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Overview on the most common microbial causative agents of diarrhea

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Abstract

In all parts of the world and among all age groups, diarrhea is a significant cause of morbidity and mortality. However, compared to high-income countries, low-income countries have fewer resources and a less resilient infrastructure, which makes them more susceptible to an unfair share of diarrheal morbidity and mortality. The word "diarrhea" originates from the Greek word "dia rEo," referring to "flow through." When the volume of colonic fluid crosses this segment's absorptive capacity due to decreased absorption and/or increased secretion, diarrhea achievements. In infectious diarrheas, the abnormal function is brought about by microorganisms that colonize the intestinal mucosa and subvert normal gut physiology either directly or via enterotoxins.

Keywords: Morbidity and mortality, Diarrheal, Colonic fluid

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Introduction

The passage of loose or watery stools that tend to be accompanied by an increase in the frequency of bowel movements is termed as diarrhea. It can also mean passing no fewer than three watery or loose stools in a 24-hour period; a loose stool conforms to the shape of the container [1, 2, 3]. Children under the age of two years old have higher rates of diarrheal illness in developing nations. Under-five children experience 4 million deaths and 1.3 billion episodes of diarrhoea annually, with an average of 4.9 episodes of diarrhoea / child a year [3]. Globally, diarrheal diseases are a leading cause of morbidity and mortality, particularly in developing nations where children are most affected by infectious diarrhea, malnourishment, and death. Diarrheal diseases claim the lives of about 5 million children and infants worldwide each year [4].

In children acute diarrhea is primarily caused by infectious organisms, such as viruses, bacteria, and parasites. Since parasite infections are now less common, viruses and bacteria are now more commonly to blame for severe diarrhea in kids [5, 6]. One of the main causes of diarrhea in children, particularly in those under five, is the human rotavirus. The majority of global reports concur that rotavirus is the main culprit behind children's acute diarrhea [7,8]. However, it seems that the etiology of the bacteria that cause diarrhea varies by region. For instance, a study from Spain found that the

main bacterial pathogens responsible for 22.2 % and 16.4% of pediatric episodes of acute diarrhea, respectively, were *Campylobacter* spp. and *Salmonella* spp. [9]. According to reports, the primary etiological causes of diarrhea in Ecuador are *Shigella* spp. and *Campylobacter jejuni* [10]. In Turkey, the primary causes of acute gastroenteritis in children are *Salmonella* spp. (25.6 %) and*C.jejuni* (18.3%) [11].

Etiology of Diarrhea:

Bacterial Pathogens

AIDS patients experience bacterial enteritis more frequently and to a greater extent than the general population. Over 20% of diarrhea episodes in AIDS patients are caused by bacterial pathogens. These pathogens include include diarrhoeagenic *Escherichia coli* [which include enteropathogenic *E.coli* (EPEC), entero-invasive *E. coli* (EIEC), enteroaggregative *E. coli* (EAggEC), entero-toxigenic *E.coli* (ETEC) [12,13], and attaching and effacing *E. coli* (A/EEC)], *Shigella* species, *Salmonella* species, *Vibrio cholera, Campylobacter jejuni, Yersinia enterocolitica*, *Clostridium difficile and Aeromonas* species [14,15].

Viral gastroenteritis is more common than bacterial gastroenteritis.Gastroenteritis is caused by bacteria in a few different ways.

Enterotoxins are produced by certain species (eg, *Vibrio cholerae*, enterotoxigenic strains of *E. coli*) that adhere to intestinal mucosa without invading. Watery diarrhea is the result of these toxins' inhibition of intestinal absorption and stimulation of adenylate cyclase, which leads to the secretion of water and electrolytes. A comparable toxin is produced by *C. difficile*.

Exotoxins that are ingested in contaminated food which are produced by some bacteria (eg, *Staphylococcus aureus*, *Clostridium perfringens, Bacillus cereus*). In the absence of a bacterial infection, the exotoxin can induce gastroenteritis. After consuming contaminated food, these toxins typically result in vomiting, acute nausea and diarrhea within 12 hours. The symptoms go away in three days.

Mucosal invasion happens when other bacteria, such as *Shigella, Salmonella, Campylobacter, C. difficile*, and some subtypes of *E. coli*, infiltrate the mucosa of the colon or small intestine and produce ulcers, bleeding, fluid that is rich in protein, and the secretion of electrolytes and water. Whether the organism produces an enterotoxin or not does not affect the outcome of the invasive process. There is evidence of this invasion and inflammation in the ensuing diarrhea, with leukocytes and RBCs visible under a microscope and occasionally with gross blood [16, 17].

