Gastrointestinal Diseases

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Introduction

Gastrointestinal diseases in the context of global health are generally communicable, pathogen born infections that involve some part of the gastrointestinal tract. The most common symptoms associated with this class of infections are diarrhea and vomiting. However these infections also present with extra-intestinal symptoms and can often be asymptomatic.

This module introduces the broad impact of gastrointestinal disease through a categorical organization of etiologic agents, treatment schema, pertinent public health challenges, and social justice issues that influence GI disease prevalence. For those who desire a deeper understanding of gastrointestinal diseases and their context, see the reading list suggested at the end of this module.
Introduction

As mentioned, this presentation is meant to serve as an overview of the topic of GI illnesses in a global health context, and is by no means exhaustive. We hope that completing the module will encourage you to pursue this important topic further. References for further information are placed throughout the module and in the bibliography. As an additional resource, a number of videos are included in the presentation like the one below which introduces the topic of GI illnesses in the developing world.

Outline

This presentation is in eight sections:
1. Introduction
2. Common gastrointestinal pathogens
3. Treatment protocols
4. Oral rehydration therapy
5. Advances to clinical treatment
6. When things go wrong
7. Systemic approaches to therapy and prevention
8. Quiz

Video Introduction to Childhood Diarrhea
Territory size reflects the proportion of childhood diarrheal incidence age 0-4. ¹ For example, India (yellow) appears very large in comparison to Australia, which has a surface area approximately two times bigger than India, indicating the high prevalence of diarrheal disease in India. ²

Humans will always suffer from gastrointestinal illness. However, the burden of diarrheal disease is unequally distributed around the world as the WHO study mentioned below states,
There is an overwhelmingly large number of pathogens that cause gastrointestinal illness. Our job here is not to describe the biology of these organisms but to explore ways that a particular organism's biology impacts its epidemiology as well as the different approaches needed for control. For more information about the following organisms see the link to a microbiology textbook in the bibliography.

In the next section we discuss the biology and epidemiology of the virus Rotavirus, helminths of the *Schistosoma* genus, and bacteria of the *Shigella* genus as a way to illustrate the three major categories of pathogens and methods of control.

Though there is a remarkable difference in the impact of specific pathogens between countries, it is important to remember that the vast majority of GI infections occur in the developing world. Also, notice the difference in diarrheal etiology between developed and developing countries. (Image adapted with permission from Kapikian AZ, et al. In Fields Virology. (Knipe DM, et al, eds). 2001; 1787-1825)
Rotavirus infection is the most common cause of severe childhood diarrhea worldwide and of diarrheal mortality in poor countries. ¹

Rotavirus is particularly relevant to our discussion because vaccines that confer immunity to certain strains of the virus are now available. The question of who gets the vaccine and when is currently being debated.

Pathophysiology:
Rotavirus is a double stranded RNA virus that infects the epithelium of the upper two-thirds of the small intestine. The overwhelming immune response to the infection causes the classic presentation of malabsorption and overwhelming diarrhea. ²

¹) Jawetz, Melnick, & Adelberg's Medical Microbiology, Chapter 37
Rotavirus is the most common cause of severe, dehydrating diarrhea among children worldwide. Each year it causes about:

- 111 million cases of disease requiring home care only
- 25 million clinic visits
- 2 million hospitalizations (40% of hospitalizations due to diarrhea!)
- More than 500,000 deaths in children aged five or younger

Overall, 95% of children worldwide are infected with rotavirus by 3 to 5 years of age, though clinical illness incidence peaks in children ages 4 to 36 months. This age group is also at greatest risk for severe disease requiring hospitalization. Rotavirus infections of adults are usually subclinical, however they occasionally cause illness in immunocompromised patients, the elderly, travelers to developing countries and the parents of children infected with rotavirus. ¹

Vaccines

In 2009 the WHO recommended that the rotavirus vaccine be included in all national immunization programs. However, only 27 countries currently vaccinate all children. The reason for this delay is that the major healthcare development organizations (ie., UNICEF, USAID, etc.) continue to demand evidence of the economic burden of the disease, projected impact of rotavirus vaccine, and estimated cost effectiveness. While research has shown that the currently available rotavirus vaccines are less effective at conferring immunity in low-income countries (46-77% compared to 85-100% in high-income countries), the case-study that follows demonstrates that vaccines are the only public health measure likely to control rotavirus disease.

1) Rotavirus infections and vaccines: burden of illness and potential impact of vaccination. Grimwood K, Lambert SB, Milne RJ.
2) Global Rotavirus Surveillance: Determining the Need and Measuring the Impact of Rotavirus Vaccines, Widdowson et al, JID 2009:200 (Suppl 1)
3) (CDC MMWR 4/2011)
Image: http://www.rotateq.com/rotavirus-vaccine.html
Case study: Nicaragua

In response to an outbreak of rotavirus in 2005, the national leadership of Nicaragua decided not to wait for academic consensus and introduced universal vaccination against rotavirus virtually overnight. The video below is a narrative summary of Nicaragua’s vaccination experience against rotavirus.

Vaccines play an important role in controlling diarrheal disease. Once children become sick, they can often be saved with oral rehydration solution, but in resource poor settings the knowledge to make, or resources to buy ORS may be inadequate.

Slide 5 shows almost no mortality due to Rotavirus in the US. Although universal vaccination against rotavirus was introduced in the United States in 2006, low mortality rates are largely due to access to clean water and hospitals.

Later in the presentation we will directly address the question of why international health leadership may hesitate to introduce wide scale infrastructural changes in developing countries.

Helminthic infections affect about 2 billion people,\(^1\) making them one of the most prevalent categories of infectious agents worldwide\(^2\). Though most cases are asymptomatic, morbidity and mortality rates are substantial, causing avoidable disease that interferes with childhood development, adult productivity and overall quality of life.

