suspected Meckel’s diverticulum

Sulfur colloid scan, Labeled RBC scan
• Obscure gastrointestinal bleeding

Angiography
• Obscure gastrointestinal bleeding
Esophagogastroduodenoscopy
• Hematemesis, melena

Colonoscopy
• Hematochezia

Video-endoscopy
• Obscure gastrointestinal blood loss
Supportive care

- Intravenous fluids (NS, RL)
- Blood products (Whole blood, PRC, FFP)
- Pressors
Specific care

- Barrier agents (sucralfate)
- H2 antagonist (cimetidine, ranitidine)
- PPI (omeprazole, lansoprazole)
- Somatostatin analogue
Endoscopy therapy

- Coagulation (cautery, heater probe, laser)
- Variceal injection or ligation
- Polypectomy
Differential Diagnosis: Neonates

Hematemesis, melena
- Swallowed maternal blood
- Stress ulcers, gastritis
- Duplication cyst
- Vascular malformations
- Vitamin K deficiency
- Hemophilia
- Maternal Idiopathic thrombocytopenic purpura
- Maternal NSAID use
Hematochezia

- Swallowed maternal blood
- Dietary protein intolerance
- Infectious colitis, Necrotizing enterocolitis
- Hirschsprung’s disease with enterocolitis
- Duplication cyst
- Vascular malformations, Vitamin K deficiency
- Hemophilia
- Maternal ITP, Maternal NSAID use
DIFFERENTIAL DIAGNOSIS: INFANTS

Hematochezia
- Anal fissure
- Intussusception
- Infectious colitis
- Dietary protein intolerance
- Meckel’s diverticulum
- Duplication cyst
- Vascular malformations

Hematemesis, melena
- Esophagitis, gastritis
Differential Diagnosis: Children

Hematemesis, melena

- Esophagitis
- Gastritis
- Peptic ulcer disease
- Mallory-Weiss tears
- Esophageal varices
- Pill ulcers
Differential Diagnosis: Children

Hematochezia
- Anal fissure
- Infectious colitis
- Polyps
- Lymphoid nodular hyperplasia
- Inflammatory bowel disease
- Henoch-Schönlein purpura
- Intussusception
- Meckel’s diverticulum
- Hemolytic-uremic syndrome
DIFFERENTIAL DIAGNOSIS: CHILDREN

Hematemesis, melena
- Esophagitis
- Gastritis
- Peptic ulcer disease
- Mallory-Weiss tears
- Esophageal varices
- Pill ulcers
DIFFERENTIAL DIAGNOSIS: ADOLESCENTS

Hematochezia

- Infectious colitis
- Inflammatory bowel disease
- Anal fissures
- Polyps
LACTOSE INTOLERANCE
Issues on lactose

• Induction of lactase?
• Lactose and infantile colic
• Lactose and recurrent abdominal pain
• Lactose and premature breastmilk
• Lactose and brain development
• Lactose and diarrhea
Terminology

- Lactase deficiency
- Lactose intolerance
- Lactose malabsorption
- Milk intolerance
Lactose

- Sugar in milk, disaccharide
- Breastmilk 7%, cow’s milk 4%
- *Pacific sea lion*
- Absorbed by the small intestinal mucosa
- 10,000 years ago – milk processing - lactose tolerant
### Racial distribution of lactose absorber and malabsorber

<table>
<thead>
<tr>
<th>Malabsorber</th>
<th>Absorber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bantu</td>
<td>Fiji</td>
</tr>
<tr>
<td>Negro</td>
<td>Australia (aborigen)</td>
</tr>
<tr>
<td>Thai</td>
<td>Indian (North America)</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Indian (South America)</td>
</tr>
<tr>
<td>China</td>
<td>Israel</td>
</tr>
<tr>
<td>Korea</td>
<td>Arab</td>
</tr>
<tr>
<td>Japan</td>
<td>Eskimo</td>
</tr>
<tr>
<td></td>
<td>America (white)</td>
</tr>
<tr>
<td></td>
<td>Finland</td>
</tr>
<tr>
<td></td>
<td>Denmark</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
</tr>
<tr>
<td></td>
<td>French</td>
</tr>
<tr>
<td></td>
<td>Australia (white)</td>
</tr>
<tr>
<td></td>
<td>English</td>
</tr>
</tbody>
</table>
## Lactose content in milk and dairy products

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>PORSSION (gram)</th>
<th>LACTOSE PER PORSSION (gram)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>244</td>
<td>11</td>
</tr>
<tr>
<td>Low fat milk</td>
<td>244</td>
<td>9 - 13</td>
</tr>
<tr>
<td>Skimmed milk</td>
<td>244</td>
<td>12 - 14</td>
</tr>
<tr>
<td>Chocolate milk</td>
<td>244</td>
<td>10 - 12</td>
</tr>
<tr>
<td>Fullcream milk (powder)</td>
<td>128</td>
<td>48</td>
</tr>
<tr>
<td>Powder milk non-fat (instant)</td>
<td>91</td>
<td>46</td>
</tr>
<tr>
<td>Cheese</td>
<td>28</td>
<td>0,6 - 0,8</td>
</tr>
<tr>
<td>Butter</td>
<td>10</td>
<td>0,1</td>
</tr>
<tr>
<td>Ice cream</td>
<td>133</td>
<td>9</td>
</tr>
</tbody>
</table>
Lactase

• Located at brushborder of gut mucosa
• Different activity in different gut segment
• Ontogeny: Intrauterine and postnatal
• Lactose malabsorption is normal in neonate
Classification of lactase deficiency

- Congenital lactase deficiency
- Secondary lactase deficiency
  - Gastroenteritis
  - Cow milk allergy
  - Giardiasis
  - Malnutrition
- Primary lactase deficiency
Diagnostic test for lactose malabsorption

- Stool analysis
- Lactose tolerant test
- Breath hydrogen test
- Lactase activity in mucosal biopsy specimen
Treatment of lactose intolerance

- Lactose free diet
- Lactase supplementation
- Probiotic
Conclusion

• Problem-based learning
• Patient as an entry point to study
• Knowledge: reading, discussion, writing
• Skill
• Experiences
• Case management