Infections with bacterial causes such as *Salmonella* and *Campylobacter* are prevalent of diarrhea in the United States. Undercooked poultry is the most common way to contract both infections, though unpasteurized milk can also be a source. Cattle and poultry are common sources of *Campylobacter*; other animals, such as puppies and kittens, pets, pigs, and birds, may also harbor the bacteria and spread the infection to people. Acute, mostly self-limited gastrointestinal illness caused by a *Campylobacter* infection is characterized by diarrhea, fever, and cramping in the abdomen [18].

One of the three most important causes of inflammatory diarrhea in the world, *salmonella* primarily affects people who live in places without access to clean water and food, basic healthcare, appropri ate nutrition, and good hygiene [19]. Undercooked eggs can spread *Salmonella*, as can coming into

contact with birds, amphibians, or reptiles. Although foodborne outbreaks do happen, *Shigella* species are frequent bacterial causes of diarrhea in United State and are typically spread from man to man. Shiga toxin produced by *Shigella dysenteriae* type 1can brought on Hemolytic-uremic syndrome, which is, which is not found in the US [20, 21].

Many subtypes of the bacteria can cause gastroenteritis due to *E. coli*.

Depending on the subtype, the epidemiology and clinical manifestations differ significantly.

The most frequent cause of infectious nosocomial diarrhea is toxin-producing *Cl. difficile* infection, which accounts for 15% to 20% of cases of antibiotic-associated diarrhea. Furthermore, its occurrence has been increasing in recent years. More than ninety percent of cases of *Cl.difficile* diarrhea are acquired in the hospital, whereas fewer than 5 % are community-acquired. Other risk factors for *Cl.difficile* diarrhea are older age, , renal failure, severe underlying illness, enteral feedings and use of rectal thermometers. 3'4>11 There is a linear relationship between length of hospital stay, colonization with *Cl.difficile*, and development of *Cl.difficile* diarrhea [23, 24, 25].

Although most are rare in the US, a few other bacteria can also cause gastroenteritis. *Y. enterocolitica* causes acute diarrhea in early childhood. It is transmitted by undercooked pork, unpasteurized milk, or contaminated water [26]. When undercooked seafood is consumed, a number of Vibrio species, such as V. parahaemolyticus, can cause diarrhea. Particularly after natural disasters or in camp over refugees, Because it can occasionally cause severe watery diarrhea in places where people lack access to clean drinking water and sanitary ways to dispose of human waste, *V. cholerae* is a concern. There are hundreds of thousands of cholera cases reported each year, with an approximate 1-2% overall case mortality rate. Cholera toxin (CT), which is made up of five binding (B) subunits and an enzymatic (A) subunit, is the main virulence factor of *V. cholerae*. When CT is internalized and its A subunit is released into the cytosol, it stimulates intracellular cAMP production, allowing cAMP-mediated intestinal fluid secretion.

This occurs after CT's B subunit binds to GM1 ganglioside receptors found in the apical membrane of intestinal epithelial cells (IEC) [27]. Rarely can *listeria* cause foodborne gastroenteritis; instead, it typically causes meningitis or bloodstream infection in older adults, pregnant women, and newborns (see Neonatal Listeriosis). *Aeromonas* can be contracted by swimming in or drinking contaminated fresh or brackish water [28].

Viral Pathogens

Viruses are a major global cause of gastrointestinal issues, particularly affecting children under the age of five in both developed and developing nations. Adenovirus is another microbe that can cause acute diarrhea, particularly in young children and infants, along with rotavirus. Enteric adenovirus or astrovirus are the main causes of the majority of other viral gastroenteritis infections [29].

Viral gastroenteritis is frequently caused by astrosviruses in both geographical and developmental contexts [30]. Seasonal outbreaks of infection are linked to hospitals, childcare centers, and hotels in temperate climates. in tropical environments with inadequate infrastructure for water and sanitation, In low- and middle-income countries (LMIC), diarrhea in children is a major cause of mortality and wasted human potential. Astroviruses are part of the problem. They are thought to be responsible for 2% to 9% of cases of acute, nonbacterial childhood diarrhea, and new strains have

been connected to complications for the central nervous system in children, such as encephalitis and meningitis. Common symptoms of astronuclein gastroenteritis include sudden, self-limiting, acute watery diarrhea; fever, anorexia, and vomiting are not always present. The mode of transmission is the fecal-oral route. For incubation, three to four days need to be spent [31, 32, 33].

Adenoviruses are the fourth most frequent cause of viral gastroenteritis in young people. All year long, infections happen, though they do tend to spike in the summer.

