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Sexually transmissible bacterial enteric pathogens

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Abstract

Bacterial enteric pathogens can be transmitted through sexual contact, with gay, bisexual, and other men who have sex with men (gbMSM) being particularly at risk. The factors and dynamics involved in sexual transmission of bacterial enteric pathogens remain incompletely understood. Intestinal pathogens with a low infectious dose, particularly *Shigella* spp., followed by *Campylobacter* spp., which has a relatively higher infectious dose, are more likely to spread through sexual contact. Asymptomatic carriers of bacterial enteric pathogens may play a role in transmission through sexual activity. Recommendations for prevention of sexual transmission of bacterial enteric pathogens include engaging in less risky sexual behavior, minimizing oral–anal contact during sexual activity, maintaining good personal hygiene, and using protective measures such as cleaning sex toys. If a partner has diarrhea, it is recommended to avoid sexual contact during active illness and for at least 1 to 2 weeks after the symptoms have resolved. In addition, oral–anal contact should be avoided for 4 to 6 weeks following resolution of symptoms. Increasing awareness of the possible sexual transmission of bacterial enteric pathogens among at-risk groups is essential for encouraging behavioral changes. Similarly, raising awareness among clinicians that care for at-risk groups is essential for providing appropriate counseling and improving patient management.

Keywords: antibiotic resistance, bacterial enteric pathogen, campylobacter, prevention, sexual transmission, shigella

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Introduction

Sexually transmitted infections (STIs) are infections that spread primarily through sexual contact, including vaginal, oral, and anal sex. Some STIs can also be passed from mother to child during pregnancy, delivery, or breastfeeding. The most common sexually transmissible pathogens include syphilis, gonorrhea, chlamydia, and trichomoniasis, as well as human papillomaviruses, herpes simplex virus, hepatitis B virus, and HIV. In addition, other pathogens can be transmitted via sexual contact, although this is not their usual mode of transmission; they include bacterial enteric pathogens (*Shigella* spp., *Campylobacter* spp., *Salmonella* spp., and diarrhoeagenic *Escherichia coli)*, *Neisseria meningitidis*, mpox, *Giardia duodenalis*, Zika virus, Ebola virus, and hepatitis A virus. These pathogens, which can be associated with sexual activity, are not included in routine STI diagnostic procedures, creating additional obstacles for STI control and prevention (1).

Enteric pathogens are mainly transmitted through fecal contamination of food or water. Exposure to infected fecal matter can also occur during various sexual practices, resulting in a number of enteric pathogens that have the potential for sexual transmission (2). The most common bacterial enteric pathogens responsible for community-acquired diarrhea include the genera *Salmonella*, *Shigella*, and *Campylobacter*, and also *Yersinia enterocolitica*.

Stool samples should be collected as soon as possible after the onset of symptoms because bacterial pathogens are generally present in higher quantities during the acute phase, increasing the likelihood of successful culture (3). Successful culture is a prerequisite step for antibiotic susceptibility testing, which is essential due to the rising prevalence of multidrug resistance in species such as *Shigella* and *Campylobacter*, particularly in gay, bisexual, and other men who have sex with men (gbMSM) populations (4). Molecular syndromic diagnostics for bacterial diarrhea has higher sensitivity than culture; however, in the case of a positive molecular test, a reflex culture is needed to perform antibiotic susceptibility testing. Stool samples are preferred for testing; a flocked rectal swab in transport medium can also be used if stool is not readily available. However, in this case, molecular diagnostics is recommended because this method has lower sensitivity (5).

Sexual transmission of bacterial enteric pathogens was already noted as early as the 1970s, with reports of enteric infections with *Shigella* spp. and *Salmonella* spp. among gbMSM (6, 7). The HIV epidemic led to sexual behavior modifications with a reduction in the incidence of HIV and other STI transmission, including bacterial enteric pathogens. In the second half of the 1990s, likely due to the introduction of combination antiretroviral therapy, STIs began to re-emerge, with a growing number of STI outbreaks reported particularly among gbMSM (4, 8).

