INTRODUCTION — Travelers' diarrhea is the most common illness in persons traveling from resource-rich to resource-limited regions of the world [1]. The fear of developing diarrhea while traveling is common among such travelers. This concern is realistic; 40 to 60 percent of travelers to these countries may develop diarrhea. Episodes of travelers' diarrhea are nearly always benign and self-limited, but the dehydration that can complicate an episode may be severe and pose a greater health hazard than the illness itself. Nevertheless, it is possible to educate a traveler to manage a diarrheal episode without compromising either their trip or their health.

The microbiology, epidemiology, and prevention of travelers' diarrhea are discussed here. The clinical manifestations, diagnosis, and treatment of travelers' diarrhea are discussed elsewhere. (See "Travelers' diarrhea: Clinical manifestations, diagnosis, and treatment").

DEFINITIONS — Travelers' diarrhea refers to diarrhea that develops during or within 10 days of returning from travel to resource-limited countries or regions. For epidemiological purposes, it is frequently categorized into three forms: classic, moderate, and mild. These forms of travelers' diarrhea are defined as follows [2]:

- Classic — passage of three or more unformed stools in a 24 hour period plus at least one of these other symptoms: nausea, vomiting, abdominal pain or cramps, fever, blood in stools
- Moderate — passage of one or two unformed stools in 24 hours plus at least one of the above symptoms or more than two unformed stools in 24 hours without other symptoms
- Mild — passage of one or two unformed stools in 24 hours without other symptoms

These definitions allow some uniformity in studies of the epidemiology and etiologies of travelers' diarrhea. For such studies, the three types can be grouped together to estimate a total number of cases of travelers' diarrhea. (See "Evaluation of fever in the returning traveler").

ETIOLOGY — Travelers' diarrhea is an infectious illness, caused by a variety of bacterial, viral, and parasitic organisms (table 1), although bacterial pathogens are the most frequent cause in acute cases. More than 90 percent of illnesses in most geographic areas are caused by bacteria; the most common organism is enterotoxigenic Escherichia coli (ETEC) [1,3,4]. For patients with persistent symptoms, parasites are more frequently implicated. (See 'Bacteria' below and 'Viruses' below and 'Parasites' below and "Travelers' diarrhea: Clinical manifestations, diagnosis, and treatment", section on 'Patients with persistent diarrhea'.)

Nevertheless, the precise microbial etiology is not identified in many cases. In a series of travelers to Jamaica with travelers' diarrhea, 322 individuals had stool specimens processed, among whom an etiologic agent was identified in 32 percent [5]. With use of newer diagnostic methods, identification of more causative pathogens may be possible.

Spices in food and changes in climate do not cause travelers' diarrhea, although variations in diet, temperature, or even time zones can alter the way a traveler feels, and the stresses of travel may exacerbate diarrheal symptoms.
**Bacteria** — Bacterial pathogens predominate as the cause of travelers' diarrhea. In the series of 322 patients with travelers' diarrhea cited above, ETEC accounted for 12 percent of cases due to bacteria followed by *Salmonella* spp, *Campylobacter jejuni*, and *Shigella* spp at 8, 6, and 0.3 percent, respectively [5]. In another study of 636 travelers to Guadalajara Mexico, Ocho Rios Jamaica, and Goa India, ETEC and enteroaggregative *E. coli* (EAEC) were responsible for the most cases at 30 and 26 percent, respectively [6]. The identification of EAEC, a novel pathogen at the time, in these stool specimens reduced the number of cases with an undiagnosed etiology from 51 to 37 percent. (See "Pathogenic Escherichia coli".)

Other organisms (*Salmonella* spp, *Shigella* spp, *C. jejuni*, *Vibrio* spp, *Aeromonas hydrophila*, and *Plesiomonas shigelloides*, as well as rotavirus and the parasites *Entamoeba histolytica*, *Cryptosporidium parvum*, and *Giardia lamblia*) accounted for 7 percent of cases [6]. Twenty percent also had infection with more than one enteric organism. Other causes of microbial food-borne illness are discussed in detail elsewhere. (See "Differential diagnosis of microbial foodborne disease".)