**Video Introduction to Helminthic Infections**
Schistosomiasis or bilharzia is a prime example of helminthic gastrointestinal infection. This disease is caused by flatworms such as *Schistosoma mansoni* and other *Schistosoma* ssp. Over 200 million people are affected by this disease. Though most cases are asymptomatic, approximately 100,000 die annually from these infections, and 80% of which occur in sub-Saharan Africa.

Acute schistosomiasis occurs just weeks after heavy exposure to larvae and presents as a serum sickness type illness with fever. In severe cases chronic infection can present with portal hypertension, cor pulmonale, liver failure and renal failure.

In Egypt, a country particularly affected by Schistosomiasis, infection is so common among men that the bloody urine seen in severe infection is considered normal by some, and referred to as “male-menstruation.”

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**Video Introduction to Schistosomiasis**

2) Bradley: Neurology in Clinical Practice, 5th ed.
3) Mandell: Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, 7th ed., Ch. 289, pgs 3595-3605
4) [http://en.wikipedia.org/wiki/Male_menstruation](http://en.wikipedia.org/wiki/Male_menstruation)
Schistosoma ssp. Lifecycle

Schistosoma ssp lifecycle dictates how and when communities are at risk to infection. A key step in the parasite’s life cycle requires inhabiting a snail as its host organism. Some have proposed using molluscicide (snail poison) to eliminate schistosomiasis.¹ What might be some of the risks to using molluscicide to manage schistosomiasis?

About 85% of all schistosomiasis cases are in Africa. What factors contribute to this trend?

Schistosomiasis is most commonly found in impoverished communities lacking potable water and adequate waste sanitation. These challenges are compounded by the under production and inadequate distribution of the medication used to treat these infections.¹

Shigellosis

Bacteria classified under the genus *Shigella* are globally endemic and a common cause of dysentery*, which begins one to two days post infection. If untreated, diarrhea will persist for up to one week.³

As with other gastrointestinal infections, prevalence is highly associated with poor infrastructure, poverty, and overcrowding. It is estimated that of the 165 million annual incidences of global Shigellosis, more than one million people die, the majority of whom are children under 5.¹,⁴

Shigellosis also affects military populations around the world accounting for approximately 500,000 cases per year.³ Historically its impact has played a debilitating role for soldiers in the field.

This micrograph reveals the first stage of shigellosis as it progresses; by this stage, the Shigella sp. bacteria have penetrated the intestinal mucosa.⁶

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¹, ³, ⁴, ⁶ Refer to notes.
Shigella and Breast Feeding
Diarrheal prevention measures and treatment are addressed in subsequent slides. It is notable however, that Shigellosis is one of the prime reasons to encourage breast feeding of infants, provided that the mother is HIV negative. Not only does it reduce the risk of bacterial ingestion, but in endemic areas breast milk provides protective antibodies against Shiga toxin and endotoxin.¹

Vaccine Development
Currently, no vaccine against shigellosis exists. Two big challenges face vaccine development - economic and biologic. Most people affected by shigellosis live in middle and low income countries, decreasing the financial incentive to develop vaccines. Furthermore, high income countries may be less interested in such a vaccine because antibiotics and infrastructure are more cost effective. Biologically, scientists face the challenge of developing a vaccine to protect against an organism that has many variants. At present, there are 47 known pathogenic Shigella serotypes.⁴

See notes
Travellers' Diarrhea

Gastrointestinal infections are not limited to those in the developing world. In fact, 20-60% of those traveling internationally will suffer a GI infection and become symptomatic during their trip. Moderate Travellers Diarrhea is defined as at least 3 loose-to-watery stools in a 24-hour period with or without cramping, nausea, fever, vomiting, or blood in the stool. ¹ Travellers to low and middle income countries with poor food quality and water quality and hygiene are more likely to get sick.

Bacteria are the most frequent culprit for the infection, with E. Coli being detected about 50% of the time. Viruses such as norovirus and rotavirus are detected about 20% of the time, while intestinal parasites rarely play a role in travelers' diarrhea. ²

¹) Management of travellers’ diarrhoea. David R Hill and Edward T Ryan
²) Systematic review: the epidemiology and clinical features of travellers’ diarrhoea. H. L. DUPONT
Image from: http://adventures.worldnomads.com

www.adventures.worldnomads.com
Prevention:
Travelers should use caution when poor food and water hygiene are the norm and avoid raw or undercooked meats, unpasteurized milk, tap water, ground-grown leafy greens, and cooked foods that have stood at room temperature. Antibiotic prophylaxis is not now recommended for all travelers. It is typically reserved for people such as professional athletes competing abroad in developing countries or American soldiers stationed in South America. However, prophylactic Bismuth Subsalicylate (Pepto Bismol) can be an effective alternative for travelers, reducing the frequency of Traveler's Diarrhea by up to 60%.  

Treatment:
Hydration with clean water and/or oral rehydration solution should be maintained for all forms of diarrhea, and in many instances antibiotics are also indicated. When indicated, determining the appropriate antibiotic for treatment is important. In many regions one dose of a broad spectrum fluoroquinolone such as ciprofloxacin can be given. However, treatment in South/South-East Asia is an exception due to endemic ciprofloxacin resistance by organisms within the genus Campylobacter. Here the macrolide azithromycin is indicated. After initial dosing, response is evaluated over 12-24 hours with continued antibiotic treatment lasting up to 3 days if diarrhea persists.  

1) Management of travellers’ diarrhoea. David R Hill and Edward T Ryan  
2) Systematic review: the epidemiology and clinical features of travellers’ diarrhoea. ² H. L. DUPONT
Have you considered?

While we generally discourage the use of antibiotics to treat simple diarrhea in most developing countries, we often send healthcare workers overseas with their own stock of Ciprofloxacin or Azythromycin. What is the rationale for this difference in treatment protocols? How does it reflect our values as individuals working in the field of Global Health and what does this behavior communicate to those that we serve?