This article reviews the distribution and characteristics of recent sexually transmitted bacterial enteric pathogens outbreaks and discusses the key issues for control and prevention.

Shigellosis

Shigellosis is a gastrointestinal infection caused by *S. sonnei*, *S. flexneri*, *S. boydii*, or *S. dysenteriae* (9). Humans are the only primary reservoir for shigellosis, which can be transmitted through fecal contamination of food or water, as well as via contaminated hands or objects. Secondary infections commonly occur due to the low infectious dose. The incubation period is 1 to 2 days, and symptoms can range from mild to severe and include diarrhea that may be bloody or prolonged, fever, abdominal pain, and tenesmus.

According to the European Centre for Disease Prevention and Control (ECDC), in 2023, 30 European Union/European Economic

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Area (EU/EEA) countries reported 6,616 confirmed cases of shigellosis, and the overall EU/EEA notification rate was 1.9 cases per 100,000 population. The second-highest notification rate was in adult males 25 to 44 years old; sexual transmission among gbMSM may have contributed to the observed gender imbalance. The increasing resistance to first- and second-line antibiotics in *Shigella* spp. in recent years is also a cause for concern (10–12). In Slovenia, 23 cases were reported in 2023 with a notification rate of 1.1 cases per 100,000 population (13).

The earliest reports of sexually transmitted shigellosis were published in the 1970s (7). A review of sexually transmitted shigellosis was recently published in this journal (9). Since the mid-2010s, several countries have observed a notable increase of shigellosis among gbMSM. This rise is accompanied by a growing number of reports of antibiotic-resistant *Shigella* strains and clusters of multidrug-resistant *Shigella* spp. (4, 14–18). In early 2022, the ECDC published its first rapid alert regarding the increase in sexually transmitted shigellosis caused by *S. sonnei* and *S. flexneri* among gbMSM in Europe (19). A new alert on the spread of extensively drug-resistant *S. sonnei* in Europe resistant to first- and second-line treatments was published in July 2023 (10). In 2024, the World Health Organization classified fluoroquinolone-resistant shigellae as a high-priority pathogen on its list of bacterial pathogens of public health importance, with the goal of guiding research, development, and strategies to combat antimicrobial resistance (20). Sexually transmitted shigellosis is more often caused by strains resistant to first-line oral antibiotics (e.g., macrolides and fluoroquinolones) and third-generation cephalosporins, increasing the risk of empiric treatment failure. A recent review indicates that antibiotic resistance is generally lower in travel-associated cases compared to sexually transmitted shigellosis (21). Infections with extensively drug-resistant *Shigella* spp. may require hospitalization because severe cases resistant to first- and second-line treatments can only be effectively treated with parenteral antibiotics, such as carbapenems (15).

Campylobacteriosis

Campylobacteriosis is a worldwide zoonosis; it is the most frequently reported acute diarrheal enteritis in high-income countries and is predominately caused by *Campylobacter jejuni* or *C. coli*. Symptoms usually begin with abdominal cramps, followed by watery diarrhea, and in approximately one-third of cases the stool may be bloody. Fever, headaches, and muscle aches are also common. Postinfectious complications can occur, such as reactive arthritis or Guillain–Barré syndrome. *Campylobacter* spp. are commonly found as commensals of the gastrointestinal tract in animals (e.g., poultry, cattle, pigs, and wild birds); the main source for human infection is consumption of contaminated food (e.g., poultry meat) or more rarely contaminated water. According to the ECDC, in 2023, 30 EU/EEA countries reported 150,823 confirmed cases of campylobacteriosis, and the overall EU/EEA notification rate was 49.36 cases per 100,000 population. Higher rates in males than females were observed in all age groups; with an overall male-to-female ratio of 1.2:1, as was already noted in previous years (11, 22). In Slovenia, 1,089 cases were reported in 2023 with a notification rate of 51.4 cases per 100,000 population (13).