There is some geographic variation to the microbial distribution of travelers' diarrhea. As an example, in Southeast Asia, *Campylobacter* species are the most common cause (approximately 30 percent), and non-cholera *Vibrio* species cause a sizable minority (approximately 10 percent) of cases [7].

Travelers taking malaria prophylaxis [8] or other antibiotics may also occasionally develop antibiotic-associated diarrhea due to *Clostridium difficile*. However, this is not a common cause of travelers' diarrhea.

**Viruses** — Viruses can also cause travelers' diarrhea. Rotaviruses are the most common among the viral pathogens, accounting for 9 percent of cases in a series from Jamaica [5]. Norovirus has also been identified as a cause of travelers’ diarrhea among international travelers [9,10]. (See "Clinical manifestations and diagnosis of rotavirus infection" and "Clinical manifestations and diagnosis of noroviruses and related viruses".)

**Parasites** — Although parasites are a less common cause of travelers' diarrhea, *C. parvum*, microsporidia, and *Isospora belli*, in addition to *G. lamblia* and *Cyclospora cayetanensis*, may contribute to diarrhea in travelers [11]. *E. histolytica* can produce intestinal infection; it is not a common pathogen in travelers' diarrhea but can be associated with persistent diarrhea (see "Intestinal Entamoeba histolytica amebiasis"). Other parasites, such as *Ascaris lumbricoides* or *Strongyloides stercoralis*, are not usually associated with diarrheal symptoms.

**EPIDEMIOLOGY**

**Risk by geographic region** — Overall, the incidence of travelers' diarrhea is approximately 10 to 40 percent, but the risk varies considerably based on destination of travel [1,12,13]. The bacterial, viral, and parasitic organisms that cause travelers' diarrhea are most often transmitted by food and water, thus risk of travelers' diarrhea is the highest in regions where sanitation and hygienic practices are poor:

- **High risk (>20 percent)** — South and Southeast Asia, Africa (with the exception of South Africa), South and Central America, and Mexico
- **Moderate risk (10 to 20 percent)** — Caribbean Islands, South Africa, Central and East Asia (including Russia and China), Eastern Europe, and the Middle East, including Israel
- **Low risk (<10 percent)** — Northern and Western Europe, Australia and New Zealand, the United States, Canada, Singapore, Japan

Areas with the highest risk for travelers' diarrhea include India, Nepal, and western/central African countries. The risk of travelers' disease also varies with the season of the year, with a higher risk during warmer and wetter seasons [14,15].
Travelers should be aware that food items on aircrafts will often be obtained at the city of departure [16]. (See “Travel advice”.)

**Travel risk factors** — Risk of travelers’ diarrhea is highest during the first week of travel and then progressively decreases with time. Certain activities during travel have also been associated with development of travelers’ diarrhea. These include buying food from street vendors, traveling to visit friends and relatives, and staying in "all-inclusive" lodgings [17].

**Host risk factors** — The development of diarrhea is related to the number of ingested organisms that reach the intestine alive. Thus, any factor which enhances the ability of bacteria to survive ingestion and transit to the intestine will increase the risk for the development of diarrheal disease. As an example, an individual who is taking histamine blockers for ulcer disease will be at increased risk for developing diarrhea since the reduction of gastric acid will allow more ingested pathogens to enter the small bowel. Similarly, an individual who has altered upper gastrointestinal (GI) anatomy (eg, after ulcer surgery, or with a blind loop syndrome) or motility may be at increased risk for the development of diarrheal disease while traveling in more contaminated environments. However, it is not clear what factors beyond exposure may influence the acquisition of viruses.

Several genetic factors have been associated with an increased risk of travelers’ diarrhea [12]. Additionally, travelers from higher-risk regions are less likely to develop travelers’ diarrhea when they themselves travel to other high-risk regions, suggestive of some protective immunity from prior exposure.

