Infectious diarrhoea

Paul Kelly

Abstract

Infectious diarrhoea remains a major cause of morbidity and mortality worldwide. Viruses, bacteria and protozoa are responsible for most infections, which are most commonly transmitted by the faecal–oral route through water, food and person-to-person transmission. Clinical presentation of infectious diarrhoea conforms to three patterns: acute watery diarrhoea; bloody diarrhoea (dysentery); and persistent diarrhoea, which can include steatorrhoea. Diagnosis still rests heavily on stool microscopy and culture, although faecal antigen tests and molecular assays are increasingly used. Oral rehydration therapy continues to be the most important supportive intervention, particularly in acute watery diarrhoea, in which death from dehydration and acidosis can be prevented in the vast majority of cases. There have been some important advances in the development of new approaches to antibiotic therapy. The non-absorbable antibiotic rifaximin is highly effective in the treatment of travellers' diarrhoea and has fewer adverse effects than systemically absorbed antibiotics. The broad-spectrum antimicrobial nitazoxanide is often effective in the treatment of cryptosporidiosis but is also effective in giardiasis, amoebiasis and *Clostridium difficile* infection. Recent meta-analyses suggest that promicrobial therapies, including faecal microbial transplantation, have a place in the prophylaxis and treatment of antibiotic-associated diarrhoea, especially *C. difficile* infection, and acute diarrhoea in children.

Keywords Antibiotics; antidiarrhoeal agents; bacteria; diarrhoea; enteropathogens; MRCP; probiotics; protozoa; viruses

Key points

- Diarrhoeal diseases remain common throughout the world, but mortality in children is falling
- Our understanding of pathogens and their effects is evolving rapidly
- The most important clinical syndromes are acute watery diarrhoea, acute bloody diarrhoea (dysentery), persistent watery diarrhoea and persistent bloody diarrhoea
- Oral rehydration remains the cornerstone of treatment
- A limited number of clinical syndromes should be treated with antibiotics
- Although the principles of treatment remain unchanged, refinements in antimicrobial therapy and in formulations of oral rehydration solution represent important advances
- The role of promicrobial therapies is beginning to have an evidence base, and faecal microbial transplantation is now the treatment of choice for recurrent *Clostridium difficile* infection

Introduction

Infections of the gastrointestinal tract are the most common intestinal disorders,[1] with a wide range of causes.[2] They have their major impact in the developing world; although mortality is falling, they are still responsible for the deaths of over half a million preschool children each year.[1]

Despite industrialization, wealth and public health interventions in the developed world to ensure water quality and sewage disposal, intestinal infections, including both food-borne (*Salmonella* spp., *Campylobacter* spp.) and waterborne (*Cryptosporidium parvum*, *Giardia intestinalis*) infections remain important causes of morbidity and mortality. Infectious enteritis caused by *Salmonella* spp., *Campylobacter jejuni* or enterohaemorrhagic *Escherichia coli* (EHEC) infection can have serious complications, such as haemolytic–uraemic syndrome (HUS). The increase in foreign travel has further contributed to the importance of infectious diarrhoea in the industrialized world, as has the increasing use of broad-spectrum antibiotics and associated antibiotic-related diarrhoea caused by *Clostridium difficile*. Opportunistic infections in various immunodeficiency states (e.g. AIDS, transplants, ulcerative colitis) are important to diagnose and treat.

Epidemiology

The key sources of human enteropathogens are food, water and other humans. Certain human infective agents are carried by animals, giving rise to conditions known as zoonoses (e.g. salmonellosis, campylobacteriosis, giardiasis, cryptosporidiosis). Domestic water supplies, swimming pools, seawater and inland freshwater lakes and rivers are also a source of enteropathogens.