The first descriptions of cases of campylobacteriosis among gbMSM were published in the 1980s, usually with *C. jejuni* as well as some cases of *C. fetus* infections (23–26). Long-lasting clusters of campylobacteriosis among gbMSM were reported in Canada between 2003 and 2013 (27). Multiple clusters of erythromycin- and ciprofloxacin-resistant *C. jejuni* among gbMSM were reported in Canada in the last 25 years, including one international multidrug-resistant cluster (in Quebec and in Washington, USA) (28, 29). Marchand-Senécal et al. reported a *C. fetus* cluster among gbMSM in Canada with intestinal and extraintestinal infections with significant morbidity (3/13 patients had bacteremia, 2/3 with aortic mycotic aneurysm) (30).

Salmonellosis

Salmonellosis is the second most frequently reported bacterial gastrointestinal infection in the EU/EEA, and it is a significant cause of food-borne outbreaks. Enteric infections due to non-typhoidal *Salmonella* spp. cause salmonellosis, whereas *S.* Typhi and *S.* Paratyphi cause typhoid/paratyphoid fever. Various animals (e.g., poultry, pigs, and cattle as well as reptiles) can serve as reservoirs for salmonellae. Humans usually become infected by eating inadequately cooked contaminated food. Non-typhoidal *Salmonella* can also cause extraintestinal infections; in the case of severe infections, antimicrobial treatment is necessary. According to the ECDC, in 2023, 30 EU/EEA countries reported 78,307 confirmed cases of salmonellosis and 745 cases of typhoid/paratyphoid fever, and the overall EU/EEA notification rate was 49.36 cases per 100,000 population. There were no differences in salmonellosis notification rates by sex (male–female ratio 1:1) (11, 31). In Slovenia, 264 cases of salmonellosis were reported in 2023 with a notification rate of 12.4 cases per 100,000 population as well as one case of typhoid/paratyphoid fever (13).

Only a handful of case reports have described typhoid fever occurring in gbMSM with no history of foreign travel in the United States and in the United Kingdom (6, 32, 33).

Diarrheagenic *Escherichia coli* (DEC)

DEC are an important cause of diarrhea, especially in children, immunocompromised patients, and travelers. The most important pathotypes are enteropathogenic (EPEC), Shiga toxin–producing (STEC), enteroaggregative (EAEC), enterotoxigenic (ETEC), enteroinvasive (EIEC), and diffusely adherent *E. coli* (DAEC).

According to the ECDC, in 2022, the STEC notification rate in the EU/EEA was 2.5 cases per 100,000 population, exceeding pre-pandemic levels and marking a 25% increase compared to the 2021 notification rate (34). The increase continued in 2023; according to the ECDC, 30 EU/EEA countries reported 78,307 confirmed cases of STEC infection, and the overall EU/EEA notification rate was 3.2 cases per 100,000 population. (11, 31). In Slovenia, 58 cases were reported in 2023 with a notification rate of 2.74 cases per 100,000 population (13).

An outbreak of *E. coli* O117:H7 STEC infection occurring in gbMSM was described in the United Kingdom in 2014; subsequent genomic epidemiology analysis has shown that the outbreak strain may have originated in Latin America and may continue to circulate in both the United Kingdom and Latin American gbMSM population. Interestingly, the outbreak lineage showed increasing levels of azithromycin resistance (35, 36).

Risk factors associated with detection of bacterial enteric pathogens in gbMSM

Studies have shown that bacterial enteric pathogens were more frequently detected in asymptomatic gbMSM with risk factors such as those living with HIV, being on HIV pre-exposure prophylaxis (PrEP), engaging in insertive oral–anal contact or anilingus, and those reporting more than five new sexual partners in the previous 3 months and group sexual encounters, compared to gbMSM that tested negative for bacterial enteric pathogens. Use of dating apps and recreational drug use (including chemsex) may contribute to riskier sexual behaviors. In addition, gbMSM with bacterial enteric pathogens were more likely to have a history of bacterial STIs (37–41).