**Risk for parasitic infection** — Ingestion of parasites that cause diarrhea requires a more contaminated environment than is usually frequented by the average traveler. Thus, parasitic pathogens uncommonly cause travelers’ diarrhea [18-20]. However, there are a few locations where travelers are more likely to acquire parasites, including Nepal (where both *G. lamblia* and *C. cayetanensis* are common) and St. Petersburg (where *G. lamblia* remain hyperendemic). The mountainous regions of the West and Northeast United States are also highly endemic for *G. lamblia*, but travelers to these locations rarely request advice prior to travel. In these situations, it may be that environmental factors such as the juxtaposition of the water supply with the habitat of a certain animal species predispose the area to a hyperinfestation with the parasite.

**PREVENTION** — The most important strategy to prevent travelers’ diarrhea is prudent selection of food and drink while traveling. Water purification can be used if sanitary water is not otherwise available. Prophylactic medications (mainly antibiotics) are generally not indicated although may be useful for select travelers for whom an episode of diarrhea could have severe consequences. These are discussed in detail below.

**Food and drink selection** — Educated choices in selecting food and drinks might result in a lower incidence of diarrheal disease. Basic advice for travelers to moderate or high-risk regions for travelers’ diarrhea includes eating only food that has been thoroughly cooked and served hot, fruits that the traveler peels just prior to eating, and pasteurized dairy products. Beverages should be bottled or disinfected. Bottled drinks should be requested without ice and should be drunk from the bottle with a straw rather than from a glass. Hot tea and coffee are usually safe alternatives to boiled water.

Travelers should be aware of additional observations regarding food safety and the transmission of diarrhea-causing organisms. These observations are also pertinent in expensive resorts or hotels; price does not guarantee appropriate hygiene:

- Freezing does not kill the organisms that cause diarrheal disease. Thus, ice in drinks is not safe unless made from adequately boiled or filtered water.
- Alcohol does not sterilize water or ice; mixed drinks may still be contaminated.
Outbreaks of diarrheal disease have been associated with bottled water (including carbonated water with insufficient carbonation) on rare occasions [21]. However, the presence of carbonation when a bottle is opened (eg, carbonated water or soft drinks) can reassure the traveler that the drink was processed in a proper fashion and is usually safe.

Fruit salads, lettuce, or chicken salads are examples of unwise food choices; the ingredients may have been improperly washed and/or may have been sitting for some time without proper refrigeration.

Condiments on the table can frequently become contaminated. One study of Mexican sauces in restaurants in Guadalajara and Houston found E. coli in more sauces in Mexico than in Houston (66 versus 40 percent); it is important to note that significant levels of contamination was not limited to Mexico [22]. Guacamole was the most frequently contaminated and was second only to pico de gallo for the highest colony count of bacteria.

Steam table buffets that offer the traveler a variety of foods from the local region are risky since the temperature of the food can promote the growth of bacteria.

Food provided on international airline flights can also be at risk of contamination.

Although common sense would suggest that following such dietary guidance can decrease the risk of travelers’ diarrhea, this has been difficult to demonstrate in formal studies. The minority of travelers are able to strictly abide by all safe food and beverage restrictions [5]. As an example, in a series of over 30,000 travelers to Jamaica, less than 3 percent stated that they had attempted to avoid potentially high-risk foods or drinks [5].

Water purification — It is usually safe to assume that the traveler will be able to find bottled water or soft drinks unless travel is to a rather remote area. Travelers who are going to be staying in rustic circumstances overseas will need to make arrangements for a safe water supply. Water can be purified in one of several ways:

- Boiling for 3 minutes followed by cooling to room temperature (do not add ice) to kill bacteria, parasites, and viruses.
- Adding two drops of 5 percent sodium hypochlorite (bleach) to a quart of water will kill most bacteria in 30 minutes.
- Adding five drops of tincture of iodine to a quart of water will kill bacteria within 30 minutes.
- Compact water filters in which the filters are impregnated with iodine remove parasitic pathogens and kill viral and bacterial pathogens; they provide a reasonable alternative for those who expect to be traveling under rustic circumstances. These are available commercially at camping or wilderness supply stores.

