Outline

- Common Foodborne Pathogens
  - Bacterial
    - Epidemiology
    - Evaluation/Management
    - Antibiotic Therapy
  - Parasitic
  - Viral

- Traveler’s Diarrhea
  - Epidemiology
  - Management/Prevention
Epidemiology

- Estimated 20-45 million cases a year
  - 1 in 4 Americans gets a food-borne illness each year
  - 300,000 patients are hospitalized
  - 400 Americans die
  - $6.5 billion in medical and other costs

- Primarily affects the very young, the elderly, and the immunocompromised

- Changes in demographics, food production/distribution, microbial adaptation, lack of public health resources are to blame
Risky Food Items

- Pink Chicken
- Pink Turkey
- Pink Burgers
- Pink Ground Pork
- Raw Fresh Fish
- Raw Shellfish
- Ready-to-Eat meats
- Raw/unpasteurized Milk
- Runny Eggs
- Alfalfa Sprouts
- Unpasteurized Apple juice/cider
- Fresh Produce
Campylobacter
Campylobacteriosis

- Most common cause of diarrhea in US
  - 1-6 million cases per year
- Sources: raw poultry, meat, unpasteurized milk
- Incubation period: 2-5 days
- Symptoms: diarrhea, abdominal cramps, fever, bloody stools, vomiting
- Duration: 2-10 days
- Treatment: macrolides (DOC-C. jejuni), quinolones, carbapenem (DOC-C. fetus)
- Sequelae: Guillain-Barre syndrome
Cases of Quinolone-Resistant *C. jejuni* Infection in Minnesota Residents, 1996-1998*

Campylobacteriosis

- Travel outside the US continues to be associated with fluoroquinolone-resistant *Campylobacter* infections.

- Most fluoroquinolone-resistant *Campylobacter* infections were domestically acquired.

- Poultry is an important source of domestically acquired fluoroquinolone-resistant *Campylobacter* infections.
C. jejuni Resistance

- **NARMS 1999 data:**
  - **Tetracycline 44%**
  - **Nalidixic acid 21%**
  - **Ciprofloxacin 18%**
  - **Erythromycin/azithromycin ≤3%**
  - **Clindamycin 1%**
Listeria
Listeriosis

- **Sources**: soft cheese, unpasteurized milk, ready-to-eat deli meats, hot dogs
- **Incubation period**: 9-48 hours (GI sx) 2-6 weeks (invasive disease)
- **Symptoms**: fever, headache, nausea, vomiting, muscle aches
- **Duration**: variable
- **Sequelae**: meningitis (immunocompromised, elderly) and stillbirths (pregnant women)
- **Treatment**: ampicillin for invasive disease
Salmonella
Salmonellosis

- **Sources:** Poultry, reptiles, livestock, pets (*non-typhi*); humans (*typhi*)

- **Incubation period:** 1-3 days

- **40,000** (*non-typhi*) and **350** (*typhi*) cases reported in the US annually

- **Duration:** 4-7 days

- **Sequelae:** reactive arthritis

- **Treatment:** antibiotics not routinely needed
Salmonella Strains

Non-*typhi*
- Asymptomatic carriage
- Gastroenteritis
- Fever
- Systemic illness

*Typhi*
- Enteric fever
  - Bacteremia
  - Dissemination
  - Diarrhea
S. typhi Infections in the U.S.

- 25% resistant to one or more antibiotics
- 17% resistant to five or more antibiotics
- No/minimal resistance to ciprofloxacin or ceftriaxone

## Antibiotic Therapy for *Salmonella*

### Species

<table>
<thead>
<tr>
<th>Species</th>
<th>DOC</th>
<th>Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typhi</td>
<td>Ceftriazone</td>
<td>TMP-SMX</td>
</tr>
<tr>
<td></td>
<td><em>FQs</em></td>
<td>Ampicillin</td>
</tr>
<tr>
<td>Other</td>
<td>Cefotax/ceftriax</td>
<td>Ampicillin</td>
</tr>
<tr>
<td></td>
<td><em>FQs</em></td>
<td>TMP-SMX</td>
</tr>
</tbody>
</table>

### Indications:
- Infants <3 months
- Immunodeficient patients
- *Typhoid fever*
- Bacteremia, dissemination with localized suppuration
Shigella
Shigellosis

- **Sources:** milk, dairy products, potato salad (food/water contaminated with fecal matter)
- **Incubation period:** 24-48 hours
- **Serogroups:** *dysenteriae, flexneri, boydii, sonnei*
- **Symptoms:** abdominal cramps, diarrhea, fever, bloody/mucus stool
- **Duration:** 4-7 days
- **Treatment:** DOC-FQ, Alts- ceftriaxone, azithromycin, TMP/SMX
- **Sequelae:** HUS, Reiter’s syndrome
**Shigella Resistance**