Read about the ethics of overseas work:

Photo credit: Rachel Ballester, 2011
Treatment Protocols

In this age of multinational Non-Governmental Organizations and evidence-based medicine, one cannot discuss treatment of an illness without referring to established protocols.

The strength of protocols lies in their adaptability under different healthcare environments – “different” in terms of healthcare infrastructure including clinic, medical and staff capabilities, as well as variable community disease profiles.

While examining the examples that follow, keep in mind that each organization has its own best-practices, and that different realities on the ground impact how the different protocols are designed and used.
Treatment Protocols

This treatment algorithm has been adapted from the Partners In Health model used in Latin America to train health promoters with little direct supervision from or access to doctors and diagnostic labs. Diarrhea unaccompanied by blood in the stool or fever does not require antibiotics. Also, note that dysentery should never be treated with bismuth (Pepto-Bismol) because it slows the body’s process of expelling pathogens and toxins.

Watery Diarrhea
(> 3 episodes of diarrhea per day)

Give oral rehydration therapy (ORS) until the patient’s shows signs of hydration. Encourage the patient to eat.

Blood or fever?

Dysentery
Step 1: Antibiotics

Step 2: Diarrhea has not improved? The infective organism may be antibiotic resistant or an amoebic. Give second line antibiotics and anti-amoebic medications

No antibiotics needed
Give ORS and possibly bismuth

Note: NEVER give bismuth to someone with dysentery.

Diarrhea without blood or fever?

Extremely ill? Abdominal Pain?

This could indicate something dangerous! Take the patient to a hospital.

PIH CHW Training Module. Daniel Palazuelos, 2011
Treatment Protocols

Does the child have diarrhoea?

**IF YES, LOOK AND FEEL:**
- Look at the child's general condition. Is the child:
  - Lethargic or unconscious?
  - Sunken eyes?
  - Not able to drink or drinking poorly?
  - Skin pinch goes back very slowly?
- Offer the child fluid. Is the child:
  - Not able to drink or drinking poorly?
  - Skin pinch goes back very slowly?
- Pinch the skin of the abdomen. Does it go back:
  - Very slowly (longer than 2 seconds)?
  - Slowly?

**Classify DIARRHOEA**

**for DEHYDRATION**

- Two of the following signs:
  - Lethargic or unconscious
  - Sunken eyes
  - Not able to drink or drinking poorly
  - Skin pinch goes back very slowly
- If child has no other severe classification:
  - Give fluid to severe dehydration (Plan C)
  - OK
- If child also has another severe classification:
  - Refer URGENTLY to hospital with mother giving frequent sips of ORS on the way
  - Advise the mother to continue breastfeeding

**SEVERE DEHYDRATION**

- If child is 2 years or older and there is cholera in your area, give antibiotic for cholera

**SOME DEHYDRATION**

- Two of the following signs:
  - Restless, irritable
  - Sunken eyes
  - Drinks eagerly, thirstily
  - Skin pinch goes back slowly
- If child also has a severe classification:
  - Refer URGENTLY to hospital with mother giving frequent sips of ORS on the way
  - Advise the mother to continue breastfeeding

**NO DEHYDRATION**

- Not enough signs to classify as some or severe dehydration
- Give fluid, zinc supplements, and food to treat diarrhoea at home
- Advise mother when to return immediately
- Follow-up in 5 days if not improving

**and if diarrhoea for 14 days or more**

- Dehydration present
- SEVERE PERSISTENT DIARRHOEA
  - Treat dehydration before referral unless the child has another severe classification
  - Refer to hospital

- No dehydration
- PERSISTENT DIARRHOEA
  - Advise the mother on feeding a child who has PERSISTENT DIARRHOEA
  - Give multivitamins and minerals (including zinc) for 14 days
  - Follow-up in 5 days

- Blood in the stool
- DYSENTERY
  - Give ciprofloxacin for 3 days
  - Follow-up in 2 days

WHO IMCI 2008

With support from organizations such as the World Bank, UNICEF, and USAID, the WHO’s strategy for the integrated management of childhood illness (IMCI) is designed as a training tool for community health workers and other healthcare providers. Ideally, this training facilitates the integration of effective community health workers and others into national healthcare systems, improving their efficiency and effectiveness. WHO IMCI 2008 (http://www.who.int/child_adolescent_health/documents/IMCI_chartbooklet/en/index.html)
Treatment Protocols

Teach the Mother to Give Oral Drugs at Home

- Follow the instructions below for every oral drug to be given at home. Also follow the instructions listed with each drug’s dosage table.
- Determine the appropriate drugs and dosage for the child’s age or weight
- Tell the mother the reason for giving the drug to the child
- Demonstrate how to measure a dose
- Watch the mother practise measuring a dose by herself
- Ask the mother to give the first dose to her child
- Explain carefully how to give the drug, then label and package the drug. If more than one drug will be given, collect, count and package each drug separately
- Explain that all the tablets or syrup must be used to finish the course of treatment, even if the child gets better
- Check the mother’s understanding before she leaves the clinic

For dysentery give Ciprofloxacin
15mg/kg/day—2 times a day for 3 days

Second-line antibiotic for dysentery:

<table>
<thead>
<tr>
<th>AGE</th>
<th>250 mg TABLET</th>
<th>500 mg TABLET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 6 months</td>
<td>1/2 tablet</td>
<td>1/4 tablet</td>
</tr>
<tr>
<td>6 months up to 5 years</td>
<td>1 tablet</td>
<td>1/2 tablet</td>
</tr>
</tbody>
</table>

For cholera:

First-line antibiotic for cholera:

Second-line antibiotic for cholera:

<table>
<thead>
<tr>
<th>AGE or WEIGHT</th>
<th>TETRACYCLINE</th>
<th>ERYTHROMYCIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 years up to 5 years (12 - 19 kg)</td>
<td>Give 4 times daily for 3 days</td>
<td>Give 4 times daily for 3 days</td>
</tr>
<tr>
<td></td>
<td>250 mg TABLET</td>
<td>250 mg TABLET</td>
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These protocols are designed to guide antibiotic use by community health workers, nurses and doctors. Guides help prevent development of antibiotic resistant bacteria, which is an increasing problem in both urban and rural settings.