Faecal–oral transmission, the main route by which these infections are spread, can occur through ingestion of contaminated food or fluids, or by direct person-to-person contact. The latter is particularly important when only small infective doses are required to initiate infection, as in shigellosis. *Vibrio cholerae* and non-cholera vibrios are transmitted by contaminated water, shellfish and other seafood, and by person-to-person contact. Food-borne infection – so-called 'food poisoning' – can be caused by true infection of the intestine or be related to the ingestion of a pre-formed toxin (Table 1). Viruses, such as the norovirus (previously known as small, round, structured viruses (SRSVs) of the Norwalk family), can be spread by aerosol, especially as vomiting is an important early symptom of the illness. This probably explains why this infection spreads so rapidly through cruise ships, hotels and hospital wards. Immunodeficiency and reduced gastric acid secretion are well-

Paul Kelly *MD FRCP is a Professor of Tropical Gastroenterology at Barts and the London School of Medicine, Queen Mary University of London, UK. Competing interests: none declared.*

Microbial pathogens responsible for food-borne diarrhoeal disease

Organism	Incubation period (hours)	Recovery
Gut colonization		
Salmonella spp.	12–48	2–14 days
Campylobacter jejuni	48–168	7–21 days
EHEC	24–168	7–21 days
Vibrio parahaemolyticus	2–48	2–30 days
Yersinia enterocolitica	2–144	1–3 days
Clostridium perfringens	8–22	1–3 days
Pre-formed toxins		
Staphylococcus aureus	2–6	Few hours
Bacillus cereus	1–2	Few hours
Clostridium botulinum	18–36	10–14 days

Table 1

recognized risk factors for intestinal infections. Intimate sexual contact, notably oro–anal sex, can be associated with transmission of enteropathogens.

Causes

Infective diarrhoea presents in a variety of ways, the recognition of which can assist clinical diagnosis and early management. The four major patterns are: (1) acute watery diarrhoea; (2) bloody diarrhoea (dysentery), usually resulting from an infective enterocolitis causing colonic ulceration; (3) persistent watery diarrhoea, sometimes with steatorrhoea and/or evidence of an enteropathy and/or malnutrition; and (4) persistent bloody diarrhoea. The major organisms responsible for these clinical syndromes are summarized in Table 2. However, there is considerable overlap between these clinical patterns; infection with some organisms, such as *Shigella* spp. and *C. jejuni*, initially presents as acute watery diarrhoea but then progresses to a dysenteric illness with fever and bloody diarrhoea. Similarly, giardiasis can start as acute watery diarrhoea but eventually becomes persistent with features of malabsorption.

Causes of infectious diarrhoea by clinical pattern

Enteropathogen	Acute watery diarrhoea	Dysentery	Persistent diarrhoea
Viruses			
Rotavirus	+	–	–
Enteric adenovirus (types 40, 41)	+	–	–
Norovirus and other SRSVs	+	–	–
Calicivirus	+	–	–
Astrovirus	+	–	–
Cytomegalovirus	+	+	+
Bacteria			
Vibrio cholerae and other vibrios	+	–	–
Enterotoxigenic *Escherichia coli* (ETEC)	+	–	–
Enteropathogenic *E. coli* (EPEC)	+	–	+
Enteroaggregative *E. coli* (EAEC)	+	–	+
Enteroinvasive *E. coli* (EIEC)	+	+	–
Enterohaemorrhagic *E. coli* (EHEC)	+	+	–
Shigella spp.	+	+	+
Salmonella spp.	+	+	+
Campylobacter spp.	+	+	+
Yersinia spp.	+	+	+
Clostridium difficile	+	+	+
Mycobacterium tuberculosis	–	+ (rare)	+
Protozoa			
Giardia intestinalis	+	–	+
Cryptosporidium parvum	+	–	+
Cystoisospora belli (formerly *Isospora belli*);	+	–	+
Cyclospora cayetanensis	+	–	+
Entamoeba histolytica	+	+	+
Balantidium coli	+	+	+
Fungi			
Microsporidia	+	–	+
Helminths			
Strongyloides stercoralis	–	–	+
Schistosoma spp.	–	+	+

Table 2

Clinical presentation

Acute watery diarrhoea

Rotavirus infection, the most common cause of acute diarrhoea in infants and young children, often takes the form of a brief prodromal illness with fever and mild respiratory symptoms that is followed by vomiting and diarrhoea. If fluid and electrolyte losses are not promptly replaced, dehydration and metabolic acidosis soon follow. The degree of dehydration can be assessed clinically by noting skin tone and tissue turgor, dryness of mucous membranes, intraocular tension and, in young infants, depression of the anterior fontanelle. As the degree of dehydration increases, there is impairment of consciousness, ultimately leading to stupor and coma. Typically, the illness lasts about 7 days. Adenovirus infection causes a more prolonged illness with pronounced respiratory symptoms.

