

Foodborne Pathogens- Bacteria

Organism	Disease Characteristics				Growth Charatctistics				Implicated foods	Reservoir	Controls	Survival	Cases/yr (est)	Fatality rate	Susceptible population	Laboratory Confirmation
	Onset*	Duration	Infective dose	Symptoms**	Gram stain/O2	Temp (deg F)	pH	Aw (min.)								
Bacillus cereus	Diarrheal toxin: 6-15 hrs, Emetic toxin: 0.5-6 hrs	24 hrs	10 orgs, 2 toxins: emetic heat stabile, diarrheal-heat labile	d, v, n	gram +, aerobic, spore former	41-131	4.9-8.8	0.93	rice, meats, dairy products, veggies, fish, pasta, soups, salads	widely distributed in environment	refrigeration, thorough and rapid cooling, proper hot and cold holding	salt tolerant, spores and emetic toxin are heat-resistant, diarrheal toxin inactivated at 50 deg C for 5 min.	27,000	0		Isolation of organism from stool of two or more ill persons and not from stool of control patients. labs do not routinely culture for this organism. Food: culture >10,000 orgs./g of food.
Campylobacter	2-5 days (1-10 days)	7-10 days (2-10 days)	400-500 bacteria	d,f,ac,n,h,ma	gram -, microaeroph.	90-113	4.9-9.0	0.98	chicken, meat, seafood,water, unpast. milk, raw clams	animals- esp. poultry, cattle, also puppies, kittens, birds, pigs, sheep, rodents	thorough cooking, pasteurization, water treatment, sanitation	sens to drying, heating, disinfection, acid, air	2,000,000	rare: 1/1000	< 5 yrs, young adults	Isolation of organism from clinical specimens from two or more ill persons. Isolation of organism from epidemiologically implicated food Stool culture requires special media and incubation at 42oC to grow.
Clostridium botulinum Type A, B (proteolytic)		months	few nanograms of toxin	n, v, weakness, diff. speaking, breathing, swallowing, abd dist., paralysis	gram +, spore forming, anaerobe	50-122	4.6-8.5	0.93	canned foods, acidified foods, whole fish, stuffed eggplant, garlic in oil, baked potatoes, black bean dip	soil, mammals	destruction: thermal processing;inhibit toxin prod.: acid., salt, Aw, nitrites, refrigeration	heat-resistant, neurotoxin is heat labile: 176 for 10 min				
Clostridium botulinum Type E (non-proteolytic)	18-36 hrs (hrs-17days)	months	few nanograms of toxin	n, v, weakness, diff. speaking, breathing, swallowing, abd dist., paralysis	gram +, spore forming, anaerobe	38-113	4.6-8.5	0.97	fish, seafood and marine animals	fresh-water and marine sediments, fish	destruction: thermal processing;inhibit toxin prod.: acid., salt, Aw, nitrites, pasteurization	neurotoxin is heat labile: 176 for 10 min	58	5-10%		Detection of botulinum toxin in serum, stool, gastric contents, or implicated food. Isolation of organism from stool or intestine.
Clostridium perfringens	8-22 hrs	12-24 hrs	100,000,000, toxin production	ac, d,	gram +, spore forming, anaerobe	54-122	5.5-9.0	0.94	meat, poultry, gravy, casseroles	Soil, GI tract of healthy people and animals (cattle, pigs, poultry, fish)	proper cooling, hot and cold holding, and reheating,	heat-resistant	250,000	rare	young and old	Isolation of 10,000 organisms/g from stool of two or more ill persons, provided specimen is properly handled. Demonstration of enterotoxin in the stool of two or more ill persons Isolation of 10,000 organisms/g from epidemiologically implicated food, provided specimen is properly handled Because Clostridium perfringens can normally be found in stool, quantitative cultures must be done.
E. coli- EPEC, Infantile diarrhea	17-72 hrs	6 hrs- 3 days	infants-low, adults-high	d,f, dehydr.	gram -, facult. anaerobe	45-121?	4.4-9.0?	0.95?	contaminated water-bottle feeding, pork, meat pies	humans- may be asympt.	sanitation, treat irrigation water, good personal hygiene	withstands freezing and acid env.	infrequent in US and Europe	50% in 3rd world	infants	Isolation of organism of same enteropathogenic serotype from stool of two or more ill persons
E. coli- ETEC, Traveller's diarrhea	24-44 hrs (10-72 hrs)	3-5 days (3-19 days)	100,000,000+	d,ac, f, n, v,	gram -, facult. anaerobe	45-121?	4.4-9.0?	0.95?	water, cheese, seafood	human	sanitation, treat irrigation water, good personal hygiene	withstands freezing and acid env.	56,000	rare	infants, debilitated elderly,	Isolation of organism of same serotype, demonstrated to produce heat-stable (ST) and/or heat-labile (LT) enterotoxin, from stool of two or more ill persons Stool culture. Requires special laboratory techniques for identification. State Lab cannot do test.