Boiling water is usually the most palatable solution to water purification if sanitary storage is feasible. The addition of iodine or chlorine to water can impart an unpleasant taste.

Chemoprophylaxis — Although antibiotics and other agents (namely bismuth salicylate) are effective in reducing the rate of travelers’ diarrhea for individuals traveling from resource-rich to resource-poor areas, we do not routinely recommend chemoprophylaxis. Use of daily antibiotics is expensive, has potential side effects, can wipe out normal gastrointestinal flora that may be beneficial, and can promote bacterial resistance [23]. Such drawbacks are not generally outweighed by the prevention of a self-limiting diarrheal illness. For chemoprophylaxis with bismuth salicylate, the doses required for efficacy are inconvenient for the traveler, and salicylate toxicity is a potential complication.

However, chemoprophylaxis may be a reasonable approach in the setting of an underlying medical condition that would increase the risk of complications from diarrhea or would be severely exacerbated by dehydration from diarrhea such that the benefits of using antibiotic prophylaxis outweigh its risks [24]. Such situations include known severe inflammatory bowel disease that could be exacerbated by an episode of...
infectious diarrhea; severe vascular, cardiac, or renal disease that would be seriously compromised by dehydration; or a severe immunocompromised state, such as advanced HIV disease or after a complicated organ transplant.

If prophylaxis is administered, the options include [5]:

- **Ciprofloxacin** — 500 mg once daily
- **Norfloxacin** (not available in the US) — 400 mg once daily
- **Rifaximin** — 200 mg once or twice daily
- **Bismuth subsalicylate** — two tablets chewed four times daily

When indicated, we typically use a fluoroquinolone or rifaximin. The choice between them depends on expected traveler tolerance or allergies and personal preference (eg, would avoid ciprofloxacin in those with high caffeine intake as it can further increase caffeine levels). Of note, these options may not be optimally effective against *Campylobacter* spp, which are a more common cause of travelers' diarrhea in South and Southeast Asia.

Prophylaxis is generally taken for the duration of the trip.

**Efficacy of antibiotics** — Fluoroquinolones and rifaximin have demonstrated efficacy in preventing travelers' diarrhea and are the most common prophylactic agents used. Although other antibiotics have been effective in older studies, increasing resistance to such agents has attenuated their efficacy [25]. Indications for and selection of antibiotics are discussed above. (See ‘Chemoprophylaxis’ above.)

Several randomized trials have reported that fluoroquinolones, particularly norfloxacin, have protective efficacy of 80 to 100 percent [24,26]. However, emerging resistance to the quinolones among pathogens, particularly *Campylobacter* spp, raise questions about how long prophylaxis with these drugs will continue to be effective.

Thus, there has been increased interest in the use of rifaximin, which is not absorbed and appears to be effective at preventing travelers' diarrhea. In a randomized, double-blind placebo-controlled trial in Mexico, 210 American adults received either rifaximin (doses included 200 mg daily, 200 mg twice daily, or 200 mg three times daily) or placebo for two weeks [27]. Rifaximin at all doses reduced the rate of travelers' diarrhea (15 versus 54 percent with placebo) without excess adverse events and was associated with minimal changes in intestinal flora. Rifaximin also prevented travelers' diarrhea, although to a more moderate degree, in a randomized, double-blind trial of 258 German adults who were travelling to South or Southeast Asia for 6 to 28 days [28]. During travel and the week following, 25 percent of patients who received rifaximin (200 mg twice daily for the duration of the trip) reported symptoms consistent with travelers' diarrhea compared with 41 percent of those who received placebo. Of note, there was a trend towards lower effectiveness among travelers to Southeast Asia; this finding may be related to the decreased susceptibility to rifaximin of *Campylobacter* species, which predominate in Southeast Asia.

The main drawback to using daily antibiotic prophylaxis is the potential for adverse effects. These include sun sensitivity, allergic reactions, altered GI flora with colonization by resistant bacteria [23], yeast infections such as candidal vaginitis, and the risk of *C. difficile* colitis.