Epidemiological investigations conducted across multiple developed nations revealed that enteric adenovirus was only the second most frequent reason why infants and young children get viral gastroenteritis children, and its positive infection rate in isolated instances and acute gastroenteritis outbreaks varied from 1.1% to 12.0%. Youngsters under the age of two are the most vulnerable.. Both respiratory droplets and the fecal-oral pathway are modes of transmission, 3-5 days are needed for incubation [34].

Rotavirus gastroenteritis is a serious global public health issue. The feco-oral route is how rotavirus is spread, and winter is when rotavirus gastroenteritis is most common. Its clinical course is generally thought to be more severe than that of other viral gastroenteritis. A mild fever, vomiting, and loose stools are the first symptoms; there is no visible blood or mucus in the stool. Diarrhea usually lasts 4–5 days, while vomiting can last 2–3 days [35, 36].

Enterocytes in the small intestine's villous epithelium are infected by viruses. Fluid and electrolytes transude into the intestinal lumen as a result; occasionally, unabsorbed carbohydrates from malabsorption in the impacted colon subsequently exacerbate by resulting in osmotic diarrhea symptoms. Watery diarrhea occurs. Diarrhea (dysentery) characterized by inflammation and fecal red blood cells (RBCs), white blood cells (WBCs), or gross blood. Other viruses, such as the enterovirus and cytomegalovirus, can induce gastroenteritis in immunocompromised patients [37].

Protozoan Pathogens

In humans, protozoan parasites are major contributors to diarrhea and other intestinal disorders [38]. In developing nations, *Giardia lamblia* and *Cryptosporidium parvum* are two significant protozoan causes of diarrhea. Youngsters under two years old may be the most common, and they may also be the most vulnerable. The associated diseases have a wide range of clinical manifestations, from self-limited diarrhea in healthy individuals and asymptomatic carriers to potentially fatal prolonged diarrhea in immunocompromised or immunosuppressed individuals (such as those with AIDS), malnourished children, and the elderly) [39, 40].

Giardia and *Cryptosporidium* spread by tainted food and water, but they can also spread from person to person and, because these protozoans are zoonotic, from domestic or wild animals to humans. Despite being acknowledged as important foodborne pathogens, foodborne parasites are still given less attention than bacterial and viral pathogens [41].

Some intestinal parasites stick to the intestinal mucosa and cause nausea, vomiting, diarrhea, and general malaise. One such parasite is Giardia intestinalis (also known as G. lamblia). Globally and in every US region, giardiasis is a problem. Chronic infections can lead to malabsorption syndrome, which is sometimes mistaken for irritable bowel syndrome. Typically, people contract it through person-to-person contact (common in daycare facilities) or by ingesting cysts in tainted food or water.

In addition to causing watery diarrhea, *Cryptosporidium parvum* can occasionally cause nausea, vomiting, and cramping in the abdomen. In healthy individuals, the illness resolves on its own after about two weeks. Immunocompromised patients may experience a severe and protracted illness that results in significant fluid and electrolyte loss. The most common way to get cryptosporidium is through contaminated water. Roughly three-quarters of outbreaks of recreational waterborne illness in the US are caused by this organism, which is resistant to chlorine [42, 43].

Entamoeba histolytica is a common cause of subacute bloody diarrhea in areas with low socioeconomic status and inadequate sanitation, despite being uncommon in the US. The surrounding environment, including social, economic, demographic, and hygiene-related behaviors that affect the spread and transmission of parasitic infections, are important in determining the prevalence of *E. histolytica* .A numerous studies identified that drinking water quality, ingestion of raw vegetables, place of residence and age as important risk factors [44]. Some researchers conjectured that infants should not be expected to contract amebiasis very often because the disease is often linked to contaminated food and water. Malnutrition, immunization, and young age are linked to more severe disease [45].

Other parasites that can mimic the symptoms of cryptosporidiosis include a group of organisms known as *microsporidia* and *Cystoisospora (Isospora) belli*. The gastrointestinal tract is home to the coccidian, unicellular protozoan parasite *I. belli*. Although *I. belli* infections are found all over the world, they are comparatively uncommon and typically arise in tropical and subtropical regions. It typically causes diarrhea that isn't bloody in tropical and subtropical regions. It is present in newly arrived immigrants, tourists coming back from endemic areas, and AIDS patients in developed nations. The most common way for *I. belli* to spread is through contaminated food or water [46, 47].

Conflict of Interest

No conflicts of interest were declared by the authors.

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Ethics Statement

Approved by local committee.

Authors' contributions

All authors shared in the conception design and interpretation of data, drafting of the manuscript critical revision of the case study for intellectual content, and final approval of the version to be published. All authors read and approved the final manuscript.

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