WHO IMCI 2008
Oral rehydration solution or ORS is considered the most important and most readily available treatment for diarrheal illness. ORS replaces lost fluids, electrolytes and calories in an individual suffering from diarrhea. Commercial or homemade ORS can be used for treatment and it is important to take stock in the pros and cons of each approach.
Commercial and Homemade ORS

The Break Down:
ORS packages cost approximately 15-20 cents USD.¹ However in 2002, as much as 17% of the world's population lived on 1$ a day.² This is the same group of people who die of diarrhea, which begs the question: Is 15 cents too expensive? For many, the answer is yes. On average diarrhea lasts 5-7 days, and children with severe diarrhea need at least 1L of ORS daily.¹ When food money is spent on ORS, these often malnourished individuals and their families are forced to further restrict their diet. This puts the sick individual at risk for exacerbation and prolongation of their diarrheal disease while increasing risk of infection among family members.

¹) David Warner, Questioning the Solution
²) www.worldmapper.org, copyright 2006 SASI

Image from: UNICEF.org
Easy Methods for Making ORS

1. WITH SUGAR AND SALT (Raw sugar or molasses can be used instead of sugar)
   In 1 liter of clean WATER put half of a level teaspoon of SALT and 8 level teaspoons of SUGAR.

   CAUTION: Before adding the sugar, taste the drink and be sure it is less salty than tears.

   To either Drink add half a cup of fruit juice, coconut water, or mashed ripe banana, if available. This provides potassium which may help the child accept more food and drink.

2. WITH POWDERED CEREAL AND SALT
   (Powdered rice is best. Or use finely ground maize, wheat flour, sorghum, or cooked and mashed potatoes.)
   In 1 liter of WATER put half a teaspoon of SALT and 8 heaping teaspoons (or 2 handfuls) of powdered CEREAL.

   Boil for 5 to 7 minutes to form a liquid gruel or watery porridge. Cool the Drink quickly and start giving it to the child.

   CAUTION: Taste the Drink each time before you give it to be sure it is not spoiled. Cereal drinks can spoil in a few hours in hot weather.
Zinc deficiency is a common problem throughout the world. Globally, zinc deficiency ranges from 4-73% between populations, and is responsible for more than 700,000 deaths annually. Of these deaths 176,000, 406,000 and 270,000 are related to diarrhea, pneumonia and malaria, respectively. In 2004 the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) revised their treatment guidelines for pediatric diarrhea to include zinc supplementation for up to two weeks.

Therapeutic trials show that zinc reduces diarrhea by nearly a day for an average diarrheal episode of five days, but has not shown a consistent effect on stool frequency or stool output. Zinc also reduces the likelihood of subsequent GI infections in the 2-3 months following treatment. The physiological mechanism by which Zinc acts in the gut is unclear, but it appears that Zinc has an effect on the overall immune response as well as permeability of the intestinal mucosa.

1. Laura C, Robert B. Comparative Quantification of Health Risks, Chapter 5 Zinc Deficiency, World Health Organization, 2004
3. Therapeutic Value of Zinc Supplementation in Acute and Persistent Diarrhea: A Systematic Review. by Patel, Archana et al.
5. Therapeutic effects of oral zinc in acute and persistent diarrhea in children in developing countries: pooled analysis of randomized controlled trials by Zulfiqar A Bhutta et al.
Advances to Clinical Treatment of Diarrhea

Vitamin A

Although vitamin A is recognized as an important micronutrient for human health, its deficiency is prevalent throughout the developing world.\(^1\) Vitamin A deficiency significantly contributes to the incidence of diarrhea*, and we now know that it can lead to an improper immune response at the site of the gut mucosa. Failure of the gastrointestinal immune response results in increased frequency and severity of diarrheal episodes.\(^2\) The inclusion of dietary vitamin A whether by fortification of grains or biannual oral supplementation is an important tool in the arsenal of diarrhea prevention.\(^3\) According to recent studies, preventive vitamin A supplementation in children 6-59 months of age has shown a significant 30% reduction in diarrhea-specific mortality.\(^3\) Due to such studies, the WHO now recommends vitamin A supplementation in regions of Africa, South-East Asia, and other places where deficiency rates are high.\(^1\)

\*Vitamin A deficiency is the leading cause of pediatric blindness in the developing world.
Advances to Clinical Treatment of Diarrhea

Other medications:

Aside from antibiotics and antihelminthic medications, there are other GI medications that are less frequently used or are used only on an in-patient basis. These medications generally improve absorption of foods and liquids and have shown significant reduction in morbidity and mortality associated with GI infection. Synthetic opiates such as loperamide (Imodium) are used to reduce GI motility and increase the duration of absorption in the intestines.\(^1\) While loperamide can be used to decrease diarrheal episodes and severity in cases of mild to moderate traveler’s diarrhea, anti-diarrheal medication is contraindicated in the case of inflammatory diarrhea such as dysentery or pseudomembranous colitis as it can prolong the body’s exposure to associated toxins produced by the infective agent.

Bismuth Subsalicylate (Pepto-Bismol) is another drug that has shown some efficacy in diarrhea relief. However, bismuth subsalicylate is not generally promoted within the context of global health because it is a costly out of pocket expense for the poor and can be harmful to someone suffering from dysentery.

