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Listeria infections: The unexpected risks in everyday foods

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ABSTRACT

Listeria monocytogenes remains a major public health concern due to its ability to survive in diverse environments, including under refrigerated conditions, and cause severe illness in vulnerable populations. In July 2024, a Listeria outbreak linked to deli-sliced meats in the United States resulted in 61 confirmed cases, 60 hospitalizations, and 10 deaths across 19 states, underscoring persistent challenges in food safety. Historical outbreaks involving dairy, produce, and processed meats highlight the complexity of contamination routes and the importance of comprehensive preventive measures. As an intracellular pathogen, Listeria requires prompt diagnosis and targeted antibiotic therapy, typically involving ampicillin and gentamicin. Control efforts are complicated by the bacterium's propensity for biofilm formation and its resilience under cold storage. Advances in sanitation protocols, whole-genome sequencing, and public health initiatives are key to reducing the incidence of listeriosis. Nevertheless, continued outbreaks emphasize the need for rigorous food safety practices, high-risk population awareness, and ongoing surveillance.

Introduction

Listeria monocytogenes, the bacterium responsible for causing listeriosis, poses a substantial public health threat, primarily because of its ability to cause severe illnesses in vulnerable groups such as pregnant women, neonates, elderly individuals, and those with compromised immune systems (Cohen et al., 2023; Macleod et al., 2022). This pathogen is challenging to control because it thrives in various environments, including refrigerated conditions, which are usually deemed safe for food preservation (Belias et al., 2024; Ribeiro et al., 2023).

A recent Listeria outbreak in the United States (US) in July 2024 linked to meats sliced at delis serves as a critical example of the ongoing challenges in food safety (Linked, 2025). This outbreak ultimately resulted in 61 confirmed cases, 60 hospitalizations, and 10 deaths across 19 states by the time the investigation closed Fig. 1. Public health officials traced the contamination primarily to the point of slicing or handling at in-store deli counters. The Centers for Disease Control and Prevention (CDC) reiterated that high-risk individuals—including pregnant women, adults aged 65 or older, and immunocompromised individuals—should avoid deli meats or reheat them to an internal temperature of 165 °F to kill any harmful bacteria. Despite the closure of this outbreak investigation, these recommendations remain critical for preventing future cases.

Historical Context

Historically, Listeria outbreaks in the US have been associated with a wide range of food products, including dairy, fresh produce, and

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processed meat (Table 1). One of the most significant outbreaks, linked to cantaloupes, occurred in 2011, resulting in 147 illnesses and 33 deaths. This incident highlighted the extensive reach of Listeria contamination and its serious health risks.

Importantly, Listeria can contaminate foods at multiple points along the farm-to-table continuum (Toit and Rip, 2024). For example, dairy products may become contaminated during milking or pasteurization if equipment is inadequately sanitized (Poimenidou et al., 2009). Produce can be contaminated by irrigation water in the field or during packing, while meats—especially deli meats—are vulnerable to cross-contamination from slicing machines used in retail settings (Sirsat et al., 2014; Brown et al., 2016). These varied routes of contamination emphasizes the importance of stringent hygiene protocols and robust surveillance.

Because of the wide variety of potential contamination sources, specific dietary advice is crucial for high-risk populations. Pregnant women, older adults, and immunocompromised individuals are advised to avoid unpasteurized cheeses, raw sprouts, undercooked meats, and to thoroughly reheat deli meats and hot dogs to 165 °F (Khsim et al., 2022; Valenti et al., 2021). Adherence to these recommendations significantly lowers the risk of listeriosis.

Pathogenesis of Listeria monocytogenes

Listeria monocytogenes is a facultative intracellular pathogen known for its ability to invade host cells, replicate intracellularly, and spread systemically (Corbo et al., 2014). The bacterium initiates infection by adhering to and entering non-phagocytic cells, such as epithelial cells, using proteins such as internalins (Fig. 2) (Osek and Wieczorek, 2022). Once inside, Listeria escapes the host vacuole using listeriolysin O and other enzymes, allowing it to replicate within the cytoplasm (Nguyen et al., 2019). The bacterium then uses an actin-based motility system to move within and between cells, facilitating its spread to various tissues, including the central nervous system and placenta (Pizarro-Cerdá and Cossart, 2018).