Acute watery diarrhoea in adults is usually caused by bacteria, most commonly enterotoxigenic *E. coli* (ETEC) in travellers or one of the food-borne pathogens in the indigenous population of industrialized countries. Symptoms of ETEC usually begin after a short incubation period and last 3–5 days on average. Watery diarrhoea is often accompanied by anorexia, nausea, vomiting, abdominal cramps, bloating and low-grade fever. In adults, severe dehydration is uncommon, although this can become clinically important in infants and young children, and in elderly individuals. Mild cholera can be indistinguishable from other agents that produce acute watery diarrhoea. However, in severe cholera, diarrhoea begins abruptly, with stool volume rates of up to 1 litre/hour.

Bloody diarrhoea, dysentery and colitis

The organisms responsible for acute bloody diarrhoea are the invasive bacterial enteropathogens (*Shigella* spp., *Salmonella* spp., *C. jejuni*, EHEC) and the protozoon, *Entamoeba histolytica*. There is often a prodromal illness of low-grade fever, headache, anorexia and lassitude. The incubation period is variable but can range from 1 to 7 days. After an initial period of watery diarrhoea, stool volume can actually decrease with the appearance of blood and mucus in the stools. Moderate or severe, cramping lower abdominal pain is an important feature of a dysenteric illness, as are tenesmus and rectal prolapse, particularly in children with shigellosis. There can be fever and mild abdominal distension with some tenderness over the colon. Clinically, it can be difficult to distinguish acute infectious colitis from non-specific inflammatory bowel disease. Any form of severe colitis can give rise to abdominal tenderness, distension and, in some cases, reduced bowel sounds owing to ileus. Proctosigmoidoscopy should form part of the initial clinical assessment and may confirm the presence of colitis.

Persistent watery diarrhoea

In adults, *G. intestinalis* is the commonest infective cause of persistent diarrhoea, often associated with anorexia, abdominal bloating, substantial weight loss and overt steatorrhoea. Intracellular protozoa are also relatively common causes of persistent diarrhoea, particularly in immunocompromised individuals (*C. parvum/hominis*, *Cyclospora cayetanensis*, *Cystoisospora belli* (formerly *Isospora belli*)); microsporidia behave in the same way but have recently been reclassified as fungi. In children, enteropathogenic *E. coli* (EPEC) is an important organism to consider; enteroaggregative *E. coli* (EAEC) seems to be associated with persistence in adults and children. Any cause of persistent diarrhoea in infants and young children can result in failure to thrive and growth retardation. *Strongyloides stercoralis* infection (Figure 1) can also cause chronic diarrhoea and malabsorption.

Persistent bloody diarrhoea

Although most of these cases are attributable to cancer or inflammatory bowel disease, it is very important to remember that tuberculosis can mimic inflammatory bowel disease (Figure 2), and this must be considered in any patient originating in a high-incidence area (Asia, Africa).

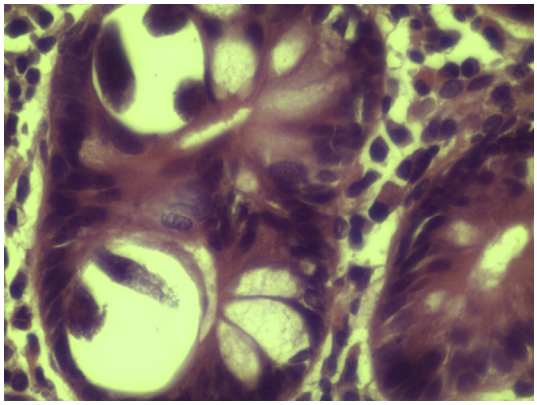

Figure 1 *Strongyloides stercoralis* seen in a duodenal biopsy specimen from an adult Zambian patient.