When considering these new and often expensive medicines is crucial to consider their relative cost, accessibility, and efficacy.

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1) Pharmacological Management of Diarrhea by Kent AJ and Banks MR
2) http://www.med.umich.edu/pediatrics/ebm/cats/subsalic.htm
Eventually, her child developed severe diarrhea that did not improve with a traditional oral rehydration solution of rice water and herbal tea. Rakku was forced to travel with her sick child to a hospital in the city. To pay for transport, she sold her last remaining possessions of value. After hours of waiting to see the doctor, an IV was started and fluids flowed into the dehydrated infant. Rakku was told to keep the baby fed and hydrated and was sent home. “On the way home the baby’s diarrhea restarted. Arriving home, Rakku had no food, money, or anything to sell. Her baby died a short time later.”
Approaches to the Treatment and Prevention of GI infections

Thus far this module has dealt primarily with point-of-care treatment protocols for various pathogens, and their pitfalls. As with almost all illness, GI illness is found more often among the poor (such as Rakku). To begin resolving the problem of diarrheal illness certain questions such as: “What factors contribute to this unequal disease distribution?” and “What can be done to alleviate them?” must be answered. We present the case of Cholera in Haiti as these questions have been explored by caregivers in this overwhelmingly poor country.

Case Study: Cholera in Haiti

Introductory video

In response to the Cholera epidemic that still grips Haiti, Paul Farmer and colleagues from Partners In Health from the Harvard School of Public Health published recommendations for the improvement of healthcare delivery in Haiti.¹ They divided their recommendations into three categories highlighting point-of-care health services, sanitation infrastructure, and health-literacy/outreach program development.
In its 2009 report titled *Diarrhoea: Why children are still dying and what can be done*, the WHO laid out its own set of recommendations to combat childhood diarrhea:¹

**Treatment package**
1. Fluid replacement to prevent dehydration*

**Prevention package**
3. Rotavirus and measles vaccinations
4. Promotion of early and exclusive breastfeeding and vitamin A supplementation
5. Promotion of hand washing with soap
6. Improved water supply quantity and quality
7. Community-wide sanitation promotion.

Lessons learned over the past 50 years of development include methods for addressing current health crises while working toward institutional change, including the importance of health care promotion at the community level. Note that Paul Farmer and his colleagues stress community surveillance and general health literacy campaigns as the backbone of healthcare promotion.

Long-term infrastructure and personnel development plans are the core elements of any project seeking a serious decrease in the prevalence of GI infection and illness.

Donors committed to international health efforts focused on developing institutional change are often hesitant to fund programs that are administered by unstable governments. However, the potential consequences of neglecting to organize healthcare delivery on a national level, and, instead, allowing the private sector to take the lead, are illustrated by the following story:
When Things Go Wrong

Cecilia Najera Lopez was a member of a rural community in the southern state of Chiapas, Mexico. One afternoon she came down with severe abdominal pain and diarrhea followed by nausea and vomiting. She decided she needed to see a physician, however there were no medical professionals in the area. After enduring two painful hours on a bumpy road Cecilia arrived at a private clinic.

Upon arrival she was attended quickly. The physician took her blood pressure first, and though he neglected to ask what her typical blood pressure was, he decided it was horribly low at 109/65. Her temperature was 37.4°C [99.3°F] which he said was elevated. The physician hooked Cecilia up to iv fluids and conduct an abdominal ultrasound.

After the ultrasound he told her she was having a reaction to the steroid/vitamin B complex injection she took for back pain, stating that the medication had been injected directly into a vein. As treatment, he was going to inject her with epinephrine to bring her blood pressure up. Fortunately, he decided against this treatment and sent her home with ciprofloxacin and omeprazole.

The physician charged Cecilia approximately 150 dollars and when she left the office, she broke down in tears. The office visit had cost her half a month's salary, far more than she could afford.1
This graph\(^1\) illustrates the magnitude of impoverishment generated by health care payments in Vietnam. Households are arranged by consumption levels, with consumption plotted on the vertical axis and their rank in the consumption distribution on the horizontal axis. Households beneath the poverty line are classified as "poor." The "drips" show the out-of-pocket payments for each household. Some drips are large enough to take previously non-poor households below the poverty line. Some previously poor households become even poorer. Comparing the headcount below the poverty line "pre" and "post" out-of-pocket payment gives a crude idea of the impoverishment caused by out-of-pocket health care payment. In this case, the proportion of poor people increases from 34 to 38 percent.\(^2\)

The economic impact of out-of-pocket expenses is especially relevant to our discussion of GI illness because with approximately 2 billion world-wide cases of diarrhea per year, it is one of the most common reasons for seeking medical attention.\(^3\)

1) Graph by A. Wagstaff 2001
2) Private Participation in Healthcare edited by April Harding and Alexander S. Preker
Systemic Approaches

Fecal-Oral Route of Infection and The Four Fs

This image is a schematic created by EG Wagner that emphasizes disease prevention through the use of primary and secondary pathogen transmission barriers. These include good hygiene, clean non-dirt floors, proper food preparation, and clean water. Transfer of pathogens from feces to one or all of the “four Fs” is the first step towards infection. Pathogens are then transferred directly from the four Fs to the host or to food, whose subsequent consumption leads to infection.

A common approach in hygiene education employs stories like “Maria con Manos Sucias”¹ [Maria, the Girl with the Dirty Hands], which places blame for poor hygiene on those with the least power to make the changes needed to improve hygiene such as building latrines and providing clean water.

Commercial and political interests often further complicate the situation by usurping the people’s ability to improve infrastructure by advocating for the privatization of village water supplies, for example.

If a substantial decrease in suffering due to GI illness is to be achieved, these are some of the factors that must be addressed.