**Efficacy of other agents** — Nonantibiotic agents have also been studied for the prevention of travelers' diarrhea. **Bismuth subsalicylate** (30 mL or two tablets four times daily with meals) can prevent a significant number of cases of travelers' diarrhea [4]. However, the doses required are inconvenient for the traveler, and salicylate toxicity is a potential complication (particularly in pregnant women, infants, and those taking aspirin for other reasons).
The highly appealing prospect of preventing travelers' diarrhea without systemic antibiotics has fueled interest in probiotics for this purpose. However, all probiotics are not identical and results of studies done with a particular agent cannot be generalized to indicate that any probiotic agent would be successful in the same clinical situation. Probiotics such as *Lactobacillus* GG have been shown to decrease the incidence of diarrhea in travelers in randomized controlled trials [29]. In contrast, another *Lactobacillus* preparation, nonviable *Lactobacillus acidophilus* (LA) showed no benefit compared with placebo in a randomized, double-blind, controlled trial in 174 travelers [30]. The reasons for this were unclear but could have been related to the bacteria not being viable or a particularity about the strain selected for the trial.

**Vaccination** — There is minimal role for the use of current vaccines to prevent travelers' diarrhea in general. Effective vaccination to protect against travelers' diarrhea is hindered by the varied pathogens that can cause it. Although enterotoxigenic *E. coli* (ETEC) predominates as an etiology of travelers’ diarrhea, vaccination strategies that have focused on this pathogen as a target have been suboptimal.

Although vaccination to protect against cholera is not routinely recommended for travelers, a number of trials suggest that the oral, killed whole-cell vaccine given with the nontoxic B subunit of cholera toxin (Dukoral) provides protection for travelers against ETEC infection [31-33]. The rationale for such protection is that the B subunit of cholera is antigenically similar to the heat-labile enterotoxin of ETEC. In two randomized trials, this vaccine reduced the incidence of diarrhea caused by ETEC by 67 percent in a trial in Bangladesh and 52 percent among travelers to Morocco [31,32].

However, a conservative estimate that took into account the incidence of ETEC infection throughout the world and the efficacy of the vaccine suggested that it may prevent ≤7 percent of travelers’ diarrhea cases [34]. This vaccine is not available in the United States.

A separate vaccination strategy for ETEC also appears to have limited utility. Despite initial promising data on vaccination with heat-labile enterotoxin from ETEC via a skin patch, it was not effective in decreasing the incidence of moderate to severe diarrhea due to either ETEC or any cause in a randomized, placebo-controlled trial that included 1644 individuals who traveled to Mexico or Guatemala [35]. In a subgroup analysis, the vaccine provided modest protection against ETEC that produced only heat-labile enterotoxin (vaccine efficacy 61 percent [95% CI, 7 to 84 percent]), but not ETEC that produced heat-stable toxin or both. This highlights the limitations of a single-antigen vaccine for travelers’ diarrhea.

The use of vaccination to prevent cholera and typhoid is discussed elsewhere. (See "Overview of cholera", section on 'Vaccines' and "Treatment and prevention of typhoid fever", section on 'Typhoid vaccines'.)

**PREPARATION PRIOR TO TRAVEL** — For travelers who present for a pre-travel evaluation, the risk of travelers' diarrhea based on the destination and the clinical manifestations of travelers' diarrhea should be discussed. The traveler should be advised about prudent food and beverage choices and the options for water purification if traveling to very remote locations. Travelers should also be counseled on self-diagnosis and treatment of travelers' diarrhea. Travelers can be given a prescription for antibiotics and antimotility agents that can be obtained prior to travel and taken if indicated. The traveler should be given enough medication for three days of therapy. Diagnosis and treatment, including indications for and selection of antibiotics, are discussed elsewhere. (See "Travelers' diarrhea: Clinical manifestations, diagnosis, and treatment").