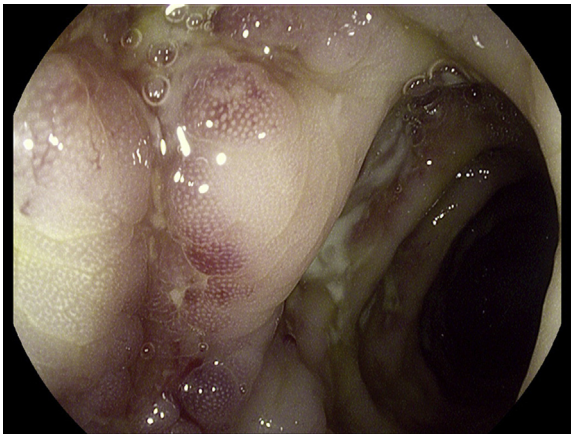

Figure 2 Pancolitis caused by tuberculosis mimics Crohn's disease in a young adult Zambian man. A series from India reported that pancolitis can occur in about 1 in 20 cases of intestinal tuberculosis.

Diagnosis

Although most episodes of acute infective diarrhoea resolve without the need to identify a specific aetiological agent, persistent diarrhoea and bloody diarrhoea always require further investigation. This is particularly important in severely ill patients, in whom a delay in starting appropriate treatment might significantly alter the outcome. Confident exclusion of an infective aetiology is rarely achieved in <24–48 hours and, although imprecise, clinical assessment is important for guiding management during this early phase of the illness.

Routine laboratory investigations are of limited diagnostic value; anaemia, a raised neutrophil count and evidence of an inflammatory process, with a raised erythrocyte sedimentation rate, serum C-reactive protein and platelet count, occur in infective colitis and non-specific inflammatory bowel disease. The cornerstone of evidence-based management is identification of the aetiological agent, which ultimately relies on stool microscopy and culture.

Serology is of limited value in the diagnosis of intestinal infection, except in amoebic colitis, in which serology is positive in 80–90% of patients. Serology can also detect *Yersinia enterocolitica* infection, although results are not usually positive for at least 10–14 days after the onset of the illness. Antibody enzyme-linked immunosorbent assays are now available for the diagnosis of strongyloidiasis and schistosomiasis, and should be regarded as first-line screening tests for travellers returning from endemic areas. Many laboratories now offer polymerase chain reaction diagnosis for intestinal pathogens (bacteria, protozoa), which has the advantage of speed (3 hours) and increased sensitivity. In fact, sensitivity can be so high that it can be difficult to distinguish between agents causing diarrhoea and background carriage of other organisms.

Treatment

Fluid and electrolyte replacement

Oral fluid and electrolyte replacement is usually effective except when losses are very severe or there is associated profound vomiting, in which circumstances intravenous

fluid with sodium- and potassium-containing solutions can be required.

Dehydration occurs more quickly in infants and young children, in whom early administration of an oral rehydration solution (ORS) is advised to prevent dehydration and acidosis. Recent evidence suggests that a single dose of ondansetron, a $5HT_3$ receptor antagonist, reduces vomiting and is a useful adjunct to rehydration therapy in children. In severe dehydration in infants and young children, intravenous rehydration is mandatory. Food should be commenced as soon as the individual can eat and drink normally. Breastfeeding should be continued in infants.

In mild cases in adults, a formal ORS is often not required but it is recommended that they should increase oral fluids, such as salty soups (sodium) and fruit juices (potassium), and take carbohydrates (salty crackers, rice, bread, pasta, potatoes) to provide glucose for the glucose–sodium co-transport system. Recent evidence suggests that new formulations of ORS with resistant starch can reduce stool volume.

Antidiarrhoeal therapy

The most commonly used antimotility agent is loperamide, which is probably most effective when combined with an antibiotic. Antimotility agents are not recommended for children and young infants, although firm evidence against their use is slender. An important advance in antidiarrhoeal therapy has been the development of an enkephalinase inhibitor racecadotril, which has proabsorptive activity because of its ability to potentiate endogenous enkephalins in the intestine. This is an effective agent for reducing stool weight and bowel frequency, and can be safely used in children. Although not in widespread use, $5HT_3$ receptor antagonists also slow colonic motility.