Clinical manifestations

Listeriosis presents in various forms, with symptoms depending on the host's health status and the site of infection (Diseminada, 2023). A large proportion of exposed individuals may remain asymptomatic or experience only mild, self-limiting gastroenteritis (Valenti et al., 2021). However, in vulnerable populations such as pregnant women, neonates, the elderly, and immunocompromised individuals, Listeria can cause severe invasive disease (Allen et al., 2022). Common manifestations include sepsis, meningitis, and encephalitis, with symptoms such as fever, confusion, and neck stiffness (Fotopoulou et al., 2024; Qu et al., 2024). Pregnant women are particularly at risk, as infection can lead to miscarriage, stillbirth, or neonatal sepsis (Kraus et al., 2024).

Diagnosis

The diagnosis of listeriosis requires both clinical and laboratory assessments (Shi et al., 2021). Clinicians should consider patient history, symptoms, and potential exposure to high-risk foods. Laboratory confirmation involves isolating Listeria monocytogenes from sterile sites, such as blood, cerebrospinal fluid, or amniotic fluid (Kaur et al., 2007). Blood culture is crucial for the detection of bacteremia. While molecular methods such as polymerase chain reaction (PCR) are critical for rapid identification and differentiation of Listeria strains—especially in outbreak investigations—they complement rather than replace culture-based methods in guiding clinical care (Gasanov et al., 2005; Jin et al., 2012; Poltronieri et al., 2009). PCR allows for faster epidemiological tracking of circulating strains and can help tailor infection control measures (Fisher et al., 2023).

Treatment

Treatment of listeriosis primarily involves the use of antibiotics. Ampicillin remains the first-line agent, often combined with gentamicin to achieve a synergistic bactericidal effect, especially in cases of central