- **1998 Oregon Health Dept. Data**: 
  - Ampicillin 54% (*S. sonnei*) - 82% (*S. flex*)
  - TMP/SMX 29% (*S. flex*) - 81% (*S. sonnei*)
  - Tetracycline 85%
  - Cefixime 0-2%
  - Nalidixic acid 0.3%
  - Ciprofloxacin 0%

*Replogle et al. CID 2000;30:515*
Escherichia coli
**E. Coli as a Cause of Diarrhea**

<table>
<thead>
<tr>
<th>Type</th>
<th>Epidemiology</th>
<th>Diarrhea</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPEC</td>
<td>Acute/chronic in infants</td>
<td>Watery</td>
</tr>
<tr>
<td>ETEC</td>
<td>Infants in developing countries; travelers</td>
<td>Watery</td>
</tr>
<tr>
<td>EIEC</td>
<td>Dysentery with fever</td>
<td>Bloody</td>
</tr>
<tr>
<td>EHEC</td>
<td>Hemorrhagic colitis, HUS</td>
<td>Bloody</td>
</tr>
</tbody>
</table>

EPEC=enteropathogenic *E. coli*; ETEC=enterotox*E. coli*; EIEC=enteroinvasive *E. coli*; EHEC=enterohemorrhagic *E. coli*; HUS=Hemolytic uremic syndrome
## Antibacterial Therapy for *E. coli* in Children

<table>
<thead>
<tr>
<th>Organism</th>
<th>Agent</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETEC</td>
<td>TMP-SMX</td>
<td>Severe or prolonged illness</td>
</tr>
<tr>
<td>EPEC</td>
<td>TMP-SMX</td>
<td>Nursery epidemic, life-threatening illness</td>
</tr>
<tr>
<td>EIEC</td>
<td>TMP-SMX</td>
<td>All cases if organism susceptible</td>
</tr>
<tr>
<td>EHEC</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>
**E. coli O157:H7**

- **Member of EHEC group**
- **Sources:** undercooked/raw hamburger, produce
- **Incubation period:** 1-8 days
- **Symptoms:** severe diarrhea (often bloody), abdominal pain, vomiting, no fever
- **Duration:** 5-10 days
- **Sequelae:** hemolytic uremic syndrome (HUS)
- **Treatment:** avoid antibiotics- may worsen outcome
# Characteristics of Children Infected with *E. coli* O157:H7

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Abx</th>
<th>No Abx</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>5.5±3.4</td>
<td>4.1±2.6</td>
<td>0.15</td>
</tr>
<tr>
<td>Bloody diarrhea</td>
<td>7 (78%)</td>
<td>57 (92%)</td>
<td>0.21</td>
</tr>
<tr>
<td>Positive stool cx</td>
<td>4.9±1.3</td>
<td>5.3±1.6</td>
<td>0.42</td>
</tr>
<tr>
<td>Progress to HUS</td>
<td>7 (78%)</td>
<td>7 (11%)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Giardia
Giardiasis

- **Sources:** contaminated water
- **Incubation period:** 1-4 weeks
- **Symptoms:** sudden onset of explosive watery stools, abdominal cramps, nausea, bloating, flatulence
- **Duration:** weeks, relapses common
- **Treatment:** metronidazole
Cryptosporidiasis/ Cyclosporiasis

- **Sources**: contaminated water, produce
- **Incubation period**: 7 days (average)
- **Symptoms**:
  - *Crypto*: abdominal pain, watery diarrhea,
  - *Cyclo*: fatigue, protracted diarrhea (often relapsing)
- **Treatment**:
  - *Crypto*: if severe, paromomycin
  - *Cyclospora*: TMP/SMX
Viral Pathogens

- Hepatitis A
- Norwalk-like Viruses
- Rotavirus
- Parvovirus
- Adenovirus
- Astrovirus
- Calicivirus
Approach to Patients with Diarrhea
Evaluation and Management

- Initiate rehydration: oral vs. IV
- Assess clinical features:
  - When/how illness began
  - Stool characteristics
  - Frequency and relative quantity
  - Presence of dysenteric symptoms
  - Symptoms of volume depletion
  - Associated symptoms
Assess epidemiological risk factors:

- **Travel history**
- **Day care attendance or employment**
- **Consumption of unsafe foods**
- Visiting farm of petting zoo; contact with reptiles or pets with diarrhea
- **Knowledge of other ill persons**
- Recent or regular medications
- **Underlying medical conditions**
- **Sexual contact (anal intercourse or oral-anal contact)**
- **Occupation as food handler or caregiver**
Evaluation

- Community-acquired or traveler’s diarrhea (esp. if accompanied by significant fever or blood in stool)
  - Test for bacterial causes:
    - Salmonella
    - Shigella
    - Campylobacter
    - *E coli* O157:H7