Antimicrobial therapy

Antibiotic therapy for infectious diarrhoea reduces the volume and severity of diarrhoea (Table 3), but there are anxieties about antibiotic resistance. Mild illnesses do not need antibiotic treatment, although treatment is recommended in certain situations, including dysenteric shigellosis, cholera, pseudomembranous colitis, some protozoal infections and persistent diarrhoea. In several diseases, the indications are less clear, but treatment is usually recommended; these include infection with the non-cholera vibrios, prolonged or protracted infection with *Yersinia*, early in the course of campylobacteriosis, *Aeromonas* and *Plesiomonas* infections, and outbreaks of EPEC diarrhoea in nurseries.

Patients should be treated if they are debilitated, particularly with malignancy, are immunosuppressed or have an abnormal cardiovascular system, valvular, vascular or orthopaedic prostheses, or haemolytic anaemia (especially if salmonellosis is involved), or are extremely young or old. Treatment is also advised for individuals with prolonged symptoms and those who relapse. There is some, still controversial, evidence that antibiotics cause HUS in EHEC infection, but this might depend on the EHEC serotype.

Probiotics and promicrobial therapy

Probiotics can shorten the duration of acute diarrhoeal illness in children, and a recent meta-analysis concluded that there is now enough evidence to support the use of probiotics for the treatment and prevention of antibiotic-associated diarrhoea. A trial of faecal microbial transplantation for *C. difficile* infection had to be stopped prematurely after an interim analysis revealed that 81 % of recipients were free of recurrence by 10 weeks.[3] Refinements of this approach will undoubtedly emerge in the coming years.

Prevention

Chemoprophylaxis: broad-spectrum antibiotics taken at approximately half the therapeutic dose can prevent certain intestinal infections, particularly cholera (tetracycline) and travellers' diarrhoea (fluoroquinolones). However, their use in the latter is not generally recommended because of concerns about adverse effects and emerging drug resistance. The non-antibiotic preparation bismuth subsalicylate is a less effective alternative. Antibiotics can be appropriate in vulnerable patients with gastrointestinal problems such as inflammatory bowel disease or intestinal failure who wish to travel to tropical countries. Rifaximin, a non-absorbable antibiotic, may be the best choice for chemoprophylaxis where indicated.

Probiotics and prebiotics: the concept that the gut can be colonized by harmless bacteria that protect against the harmful effects of enteropathogens has been around since the time of Louis Pasteur. As noted above, probiotics now have an evidence base in the treatment and prevention of antibiotic-associated diarrhoea in adults and children. Prebiotics, such as oligofructose, encourage proliferation of 'healthy' bacteria such as bifidobacteria. Oligofructose decreases the relapse rate of *C. difficile* infection after metronidazole or vancomycin treatment.

Vaccines

Although parenteral vaccines against cholera and typhoid have been available for many years, their efficacy is low compared with parenteral vaccines against yellow fever or hepatitis B. The major thrust of vaccine development in recent years has focused on oral vaccines, to ensure that there is the capacity for a local protective immune response in the gut. A whole-cell–B-subunit oral cholera vaccine (Dukoral®) is moderately effective, as are genetically engineered, live, oral cholera vaccines.[4] These cholera vaccines also have some protective effects against travellers' diarrhoea caused by other organisms and the whole-cell–B-subunit vaccine is currently marketed in some countries for travellers' diarrhoea. Two new vaccines against rotavirus infection (Rotarix®, RotaTeq®) have been shown to be safe and are now available.[5] Vaccines against *Shigella* and ETEC are also under development.

Complications

Haemolytic–uraemic syndrome

Shigella dysenteriae type 1 infection has been known for several decades to cause HUS, and it is now well established that it is also responsible for a substantial proportion of the mortality associated with EHEC infection. HUS, which comprises acute renal failure, thrombocytopenia and microangiopathic haemolytic anaemia, is also described with *Salmonella typhi*, *C. jejuni* and *Yersinia pseudotuberculosis*