It has repeatedly been shown that improved hand washing rates lead to reduced GI illness in low income settings. However, no single protocol or curriculum, by itself, has been shown to improve hand washing rates.² We need a more collaborative and holistic approach that includes “social science disciplines coupled with clinical, biological, chemical, engineering and epidemiological approaches.”² A dynamic where health workers and residents (i.e. teachers and students) together explore the circumstances in which they live, and develop consciousness of the forces which govern their lives.³ This approach leads to novel methods of healthcare development appropriate for each particular setting, and do not fall into the age-old traps of paternalism and blaming the victims.

¹) www.slideshare.net/sacnite/la-historia-de-maria-manos-sucias
²) Systematic review: handwashing behaviour in low- to middle-income countries: outcome measures and behaviour maintenance by Stephen M. Vindigni
³) Pedagogy the Oppressed, Paulo Freire
Conclusion

This module introduces gastrointestinal illness by discussing representative pathogens, treatment, ORT, relevant clinical advances, and the challenges facing prevention. Though many approaches to change exist, we hope to emphasize the message of social justice, collaboration, and empowerment. As Paulo Friere once said “Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing, hopeful inquiry human beings pursue in the world, with the world and with each other.”

To expand upon the themes of GI disease and social justice please look to the suggested reading list on the slide following the post-module quiz.

Paulo Freire’s philosophy and approach to education is cornerstone to the approach that many utilize in the setting of global health. It rejects the traditional construct of “banking” information on behalf of repressed individuals and instead favors a collaborative approach, facilitating consciousness and empowerment of teacher-students and student-teachers. To learn more, please read *Pedagogy of the Oppressed*, and visit: www.freire.org

1) *Pedagogy of the Oppressed*, Paulo Freire
1. What is the annual incidence of diarrhea worldwide?
2. What is the leading cause of morbidity and mortality with diarrhea?
3. What is the most readily reversible cause of morbidity and mortality with diarrhea?
4. Diarrheal illness should:
   A. Always be treated with oral rehydration solution
   B. Always be treated with antibiotics
   C. Always be treated with bismuth
   D. Sometimes be treated with bismuth
   E. A, B, and C
   F. A and D
   G. A, B, D
5. Oral Rehydration Solution (ORS) is composed of:
   A. Clean water, salt, and sugar
   B. Clean water and salt and baking soda
   C. Clean water, salt and cereal
   D. A and B
   E. A and C
6. The major categories of gastrointestinal infections include (3):
7. The most common cause of diarrhea is:
8. Some of the most important preventative measures to GI infection include…..
9. T/F Bismuth (Pepto-Bismol) is the best remedy for alleviating symptoms in people with dysentery.
1. What is the annual incidence of diarrhea worldwide? -- **1.2 billion cases/year**

2. What is the leading cause of morbidity and mortality with diarrhea? -- **Dehydration**

3. What is the most readily reversible cause of morbidity and mortality with diarrhea? -- **Dehydration**

4. Diarrheal illness should:
   A. Always be treated with oral rehydration solution
   B. Always be treated with antibiotics
   C. Always be treated with bismuth
   D. Sometimes be treated with bismuth
   E. A, B, and C
   F. A and D
   G. A, B, D

5. Oral Rehydration Solution (ORS) is composed of:
   A. Clean water, salt, and sugar
   B. Clean water and salt and baking soda
   C. Clean water, salt and cereal
   D. A and B
   E. A and C

6. The major categories of gastrointestinal infections include (3): **Viral, bacterial & helminthic infections**

7. The most common cause of diarrhea is: **Rotavirus**

8. Some of the most important preventative measures to GI infection include….. proper hygiene (ie hand washing), clean non-dirt floors, proper food preparation, clean water and vaccines

9. T/F Bismuth (Pepto-Bismol) is the best remedy for alleviating symptoms in people with dysentery. -- **False; Never give bismuth to someone with dysentery, it can cause Reye’s Syndrome is certain cases**
Suggested Reading

• *Questioning the Solution*, by David Werner
• *Pedagogy of the Oppressed*, by Paulo Freire
• *Pathologies of Power*, by Paul Farmer
• *Where There Is No Doctor*, by David Werner

• Note: both *Questioning the Solution* and *Where There Is No Doctor* are available free of charge on the website [www.hesperian.org](http://www.hesperian.org)

• For more suggested readings please visit Partners In Health at: [http://www.pih.org/pages/recommended-reading/](http://www.pih.org/pages/recommended-reading/)
Credits

• Barak Sered, University of Massachusetts Medical School, Class of 2014
• John Prucha, University of Colorado Medical School, Class of 2014
• Ahmar Hashmi, University of Texas Medical School, Class of 2014
• Jenn Carpenter, MD, Queen’s University
• Daniel Palazuelos, MD, Partners In Health
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Notes on Slide 4

Humans will always suffer from gastrointestinal illness. However, the burden of diarrheal disease is unequally distributed around the world as the WHO study mentioned below states, and as the map on this slide illustrates. In 2009 the World Health Organization estimated that there were 2.5 billion cases of severe diarrhea in children under the age of five. Of these cases, greater than half were isolated to African and South Asian countries. 1.5 million of these pediatric diarrheal cases resulted in death, ranking diarrhea as the second greatest killer of children in this age group after pneumonia.3

http://www.worldmapper.org/
1)www.worldmapper.org, copyright 2006 SASI Group and Mark Newman
Limitations to the data used to populate this map include recall bias and the use of only one two-week period.
3) UNICEF/WHO, Diarrhoea: Why children are still dying and what can be done, 2009

Return to Module

Notes on Slide 10

In many regions with high incidence of helminthic infections the solution is chronic treatment, which keeps parasite burden low. Doing so minimizes morbidity rates and improves childhood growth and development. Ideally, rates of parasitic infection can be reduced by improving infrastructure; access to clean water, improving excreta disposal and hygiene.