E. coli- EIEC, Bacillary dysentery	12-72 hrs	uncertain	10	ac,d, v, f, ch	gram -, facult. anaerobe	45-121?	4.4-9.0?	0.95?	water, cheese, potato salad, canned salmon	human	sanitation, treat irrigation water, good personal hygiene	withstands freezing and acid env.	infrequent	rare	children	Isolation of same enteroinvasive serotype from stool of two or more ill persons
E. coli- EHEC (ie. E. coli O157:H7)	3-4 days (1-9 days)	2-9 days	est. 10	ac,d, v, f, HUS	gram -, facult. anaerobe	45-121	4.4-9.0	0.95	ground beef, raw milk, sausage, apple cider, mayo, water, raw veggies, lettuce, sprouts	cattle, deer	cooking, hot and cold holding, sanitation, prevent x-contamination, avoid fecal contam. of animal carcasses	withstands freezing and acid env.	93,000	overall 1%, up to 50% in elderly,	very young, elderly	Isolation of E. coli O157:H7 or other Shiga-like toxin producing E. coli from clinical specimen. Requires special media to grow. If suspected, specific testing must be requested. Shiga toxin testing may be done using commercial kits:Isolation of E. coli O157:H7 or other Shiga-like toxin-producing E. coli from epidemiologically implicated food
Listeria monocytogens	3 days to 3 weeks		unknown	flu-like, sept., meningitis, abortion	gram +, facult. anaerobe	31-113	4.4-9.4	0.92	dairy, vegetabels, meat, poultry, fish, cooked ready-to-eat products, soft cheeses, raw milk, deli meats	soil, silage, forage, other environmental sources	cooking, pasteurization, prevent x-contamination	salt and nitrite tolerant, doubling time of 1.5 days at 40 deg	2,500	20%	pregnant women, children, immunocomp., elderly	Isolation of organism from normally sterile site. Isolation of organism of same serotype from stool of two or more ill persons exposed to food that is epidemiologically implicated or from which organism of same serotype has been isolated
Salmonella non-typhi	12-36 hrs (6-72 hrs)	1-7 days	100s-1000s	n, v, ac,d, f, ch, h	gram -, facult. anaerobe	41-115	4.2-9.5	0.94	meat, poultry, seafood, eggs, raw milk, yeast, sauces, sprouts, melons, mangos, salad dressing, OJ, chocoate, etc.	domestic and wild animals: poultry, swine, cattle, rodents, reptiles, pets, water, soil, insects, humans	sanitation, cooking, hot and cold holding, prevent x-contamination, pasteurization	sens to mod heat tx, can adapt to acidic env.	1,300,000	< 1%	young, debilitated, old, immunocomp.	Routine stool cultures. Isolation of organism from epidemiologically implicated food.

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Salmonella Typhi	1-3 weeks (3 days - 3months)		low, 10-100?	f, h, malaise, cough, d, but constipation more common in adults	gram -, facult. anaerobe	41-115?			contaminated water and food: raw fruits and vegetables, milk, shellfish	humans	prevent ill workers from working, good personal hygiene, sanitation, proper cooking		<500	10%, 1% with prompt antibiotic treatment	Immunocomp., low gastric acid	Stool, blood, or urine culture
Shigella	12-96 hrs	4-7 days	10-100	f,ac, d, tenes.	gram -, facult. anaerobe	45-118	4.9-9.3	0.97	Poultry, meat, fish,fruit, dairy products, bakery products	humans	cooking, cold and hot holding, good personal hygiene, sanitation, water tx	can survive acidic conditions	90,000	rare: <1/1000	malnourished children, elderly, immunocomp.	Routine stool cultures. Isolation of organism from epidemiologically implicated food.