Antimicrobial therapy for acute infectious diarrhoea

Organism	Efficacy of antimicrobial therapy	Drug of choice	Alternative choice
Bacteria			
Vibrio cholerae	Proven	Tetracycline 500 mg four times daily, 3 days Ciprofloxacin 1000 mg single dose	Sulfamethoxazole/trimethoprim 960 mg twice daily, 4 days Doxycycline 300 mg single dose Erythromycin 500 mg four times daily, 3 days Ciprofloxacin 500 mg twice daily, 3 days
ETEC	Proven	Ciprofloxacin 500 mg twice daily, 3—5 days Norfloxacin 400 mg twice daily, 3—5 days	Ciprofloxacin 500 mg single dose
EPEC	Possible	Ciprofloxacin 500 mg twice daily, 5 days	
EIEC	Possible	Ciprofloxacin 500 mg twice daily, 5 days	
EHEC	Probably harmful	Possibly fluoroquinolone	
Shigella spp.	Proven efficacy in dysenteric shigellosis	Ciprofloxacin 500 mg twice daily, 5 days Other quinolones — norfloxacin	Short-term quinolone 400 mg daily, 5—7 days, or other third-generation cephalosporins Nalidixic acid 1 g four times daily, 5—7 days
Salmonella spp.	Doubtful efficacy in enterocolitis Proven efficacy in severe salmonellosis (dysentery, fever)	Ciprofloxacin 500 mg twice daily, 10—14 days Third-generation cephalosporins, 10—14 days Carrier state: norfloxacin 400 mg twice daily, 28 days	Amoxicillin needs guidance on local sensitivity patterns
Campylobacter spp.	Possible efficacy in *Campylobacter* enteritis Proven efficacy in *Campylobacter* dysentery/sepsis	Erythromycin 250—500 mg four times daily, 7 days	Ciprofloxacin 500 mg twice daily, 5—7 days Azithromycin 500 mg daily, 3 days
Yersinia spp	Doubtful efficacy in *Yersinia* enteritis Proven efficacy in *Yersinia* septicaemia	Ciprofloxacin 500 mg twice daily, 7—10 days	Tetracycline 250 mg four times daily, 7—10 days
Clostridium difficile	Proven	Metronidazole 400 mg three times daily, 7—10 days	Vancomycin 125 mg four times daily, 7—10 days Fusidic acid, teicoplanin
Protozoa			
Giardia intestinalis	Proven	Metronidazole 400 mg three times daily, 7—10 days	Tinidazole 2 g single dose
Cryptosporidium spp.	Proven	Nitazoxanide 500 mg twice daily, 3 days	Paromomycin 500 mg four times daily, 7—10 days
Isospora belli	Proven	Sulfamethoxazole/trimethoprim 960 mg four times daily, 10 days	
Cyclospora cayetanensis	Proven	Sulfamethoxazole/trimethoprim 960 mg twice daily, 7 days	
Encephalitozoon intestinalis *Enterocytozoon bieneusi*	Proven	Albendazole 400 mg twice daily, 4 weeks Fumagillin 60 mg 14 days	
Entamoeba histolytica	Proven	Metronidazole 800 mg three times daily, 5 days Diloxanide furoate 500 mg three times daily, 10 days	Paromomycin 25—35 mg/kg three times daily, 7—10 days
Balantidium coli	Proven	Metronidazole 400 mg three times daily, 10 days	Tetracycline 500 mg four times daily, 10 days
Travellers' diarrhoea	Proven	Rifaximin 200 mg three times daily, 3 days	Ciprofloxacin 500 mg single dose

Note that the use of fluoroquinolones for mild to moderate infections is under increasing scrutiny because of increasing evidence about joint and tendon problems; the European Medicines Agency has recently withdrawn marketing authorization for several fluoroquinolones.
EHEC, enterohaemorrhagic *Escherichia coli*; EIEC, entero-invasive *E. coli*; EPEC, enteropathogenic *E. coli*; ETEC, enterotoxigenic *E. coli*.

Table 3

infections. HUS occurs in about 6% of patients with EHEC infection and carries a mortality of 3–5%.