1)http://www.who.int/wormcontrol/en/action_against_worms.pdf
2)Mandell: Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, 7th ed.
3) Illustration from: http://www.pathobio.sdu.edu.cn/sdjsc/engparabook/ch087.htm

Return to Module

Notes on Slide 14

*Shigella flexneri*, the most common of the Shigella species was discovered in the early 1900s, allowing for a distinction between ameobic and bacterial dysentery.5 Infections from *S. flexneri* causes significant post-infectious sequelae in 2% of the people that contract it.4,5 Symptoms include joint pain, eye irritation and painful defecation.1 For
some, joint pain develops into chronic arthritis. The morbidity and mortality rates of
these infections obviates the necessity for effective prevention and treatment measures
such as hygiene, sanitation, breastfeeding, ORT and pharmaceuticals.3

*Dysentery is diarrhea described as bloody mucoid diarrhea with fever, abdominal
cramps and rectal pain.1,2

Shigella
2) Herbert L DuPont, Shigella Species (Bacillary Dysentary), *Mandell: Mandell,
Douglas, and Bennett's Principles and Practice of Infectious Diseases*, 7th ed, Ch 224
4) Kotloff K.L, et al; "Global burden of Shigella infections: implications for vaccine
development and implementation of control strategies"; Bulletin of the World Health
Organization, 1999, 77 (8)

Notes on Slide 15

Shigella
2) Herbert L DuPont, Shigella Species (Bacillary Dysentary), *Mandell: Mandell,
Douglas, and Bennett's Principles and Practice of Infectious Diseases*, 7th ed, Ch 224
4) Kotloff K.L, et al; "Global burden of Shigella infections: implications for vaccine
development and implementation of control strategies"; Bulletin of the World Health
Organization, 1999, 77 (8)


Read more about the need for expanding the political and financial commitment
necessary to develop effective therapy for “neglected tropical diseases;”
http://www.plosntds.org/article/info%3Adoi%2F10.1371%2Fjournal.pntd.0000635

Notes on Slide 24

Organizations that use large amounts of commercial ORS such as USAID and the WHO
site studies indicating that the improper production of homemade ORS is reason enough
to avoid homemade solutions. Others such as David Warner, the author of *Where there is No Doctor* and founder of the *Hesperian Foundation* argue that homemade ORS is most favorable in resource-poor settings. If made improperly ORS can be harmful rather than helpful, however many traditional rehydration remedies rival or outperform the manufactured sucrose/salt/bicarbonate solutions. Many would go on to argue that teaching people to make their own ORS or use traditional rehydration methods is a question of access, self-reliance and empowerment. As demonstrated by *Rakku's Story on slide 31*, reliance on manufactured ORS solution or packets can pose significant problems for diarrheal treatment such as treatment delay and excessive cost, requiring the use of extremely limited monetary resources for a product that can be made in-house for a fraction of its commercial price.

Bearing this in mind, please continue to the next slide so see Warner’s perspective on the pros and cons of Commercial and Homemade ORS.

Read about 8-year-old Mee Akter who learned to make homemade ORS at school:  

Lft Image from:  


**Return to Module**

**Notes on Slide 25**

ORS made with sugar and salt is the mainstay for a quick and easy rehydration solution. The ingredients are cheap and commonplace almost everywhere.

Cereal based ORS has been shown to be equally or more effective than sugar/salt solutions. The use of cereal based ORS introduces another level of flexibility allowing the use of different local grains to treat dehydration. For example a rice-based ORS solution may be used in Vietnam while a corn-based ORS solution may be used in Mexico. In the case of cholera and cholera-like illness, rice based ORS significantly outperforms other formulas when measuring their ability to shorten duration of illness and volume loss.¹ Applying such recipes can also promote the inclusion of pre-existing knowledge amongst those using it.²

**ORS Recipe Summary:**

1L clean H₂O + ½ tsp. salt + 8 tsp. sugar  
or  
1L clean H₂O + ½ tsp. salt + 8 heaping tsp. or 2 handfuls of powdered cereal, boil 5-7 min and cool. Note: If possible, add ½ cup of fruit juice, coconut water or mashed ripe banana to drink as a potassium source.
Clean water is ideal for rehydration in the event of diarrhea, however if clean water cannot be obtained or made, use what is available. Dirty water though dangerous, is better than no water at all and will serve to hydrate someone suffering from severe diarrhea.

2) David Warner, Questioning the Solution. Image from: Where there is no Doctor by David Warner

Notes on Slide 29

Rakku’s Story illustrates the challenges faced by those hoping to improve the lives of people living in poverty, particularly in second and third world countries. For Rakku, barriers that prohibited her from meeting her children's needs go far deeper than a superficial assessment of poverty and poor medical infrastructure. Looking deeper it is possible to begin understanding why Rakku lives in poverty, why she must work far from home on someone else's land, factors contributing to her family’s size, why her child suffers from malnutrition, why he is constantly struggling against infection, why he wasn’t sufficiently cared for in the hospital and ultimately, why he died of dehydration. The factors that belay Rakku’s family into the socioeconomic position they find themselves are those that must be changed. From the perspective of an international aid worker, both the cause and effect of injustice must be tackled on individual and societal levels.