Other details of travel advice are found elsewhere. (See "Travel advice").

**INFORMATION FOR PATIENTS** — UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5"to 6" grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and
more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Beyond the Basics topics (see "Patient education: General travel advice (Beyond the Basics)" and "Patient education: Food poisoning (foodborne illness) (Beyond the Basics)" and "Patient education: Giardia (Beyond the Basics)" and "Patient education: Travelers' diarrhea (The Basics)"

**SUMMARY AND RECOMMENDATIONS**

- Travelers' diarrhea is the most common illness in persons traveling from resource-rich to resource-limited regions of the world. The risk varies considerably based on destination of travel and is highest in regions where sanitation and hygienic practices are limited. Areas with the highest risk for travelers' diarrhea include India, Nepal, and western/central African countries. (See 'Introduction' above and 'Epidemiology' above.)
- Travelers' diarrhea is an infectious illness, caused by a variety of bacterial, viral, and parasitic organisms (table 1). Bacterial pathogens are the most frequent cause in acute cases. The most common organism overall is enterotoxigenic *Escherichia coli* (ETEC), but there is some geographic variation. As an example, in Southeast Asia, *Campylobacter* species predominate. (See 'Etiology' above.)
- The most important strategy to prevent travelers' diarrhea is prudent selection of food and drink while traveling. Basic advice includes eating only food that has been thoroughly cooked and served hot, fruits that the traveler peels just prior to eating, and pasteurized dairy products. Beverages should be bottled. Water purification can be used if sanitary water is not otherwise available. (See 'Food and drink selection' above and 'Water purification' above.)
- For individuals traveling from resource-rich to resource-limited settings, we suggest not routinely administering chemoprophylaxis to prevent travelers' diarrhea (Grade 2B). While effective, agents used for chemoprophylaxis (fluoroquinolones, rifaximin, and bismuth salicylate) have known and potential drawbacks that outweigh the benefit of preventing a self-limited illness. However, chemoprophylaxis is reasonable for travelers with underlying medical conditions that increase the risk of complications from diarrhea or would be severely exacerbated by dehydration from diarrhea (eg, inflammatory bowel disease, serious cardiovascular disease, immunocompromised state). (See 'Chemoprophylaxis' above.)
- In addition to advice about prudent food and beverage choices, travelers who present for a pre-travel evaluation should be counseled on self-diagnosis and treatment of travelers' diarrhea. Travelers can be given a prescription for antibiotics and antimotility agents that can be obtained prior to travel and taken if indicated. This is discussed in detail elsewhere. (See 'Travelers' diarrhea: Clinical manifestations, diagnosis, and treatment'.)

Use of UpToDate is subject to the Subscription and License Agreement.

**REFERENCES**


**Pathogens causing travelers' diarrhea**

<table>
<thead>
<tr>
<th>Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterotoxigenic Escherichia coli</td>
</tr>
<tr>
<td>Enteroaggregative E. coli</td>
</tr>
<tr>
<td>Campylobacter jejuni</td>
</tr>
<tr>
<td>Salmonella species</td>
</tr>
<tr>
<td>Shigella species</td>
</tr>
<tr>
<td>Clostridium difficile</td>
</tr>
<tr>
<td>Vibrio parahemolyticus (V. cholerae less common)</td>
</tr>
<tr>
<td>Aeromonas hydrophilia</td>
</tr>
<tr>
<td>Plesiomonas shigelloides</td>
</tr>
<tr>
<td>Yersinia enterocolitica</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Viruses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotavirus</td>
</tr>
<tr>
<td>Norovirus</td>
</tr>
<tr>
<td>Enteric adenovirus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giardia lamblia</td>
</tr>
<tr>
<td>Cryptosporidium parvum</td>
</tr>
<tr>
<td>Cyclospora cayetanensis</td>
</tr>
<tr>
<td>Microsporidia</td>
</tr>
<tr>
<td>Cystoisospora belli</td>
</tr>
<tr>
<td>Entamoeba histolytica (not common)</td>
</tr>
</tbody>
</table>