Non-septic arthritis and Reiter's syndrome

These conditions are commonly associated with several invasive organisms including *Salmonella* spp., *Shigella* spp., *Y. enterocolitica* and *C. jejuni*. More than 70% of patients who develop non-septic arthritis are human leukocyte antigen (HLA)-B27 positive. Non-septic arthritis can be associated with iritis and conjunctivitis, which can occur in up to 90% of patients with arthritis after shigellosis, and in up to 25% of those with *Salmonella*, *Campylobacter* or *Yersinia* infections. The term 'Reiter's syndrome' is reserved for the classic triad of arthritis, urethritis and conjunctivitis. Again, HLA-B27 positivity strongly predicts the likelihood of developing Reiter's syndrome and is indicative of its severity.

Guillain–Barré syndrome

There is now a clear link between *C. jejuni* infection and Guillain–Barré syndrome. If the syndrome follows *Campylobacter* infection, it appears to be predominantly a motor disorder and has a particularly poor outcome, with an increased risk of requiring ventilatory support, and of severe disability at 1 year.

Septic arthritis

Purulent synovitis during enteric infection is relatively rare, occurring in 0.2–2.5% of individuals with *Salmonella* infection. Infection is usually monoarticular involving the large joints. Joint symptoms generally begin within 2 weeks of the gastrointestinal symptoms but can take up to 7 weeks to appear. There is no association with HLA-B27.

Post-infectious irritable bowel syndrome (IBS)

There is evidence that acute intestinal infection can trigger diarrhoea-predominant IBS after clearance of the enteropathogen, but it is not clear if this is a causal relationship. It has been proposed that this might be related to subclinical 'inflammation' and an increase in 5-hydroxytryptamine-containing enterochromaffin cells. Management is the same as for other causes of IBS. ◆

KEY REFERENCES

1 Liu L, Oza S, Hogan D, Chu Y, et al. Global, regional, and national causes of under-5 mortality in 2000-15: an updated systematic analysis with implications for the Sustainable Development Goals. *Lancet* 2016; **388:** 3027–35.

2 Liu J, Platts-Mills JA, Juma J, et al. Use of quantitative molecular diagnostic methods to identify causes of diarrhoea in children: a reanalysis of the GEMS case-control study. *Lancet* 2016; **388:** 1291–301.

3 van Nood E, Vrieze A, Nieuwdorp M, et al. Duodenal infusion of donor feces for recurrent Clostridium difficile. *N Engl J Med* 2013; **368:** 407–15.

4 Clemens JD, Nair GB, Ahmed T, Qadri F, Holmgren J. Cholera. *Lancet* 2017; **390:** 1539–49.

5 Burnett E, Parashar U, Tate J. Rotavirus vaccines: effectiveness, safety, and future directions. *Paediatr Drugs* 2018; **20:** 223–33.

TEST YOURSELF

To test your knowledge based on the article you have just read, please complete the questions below. The answers can be found at the end of the issue or online here.

Question 1

A 25-year-old man presented with a 3-day history of acute bloody diarrhoea after a visit to Indonesia.

On clinical examination, his temperature was 37°C. The abdomen was not tender.

Investigations

- Plain abdominal radiograph was normal
- Amoebic serology was awaited

Which of the following management options is best:

A. Arrange immediate full colonoscopy
B. Treat with loperamide 4 mg
C. IV fluids while awaiting serology
D. Treat with metronidazole 800 mg 8-hourly
E. Treat with ciprofloxacin 500 mg 12-hourly

Question 2

A 75-year-old woman presented with diarrhoea (liquid stool four times per day; no blood) while recuperating from cardiac surgery.

Investigation

- *Clostridium difficile* (toxin A positive) had been isolated from stool

What is the most appropriate action to take next?

A. Treat with vancomycin
B. Treat with *Saccharomyces boulardii*
C. Treat with faecal microbial transplantation
D. Stop all antibiotics
E. Treat with metronidazole

Question 3

A 33-year-old man presented for advice about preventing diarrhoea. He was about to travel to central Africa for 6 months. He had had mild ulcerative colitis for 10 years, and was taking azathioprine 100 mg daily. He was an aid worker.

What is the best advice to give?

A. Avoid oral vaccines
B. Take regular probiotics
C. Have oral vaccines against cholera and typhoid
D. Take ciprofloxacin 250 mg every day
E. Avoid unwashed food or ice cubes