- Persistent Diarrhea >7 days (esp. if immunocompromised)
  - Test for Parasites:
    - *Giardia*
    - *Cryptosporidium*
    - *Cyclospora*
    - *Isospora*
Treatment

- Most cases are self-limiting
- Only require fluid replacement and supportive care
- Avoid antimotility agents (lomotil, imodium), especially in infants, young children, or in cases of bloody diarrhea
- If treating with antibiotics:
  - Consider resistance rates in empiric selection
  - Determine susceptibility of offending agent
## Drug Therapy

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>FQs</th>
<th>Doxy</th>
<th>Macrolides</th>
<th>Ceftriaxone</th>
<th>Bactrim</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Campy</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E coli</strong></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Salmonella</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Shigella</strong></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td><strong>Vibrio</strong></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Yersinia</strong></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
**Resources**

- **Diagnosis and Management of Foodborne Illnesses: MMWR 2001;50(RR2):1-69**
  [www.cdc.gov/mmwr/preview/mmwrhtml/rr5002al.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5002al.htm)

- **Practice Guidelines for the Management of Infectious Diarrhea: CID 2001;32:331-351**
  [www.journals.uchicago.edu/CID/journal/issues/v32n3/001387/001387.html](http://www.journals.uchicago.edu/CID/journal/issues/v32n3/001387/001387.html)
Traveler’s Diarrhea
At-Risk Destinations

High Risk (20-50%)
- Latin America
- Africa
- Middle East
- S. Asia

Intermediate Risk (15-20%)
- E. and S. Europe
- Caribbean Islands
- China

Low Risk (<10%)
- North America
- C. Europe
- Japan
- Australia
TD: Etiology

- Rapid, dramatic change in GI flora
- Include potential pathogens:
  - ETEC (most common, 5-70%)
  - Campylobacter (0-30%)
  - Rotavirus (0-20%)
  - Salmonella (0-15%)
  - Shigella (0-15%)
  - Unknown (10-40%)
- Ingested large inoculum to overcome defense mechanisms
TD: Clinical Presentation

- Overall, ≤50% affected in 2 wk stay
- Onset: 1/3 in 1st 2 weeks
- 4-5 loose stools over 4-5 days (85%)
- Sequelae:
  - 40% modify activities
  - 20% confined to bed
  - 1% hospitalized
  - 2% chronic diarrhea >1 month
Prevention is KEY

- Cautious food and beverage consumption
- Immunization (no vaccines currently available)
- Nonantimicrobial medications
  - Pepto-Bismol (2 tabs QID): ↓ by 60%
  - Antiperistaltics DO NOT work
- Prophylactic antibiotics (52-95% effective)

(CURRENTLY NOT RECOMMENDED)
Treatment

- Oral fluids: in most cases, all that is needed
- Pepto-Bismol: limit to 48 hours
  - Decreased frequency of stools
  - Shortened duration of illness
- Antimotility agents: avoid in patients with blood in stool or high fever
- Antibiotics:
  - Illness can be shortened to 1-1.5 days
  - Three days of treatment recommended, but single dose therapy is an option
# Antibiotics

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Single Dose (mg)</th>
<th>Multiple Dose (mg x 3 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norfloxacin</td>
<td>800</td>
<td>400 BID</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>500</td>
<td>500 QD</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>750</td>
<td>500 BID</td>
</tr>
<tr>
<td>Ofloxacin</td>
<td>400</td>
<td>200 BID</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>1000</td>
<td>500 QD</td>
</tr>
<tr>
<td>Cefixime</td>
<td>400</td>
<td>200 BID</td>
</tr>
</tbody>
</table>

Doxycycline and TMP/SMX resistance globally-- avoid
<table>
<thead>
<tr>
<th>Clinical</th>
<th>Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild:</td>
<td>None; loperamide</td>
</tr>
<tr>
<td><em>(1-2 stools/24 hr)</em></td>
<td></td>
</tr>
<tr>
<td>Moderate:</td>
<td>Add single dose FQ</td>
</tr>
<tr>
<td><em>(≥3 stools/24 hr)</em></td>
<td></td>
</tr>
<tr>
<td>Mod-severe:</td>
<td>Cont. abx for 3 days</td>
</tr>
<tr>
<td><em>(≥6 BM + fever or blood)</em></td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

- Food products, e.g. poultry, are an important source of domestically acquired GI infections.

- **Antibiotics not routinely needed**
  - Most cases are self-limiting
  - Only require fluid replacement and supportive care

- If treating with antibiotics:
  - Consider resistance rates in empiric selection
  - Determine susceptibility of offending agent

- Avoid antibiotics in pts. with bloody diarrhea, until *E. coli O157:H7* is ruled out - may worsen outcome

- Avoid antimotility agents (lomotil, imodium), especially in infants, young children, or in cases of bloody diarrhea

- Prevention is KEY