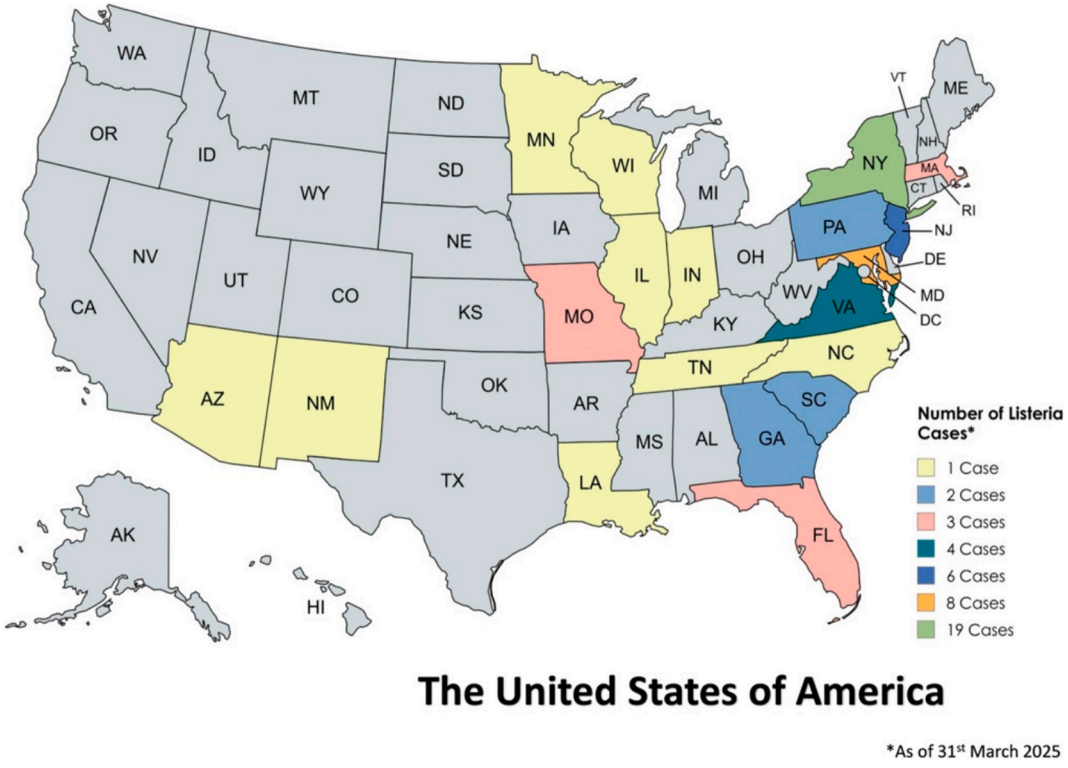

Fig. 1. Geographic Distribution of Listeria Cases in the U.S. (As of March 31st, 2025).

Table 1
Listeria Outbreaks in the U.S. from 2012 to 2024.

Date	Outbreak Source	Reported Cases	Hospitalizations	Deaths	Notes
Feb 2024	Cheese	20	18	2	Affected predominantly Hispanic communities.
Nov 2023	Peaches, Nectarines, Plums	16	15	1	Linked to stone fruit distribution.
Aug 2023	Ice Cream	15	14	1	Contamination linked to improper sanitation processes.
Feb 2023	Meat Products	12	11	1	Recurring issue in deli meats, emphasizing need for improved handling practices.
Nov 2022	Mushrooms	36	31	4	Significant outbreak highlighting the risks associated with imported foods.
Nov 2022	Meat Products	23	21	2	Continued concern with meat processing and storage.
Sep 2022	Packaged Salad	10	9	1	Recall issued; affected products linked to a specific processing facility.
Jun 2022	Raw Milk	5	4	0	Emphasized risks of consuming unpasteurized dairy products.
Dec 2021	Bagged Salads	28	26	3	Outbreak linked to a popular salad brand; widespread recalls initiated.
Oct 2020	Meat Products	10	10	0	Similar to previous outbreaks, linked to improper storage and handling.
Mar 2020	Mushrooms	36	30	4	Highlighted risks associated with fresh produce.
Dec 2019	Eggs	7	6	0	Raised concerns over egg processing and handling.
Aug 2019	Meat Products	10	9	1	Continued focus on meat safety.
Apr 2019	Pork Products	6	5	1	Linked to specific pork processing plant.
Nov 2018	Ham	4	4	1	Outbreak raised concerns over cured meats.
Mar 2017	Soft Cheese	8	7	2	Emphasized risks with soft, unpasteurized cheeses.
May 2016	Frozen Vegetables	9	8	1	Recall of numerous frozen vegetable products.
Mar 2016	Raw Milk	3	3	0	Reiterated risks of raw milk consumption.
Jan 2016	Bagged Salads	9	7	2	Linked to contaminated salad greens.
Sep 2015	Soft Cheeses	30	28	3	Outbreak linked to a single brand of cheese.
Mar 2015	Ice Cream	10	10	3	High-profile case, led to major recalls.
Dec 2014	Caramel Apples	35	34	7	Unusual source, highlighted importance of food safety across all food products.
Oct 2014	Cheese	12	11	1	Outbreak linked to cheese imported from Latin America.
Nov 2014	Bean Sprouts	10	9	2	Raised concerns over fresh produce safety.
Feb 2014	Cheese	10	9	2	Similar to other cheese-related outbreaks, linked to soft cheese varieties.
Jul 2013	Cheese	10	9	2	Focused on imported soft cheeses.
Sep 2012	Cheese	20	18	2	Emphasized need for stringent testing and safety protocols for dairy products.