2) Werner, David. Questioning the Solution
“RAKKU’S STORY (in more detail)
Rakku had wanted to only breastfeed her baby. This had long been the tradition of women in her village. However, in order for her family to survive, Rakku had to work in the land owner’s fields from dawn to dusk. With the long hours of separation from her baby, she had little choice but to give her baby other foods. Soon she no longer could produce much breast milk.
As both a landless peasant and a woman, Rakku was doubly disadvantaged. For long hours of exhausting work, she was paid too little to adequately feed her family. Since the age of seven, her older son, Kannan, had been helping make ends meet by taking the cattle of several landowning families out to graze in the scrub. While she was working in the distant fields, Rakku left her baby in their wattle hut in the care of her five-year-old daughter, Ponnu. Each morning before dawn, Rakku would haul water from the distant water hole. She would pound a few handfuls of ragi (millet) and cook it into a gruel for the family to eat. Although there was often not enough ragi to fill all their stomachs,
Rakku would always leave a little on the plate, instructing Ponnu to feed it to the baby while her mother was at work in the distant fields. Even with the older children also working, the family’s earnings could scarcely buy enough food. The baby, like the rest of the family, often went hungry. Worsening malnutrition and repeated bouts of diarrhea soon became a vicious cycle. Sometimes Rakku took the sick baby to a traditional healer, who gave him rice water and herbal teas. The baby would usually get better for a few days, but soon Rakku’s baby became thinner and thinner. One day he developed such severe diarrhea that did not get much better even when Rakku gave him the traditional remedies of rice water and herbal tea. His “runny stomach” continued for several days, until the baby was as limp and shriveled as a rice paddy in a drought.

In desperation, Rakku decided to take her baby to the hospital in the city. This was a hard decision, as Rakku had to miss a day’s work and a day’s pay. At best, this meant a day without food, for the family had no reserves. At worst, Rakku might lose her job—the consequences of which she was afraid to think about. She knew that a wiser mother would let her sick baby die to preserve the rest of the family. But Rakku’s love for her baby was too strong. Rakku sold a bronze pot she had inherited from her mother—the last of her remaining possessions of any value—to pay for bus fare and medicine, and took her baby to the city hospital. She had to pay a bribe to the guard to let her in the hospital gate.

After hours of waiting in long lines, at last her baby was seen. By then the baby was on the verge of death. The doctor scolded Rakku for waiting so long, and for not taking better care of her baby. He referred her to a nurse, who carefully explained to her the importance of breast-feeding and something the nurse called “hygiene.” Above all, the nurse emphasized, her baby needed more and better food. Rakku listened in silence. Meanwhile, the doctor put a needle into a vein in the baby’s ankle and connected it by a thin tube to a bottle of glucose water. By evening the baby’s shrunken body filled out a bit, and he seemed more alert. The diarrhea had stopped, and the late night nurse removed the needle from the baby’s leg. The next morning a doctor gave Rakku a prescription for medicines to buy in the pharmacy and sent them home.

On the way home the baby’s diarrhea began again. Arriving back home, Rakku had neither food, nor money, nor anything left to sell. Her baby died a short time later.”

Notes on Slide 30

The document identifies three principal goals:
1) Continue aggressive case finding and treatment
2) Shore up Haiti’s water infrastructure by building systems for consistent chlorination/filtration, distributing point-of-use water purification tools and improving waste management.
3) Further improve preventative care by bolstering cholera surveillance, expanding education campaigns, water sanitation, hygiene (WASH) efforts, advocating for scaled-up production of the cholera vaccine and the development of a vaccine strategy for Haiti.¹

The issue of cholera vaccination deserves particular attention as a number of NGO’s working in Haiti have argued that the high cost and low availability of the vaccine precludes it from being used as a first-line tool in the battle against cholera.² While analysis of the current situation facing Haiti is fair, accepting the status-quo approach to controlling diarrheal born disease in Haiti is insufficient. It is important to consider that significant technological and political advances are currently being made which support providing this vaccine as part of the national cholera prevention plan. For example the WHO recently approved an additional, cheaper cholera vaccine, allowing for an increase in global supply³. The issue is not who should receive the vaccine but rather how the cholera vaccine be provided for everyone.

¹Meeting Cholera’s Challenge to Haiti and the World: A Joint Statement on Cholera Prevention and Care by Paul Farmer et al.
http://www.plosntds.org/article/info%3Adoi%2F10.1371%2Fjournal.pntd.0001145


Return to Module

Notes on Slide 31

* "Oral rehydration therapy is the cornerstone of fluid replacement. New elements of this approach include low-osmolarity ORS, which are more effective at replacing fluids than the previous ORS formulation, and zinc treatment, which decreases diarrhoea severity and duration. Important additional components of the package are continued feeding, including breastfeeding, during the diarrhoea episode and use of appropriate fluids available in the home if ORS are not available.”

** "New aspects of this approach include rotavirus vaccination, which was recently recommended for global introduction. In terms of community-wide sanitation, new approaches to increase demand to stop open defecation have proven more effective than previous strategies.”


Return to Module
Notes on Slide 32

The underlying themes of poor medical infrastructure, poor medical training, and exploitation are common. All of these themes presented challenges to Cecilia, limiting her ability to access adequate healthcare. Unlike some, she was able to pay for a two hour bus ride to see a private physician. However the cost of her doctor’s visit may have translated into an inability to care for herself and her family, causing short and long term challenges including access to food and future healthcare services. If the situation had been more emergent, as it sometimes is, a two hour trip might have been too long to survive. Digging deeper, it is important to consider Cecilia’s decision to go to a private versus public clinic. Bearing in mind that a public clinic is cheaper, why might a private clinic appear to be a better choice? For many in Chiapas, the public clinic experience includes long waits (sometimes forcing people to sleep on the streets with the hope of being seen the next day), disrespectful medical staff, and inadequate treatment. Although private clinics attend to their patients faster, an appropriate standard of care is often compromised by poorly trained medical professionals and greed. In Cecilia’s case an ultrasound may have been indicated, however an ultrasound without a physical exam and history raises suspicions of either poor training or profiteering. Conversely, most physician’s would be unlikely to agree with the physician’s explanation of Cecilia’s symptoms and treatment, particularly when her low blood pressure was likely due to dehydration and baseline low blood pressure.

1) Account by Rachel Ballester, RN

Return to Module