Discussion

Sexual transmission of bacterial enteric pathogens was first described in the 1970s with reports of enteric infections with *Shigella* spp. and *Salmonella* spp. among gbMSM (6, 7). Epidemiological data particularly support sexual transmission of *Shigella* spp. and *Campylobacter* spp. (2). Intestinal pathogens with a low infectious dose, particularly *Shigella* spp. and to a somewhat lesser extent *Campylobacter* spp., are more prone to transmission through sexual contact, especially in circumstances in which the risk of fecal contamination is higher (42). The infectious dose for shigellae is quite low, with studies in healthy volunteers demonstrating that as few as 10 colony-forming units (CFU) of *S. dysenteriae* serotype 1 bacteria or 180 CFUs of *S. flexneri* or *S. sonnei* bacteria can lead to symptomatic infection, making shigellosis one of the most transmissible forms of bacterial diarrhea (43). The infectious dose of *Campylobacter* spp. is higher than that of *Shigella* spp., but still relatively low. Studies in healthy volunteers have shown than 500 to 800 CFU can cause symptomatic infection (44, 45). In contrast, the infectious dose for DEC and *Salmonella* spp. is much higher, estimated to be over 105 CFU. (45).

Another important aspect of bacterial enteric pathogens is a reservoir in asymptomatic people. There are limited data on the prevalence of bacterial pathogens in the general asymptomatic adult population, particularly using sensitive molecular techniques. In a Dutch study, no cases of *Shigella* spp. or EIEC were found in an asymptomatic (control) group of 1,195 people, whereas 33 (2.8%) were positive for *Campylobacter* spp. and four (0.3%) for *Salmonella* spp. using molecular methods (46). In a smaller Slovenian study on the usefulness of molecular methods for the diagnosis of infectious diarrhea in adults, *Shigella* spp./EIEC and *Giardia* spp. were detected in one individual among 154 asymptomatic adults (a prevalence of 0.6%); three (1.9%) were positive for *Campylobacter* spp., and none for *Salmonella* spp. (47). A 2024 meta-analysis of six studies from Australia, the United Kingdom, the Netherlands, and the United States on the prevalence of bacterial enteric pathogens in asymptomatic gbMSM found that 1.1% of 3,766 gbMSM were positive for *Shigella* spp. in their stool (95% CI [0.7, 1.7]), 1.9% for *Campylobacter* spp. (95% CI [1.5, 2.5]), and 0.3% for *Salmonella* spp. (95% CI [0.1, 0.6]) using molecular methods (41). The heightened risk of bacterial enteric pathogens in gbMSM has been attributed to specific sexual behaviors that result in oral-anal transmission. Bacterial enteric pathogens were more common in asymptomatic gbMSM with risk factors such as HIV PrEP use, HIV infection, multiple (> 5) new sexual partners in the past 3 months, and engaging in certain sexual behaviors such as oral–anal contact during sex. Use of dating apps and recreational drug use may contribute to riskier sexual behaviors (37–39).

Prevention of sexual transmission of bacterial enteric pathogens

In patients with diarrhea, taking a brief sexual history may help clinicians tailor educational prevention messages and, if indicated, guide antibiotic selection in light of antimicrobial resistance patterns in *Shigella* spp. (and *Campylobacter* spp.) among gbMSM. It can also inform the decision on whether to offer STI screening. Although the sexually active gbMSM population may be disproportionately affected, there is also a possibility of sexual transmission of bacterial enteric pathogens during heterosexual sexual practices (2, 48). All sexually active adults diagnosed with diarrhea should receive not only guidance on hand hygiene, avoiding swimming while ill, and steering clear of potentially contaminated food and water sources, but also counseling on the risk of transmission during sexual activity (2, 48).