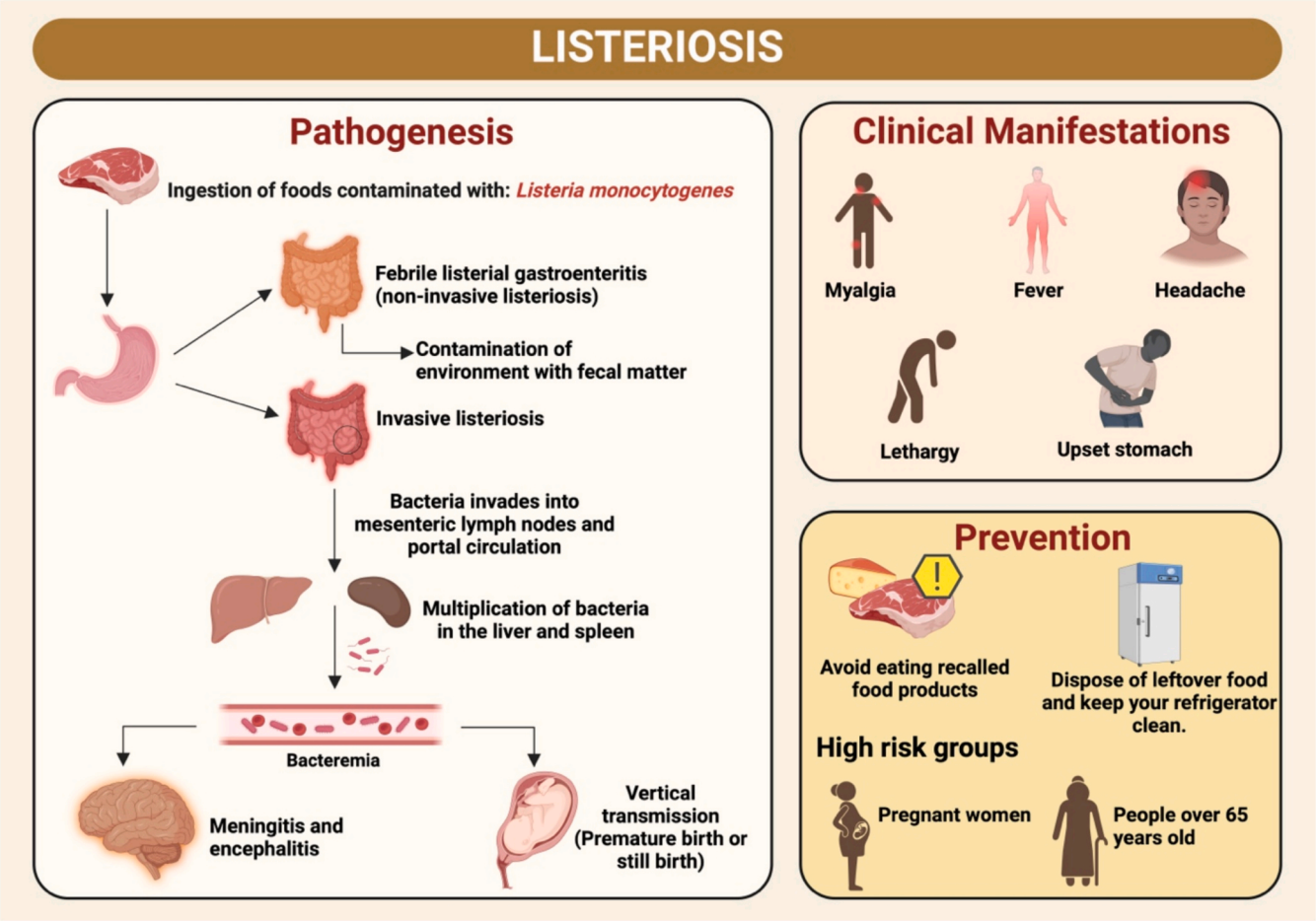

Fig. 2. Pathogenesis, Clinical Manifestations, and Prevention of Listeriosis.

nervous system (CNS) involvement (Sutter et al., 2024). In pregnant women with listeriosis, ampicillin alone or with gentamicin is recommended, taking into account maternal and fetal safety (Valenti et al., 2021; Madjunkov et al., 2017). For penicillin-allergic patients, alternatives such as trimethoprim-sulfamethoxazole can be considered, although clinical data are more limited (Okun et al., 2001). Duration of therapy may vary; CNS infections generally require longer treatment (2–3 weeks or more) to fully clear the pathogen (Xu et al., 2023). Early diagnosis and prompt initiation of antibiotic therapy are crucial, particularly in high-risk groups.