Staph. aureus	w/in 4 hrs	6-24 hrs	100,000 cells per gram: produce toxin	v,d,ac, n, prostration	gram +, facult. anaerobe	45-122	4.0-10	0.83 (growth) 0.88 (toxin)	poultry, meat, salads, bakery products, sandwiches, dairy	humans, animals, dust, sewage, water	good personal hygiene, hot and cold holding	tolerant of high salt and low moisture	185,000	rare	infants, elderly, debilitated	Normally a clinical diagnosis. Isolation of organism of same phage type from stool or vomitus. Detection of enterotoxin in epidemiologically implicated food.Isolation of 105 organisms/g from epidemiologically implicated food, provided specimen is properly handled
Strep. pyogenes (Group A)	1-3 days	variable	est <1000	sore throat, f, n, h, v, +/- rash, tonsillitis, Scarlet fever, sept.	gram +, micro-aerophilic				milk, ice cream, eggs, steamed lobster, ground ham, potato salad, egg salad, custard, rice pudding, and shrimp salad.	humans, raw milk	poor hygiene, ill food handlers, the use of unpasteurized milk, time/temp abuse					Culturing of nasal and throat swabs, pus, sputum, blood, suspect food, environmental samples.
Other Strep. species (Group D)	2-36 hrs		est > 10,000,000	d, ac, n, v, f, ch, dizziness	gram +, micro-aerophilic				sausage, evaporated milk, cheese, meat croquettes, meat pie, pudding, raw milk, and pasteurized milk.	humans, raw milk	underprocessing and/or poor and unsanitary food preparation		50,000	0		Culturing of stool samples, blood, and suspect food
Vibrio parahaemolyticus	12-24 hrs (4-96 hrs)	4-7 days	1,000,000-10,000,000	d, ac, n, v, f, sept.	gram -, facult. Anaerobe	41-109	4.8-11.0	0.94	shellfish, finfish	estuarine water	cooking, prevent recontamination, time/temp abuse, product source	salt tolerant, heat sensitive, sensitive to freezing	5000			Stool cultures.Isolation of Kanagawa-positive organism from stool. Requires special media to grow. If suspected, must request specific testing.Isolation of 105 Kanagawa-positive organisms/g from epidemiologically implicated food, provided specimen is properly handled
Vibrio cholerae 01	6 hrs- 5 days	hours to days	1,000,000	d, ac, n, v, dehyd.	gram -, facult. anaerobe	50-109			various, seafoods, beverages	humans, sewage contam, water	cooking, prevent recontamination, time/temp abuse, product source	salt tolerant, heat sensitive, sensitive to freezing	49	< 1%		Stool culture; Requires special media to grow. If suspected, must request specific testing. Isolation of toxigenic organism from stool or vomitus. Significant rise in vibriocidal, bacterial-agglutinating, or antitoxin antibodies in acute- and early convalescent-phase sera among persons not recently immunized. Isolation of toxigenic organism from epidemiologically implicated food.
Vibrio cholerae non-01	6 hrs- 3 days	6-7 days	1,000,000	d, ac, n, v, f, sept.	gram -, facult. anaerobe	41-111			oysters	estuarine water	cooking, prevent recontamination, time/temp abuse, product source	salt tolerant, heat sensitive, sensitive to freezing				Isolation of organism of same serotype from stool of two or more ill persons
Vibrio vulnificus	24-48 hrs (12-72 hrs)		unknown	n,ch,f, 50% death	gram -, facult. anaerobe	46-109	5.0-10.2	0.96	oysters	estuarine water	cooking, prevent recontamination, time/temp abuse, product source	salt tolerant, heat sensitive, sensitive to freezing	47	40%	immunocomp., liver dz, diabetes, leukemia	Stool, wound, or blood cultures. Requires special media to grow. If is suspected, must request specific testing.
Yersinia	3-7 days	1-3 days (2-3 weeks)	unknown	f, ac,d,v,arth, sept.	gram -,facult. anaerobe	30-108	4.2-9.6	0.97	raw milk, raw vegetables, ice cream, cake, pork, soy, salad, seafood	animals esp. pigs, also birds, rodents, small mammals, soil, fresh water sources	sanitation, cooking, water tx., hot and cold holding, pasteurization.	withstands freezing and thawing, sens to heat and sanitizers, low salt tolerance	86,000	rare	young, debilitated, old, immunocomp.	Isolation of organims from clinical specimen. Requires special media to grow. If suspected, must request specific testing. Isolation of pathogenic strain of organism from epidemiologically implicated food.

*Times in parenthesis indicate the extreme ranges of onset times. Times not in parenthesis are more typical for disease.
**d=diarrhea, v=vomiting, n=nausea, f=fever, ac=abdominal cramps, ch=chills, h=headache, tenes=tenesmus, sept=septicemia, arth=arthralgia, ma=muscle aches