Clinicians should consider the possibility of sexual transmission of enteric pathogens when assessing gbMSM with diarrhea or proctocolitis and consider expanding diagnostic tests to include enteric pathogens. In most patients with acute diarrhea, symptomatic treatment (e.g., oral rehydration solution) along with standard hygiene measures to prevent secondary spread is recommended. Empiric antibiotic treatment is generally not advised for immunocompetent adults, except for those with more severe illness or acute dysentery syndrome. Asymptomatic contacts of patients with acute diarrhea do not require empiric antibiotic treatment (48). Providing appropriate educational guidance on prevention to patients with diarrheal illnesses is essential. To prevent sexual transmission of bacterial enteric pathogens, safe sexual practices, utilizing protective measures (e.g., condoms and gloves), cleaning sex toys and implements, and good personal hygiene before and after sexual contact are recommended in addition to standard measures to prevent secondary spread of diarrhea. If a partner has diarrhea, sexual contact should be avoided during and for at least 1 to 2 weeks after the symptoms have subsided, and oral-anal contact should be refrained from for 4 to 6 weeks to reduce the risk of transmission (2, 10, 48, 49).

The usefulness of screening asymptomatic gbMSM for bacterial enteric pathogens is uncertain. Screening could potentially reduce transmission in the at-risk population by increasing awareness and promoting behavioral changes. However, it may also lead to increased antibiotic use, raising the risk of antimicrobial resistance in both the target bacterial enteric pathogen as well as non-target bacteria (50). A recent review has highlighted the growing antibiotic resistance in classic STIs, with the gbMSM population being particularly affected. One such example is increasing macrolide resistance in pathogens such as *N. gonorrhoeae*, *Mycoplasma genitalium*, and *Treponema pallidum* (51). Macrolide resistance is also problematic in sexually transmissible bacterial enteric pathogens (21, 27, 29). A few studies have demonstrated that screening for STIs leads to a considerable increase in macrolide consumption in PrEP users (52, 53). Further studies are needed to determine whether the benefits of such screening outweigh the potential risks (50).

Increased awareness about the potential sexual transmission of enteric pathogens can not only enhance clinical management of both STIs and diarrhea, but can also strengthen public health response. There are limited published data on the effectiveness of interventions to prevent sexual transmission of enteric organ-

isms. Wayal et al. found that the gbMSM community in the United Kingdom had limited awareness of the potential sexual transmission of *Shigella* spp. Specifically, their knowledge of *Shigella* spp. transmission was significantly lower compared to other STIs, such as chlamydia or syphilis, within the same group, particularly among HIV-negative or HIV-unknown-status gbMSM (54). Educating at-risk populations—especially gbMSM—and discussing risk-reduction strategies that may help minimize transmission are essential components of prevention efforts by promoting behavioral changes.

Patients diagnosed with sexually transmitted enteric pathogens should discuss the risk of sexual transmission with their healthcare provider because further management similar to that for newly diagnosed STIs is recommended in such cases (10, 49).

Conclusions

Bacterial enteric pathogens, particularly *Shigella* spp., can be transmitted through sexual contact. Because oral-anal contact during sex may be more frequent among sexually active gbMSM, this group is likely disproportionately affected. However, there is also a possibility of sexual transmission of bacterial enteric pathogens during heterosexual sexual practices (2, 48).

Although the factors and dynamics contributing to the sexual transmission of bacterial enteric pathogens are not yet fully understood, the incidence of shigellosis in particular has been steadily increasing, especially over the last decade. Of particular concern is the international spread of multidrug-resistant *Shigella* spp. as well as *Campylobacter* spp., which pose significant challenges for both treatment and containment.

Raising awareness among at-risk populations about the potential for sexual transmission is essential for limiting its spread by promoting behavioral changes. Equally important is increasing awareness among clinicians to ensure timely diagnosis and effective management of sexually transmitted bacterial enteric pathogens, as well comprehensive counseling of patients regarding STIs.

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