Additionally, supportive care is provided to manage the symptoms and complications associated with the infection. Recent advancements have introduced novel bacteriocins, such as those produced by Lactobacillus plantarum B21, which show promise in treating antibiotic-resistant strains of Listeria by damaging bacterial cell walls and preventing the development of resistance (Leslie et al., 2021).

Control measures in food production

Controlling Listeria monocytogenes in food production environments presents significant challenges, primarily due to the bacterium's ability to form biofilms. This matrix can shield Listeria from disinfectants and cleaning agents, making it difficult to eliminate from food-processing equipment, countertops, and other surfaces (Radoshevich and Cossart, 2018). The ability of Listeria to thrive under refrigerated conditions complicates control measures in facilities that depend on cold storage (Osek et al., 2022). This resilience to low temperatures allows bacteria to persist and potentially contaminate food products. The pathogen's ability to survive in such conditions means that contaminated items can carry bacteria from production facilities to consumers' homes without any noticeable spoilage, thereby posing a hidden threat. The long incubation period of listeriosis, which can range from several days to a few weeks, adds another layer of complexity to outbreak investigation (Radoshevich and Cossart, 2018). By the time an outbreak is detected and products are recalled, they may have already reached a wide consumer base.

Innovative methods for managing Listeria risks

Advances in genomic technology have provided new tools for understanding and combating Listeria. Whole-genome sequencing (WGS) has become a critical method for identifying and tracking specific strains of Listeria involved in outbreaks (Whole Genome Sequencing Of L. Monocytogenes and Innocua, 2000). This technology allows for precise epidemiological investigations, enabling public health officials to link cases of illness to specific sources of contamination more accurately.

Innovations in sanitation and cleaning protocols are also being explored to improve the effectiveness of Listeria control in food-processing environments. Chemical sanitizers such as lactic acid, peroxy acid, and quaternary ammonium compounds have been shown to produce reductions of 2.6 to 3.6 log CFU/cm^2 (Trinetta, 2022). Using these treatments sequentially often results in enhanced antimicrobial effects.

Moreover, there is growing interest in utilizing natural antimicrobial compounds derived from plants or microorganisms. Lactic acid bacteria (LAB), for instance, can produce bacteriocins that inhibit Listeria monocytogenes (Zawiasa and Olejnik-Schmidt, 2025). One example is bacteriocin-producing Leuconostoc carnosum DH25, which has demonstrated effectiveness in inhibiting Listeria growth in raw sausage (Tönz et al., 2024). These LAB-derived compounds show resilience to temperature and pH changes, highlighting their potential as safe and effective tools for enhancing food safety in meat products.

Future Directions

Public health campaigns and educational initiatives are essential components of Listeria prevention strategies. These efforts focus on informing consumers about safe food handling practices, such as the importance of cooking foods at appropriate temperatures and avoiding high-risk products such as unpasteurized dairy. For high-risk populations, recommendations also include storing perishable foods at or below 4 °C (40 °F), reheating deli meats to 165 °F, and practicing strict separation of raw and ready-to-eat items to avoid cross-contamination (Yang et al., 2006). Targeted guidance for pregnant women, immunocompromised individuals, and older adults can help reduce the incidence of listeriosis among those most susceptible to severe outcomes.

Conclusion

Listeria monocytogenes poses a significant public health challenge because of its ability to thrive in diverse environments and to contaminate a wide range of food products. Persistent outbreaks underscore the critical need for rigorous food safety practices, enhanced diagnostic tools, and sustained public awareness programs.

Ethical approval Statement

Ethical approval was not required because this is a review article. The highest ethical standards were followed during the manuscript development.

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