Appendix. Number of foodborne disease outbreaks by etiology* and contributing factor, Foodborne Disease Outbreak Surveillance System, United States -- 1998-2008																Outbreaks in which contamination factor reported	Outbreaks in which any contributing factor reported
	Contributing Factor Code																
	Contamination Factors																
Etiology	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**		
Bacterial																	
Bacillus cereus	.	.	.	.	.	26	2	1	23	31	6	5	46	14	14	114	183
Brucella spp	.	.	.	.	.	3	1	.	.	.	.	.	.	.	.	3	3
Campylobacter jejuni	.	.	.	.	.	51	27	1	27	13	3	4	22	4	11	94	100
Campylobacter spp	.	.	.	.	.	17	7	.	14	6	4	3	14	5	1	39	41
Clostridium botulinum	8	.	.	.	1	8	3	.	.	.	.	.	1	1	2	20	26
Clostridium perfringens	3	.	1	.	2	80	5	1	24	29	7	10	45	18	42	191	426
Escherichia coli, Enterotoxigenic	.	.	.	.	.	3	4	.	.	1	1	2	2	.	.	6	9
Escherichia coli, Shiga toxin-producing	.	1	.	.	.	82	19	2	27	20	5	11	14	4	10	131	143
Escherichia coli, other	.	.	.	.	.	.	.	.	1	1	.	.	1	1	.	1	1
Listeria	.	.	.	.	.	4	3	.	1	.	.	.	4	2	5	14	14
Salmonella	2	.	.	.	5	274	108	6	200	125	33	133	173	45	60	662	780
Shigella flexneri	.	.	.	.	.	.	.	.	1	5	2	4	3	1	.	8	8
Shigella sonnei	1	.	.	.	.	4	2	.	1	12	4	20	7	3	5	36	39
Shigella spp.	.	.	.	.	.	.	.	.	2	3	.	4	.	.	.	6	7
Staphylococcus enterotoxin	.	.	1	.	.	4	.	.	49	128	23	77	65	11	31	262	348
Vibrio parahaemolyticus	1	.	.	.	.	20	20	5	6	9	1	1	7	2	1	46	52
Vibrio spp	.	.	.	.	.	1	4	1	.	.	.	.	1	.	.	7	7
Yersinia enterocolitica	.	.	.	.	.	2	.	.	5	.	.	.	4	.	.	7	7
Other bacterial	1	.	.	.	.	2	1	.	3	10	7	1	11	2	2	28	43
Total Bacterial	**16**	**1**	**2**	**.**	**8**	**581**	**206**	**17**	**384**	**393**	**96**	**275**	**420**	**113**	**184**	**1,675**	**2,237**
Viral																	
Astrovirus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hepatitis A	.	.	.	.	1	4	6	1	1	15	5	22	3	.	6	39	39
Norovirus	1	.	.	.	2	75	68	13	70	691	233	1,069	232	38	176	1,713	1,770
Rotavirus	.	.	.	.	.	.	.	.	.	3	3	5	1	.	.	7	7
Other viral	.	.	.	.	.	3	3	.	4	11	1	20	7	.	7	38	39
Total Viral	**1**	**.**	**.**	**.**	**3**	**82**	**77**	**14**	**75**	**720**	**242**	**1,116**	**243**	**38**	**189**	**1,797**	**1,855**
Chemical and Toxin																	
Ciguatoxin	134	.	.	.	.	.	.	4	.	.	.	.	.	.	.	138	138
Cleaning agents	.	.	2	.	.	.	.	.	.	.	.	.	.	.	2	4	5
Heavy metals	1	.	2	1	2	2	.	.	.	.	.	.	.	.	2	9	9
Monosodium glutamate	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	1	1
Mycotoxins	7	.	1	.	.	.	1	.	.	.	.	.	.	.	.	8	8
Neurotoxic shellfish poison	5	.	.	.	.	.	.	.	.	.	.	.	.	.	4	5	5
Paralytic shellfish poison	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	8
Pesticides	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	2	2
Plant/Herbal toxins	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	3
Puffer fish tetrodotoxin	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2
Scombroid toxin/Histamine	171	.	.	.	.	4	4	1	1	1	1	.	2	3	19	197	238
Other chemical	6	5	24	2	2	.	.	1	2	12	5	.	10	7	6	59	61
Other natural toxins	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	5	7
Total Chemical	**340**	**5**	**31**	**4**	**4**	**6**	**5**	**6**	**3**	**13**	**6**	**.**	**12**	**10**	**36**	**441**	**487**
Parasitic																	
Anisakiasis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1
Cryptosporidium parvum	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	2	2
Cryptosporidium spp	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	1
Cyclospora cayetanensis	.	.	.	.	.	11	5	.	.	.	.	.	1	.	1	12	12
Giardia lamblia	.	.	.	.	.	1	.	.	.	3	.	4	1	2	.	7	7
Trichinella spiralis	1	.	.	.	.	2	5	.	.	.	.	.	.	.	.	7	8
Other parasitic	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	1	1
Total Parasitic	**1**	**.**	**.**	**.**	**.**	**16**	**12**	**.**	**.**	**4**	**.**	**5**	**2**	**2**	**2**	31	32
Known Etiology §	**358**	**6**	**33**	**4**	**15**	**685**	**300**	**37**	**462**	**1,130**	**344**	**1,396**	**677**	**163**	**411**	**3,944**	**4,611**
Unknown Etiology ¶	**11**	**1**	**14**	**4**	**4**	**65**	**36**	**5**	**283**	**445**	**85**	**144**	**457**	**127**	**182**	**1,145**	**1,593**
Multiple Etiology	**2**	**.**	**.**	**1**	**.**	**28**	**7**	**1**	**28**	**57**	**30**	**24**	**68**	**18**	**27**	**163**	**221**
Total	**371**	**7**	**47**	**9**	**19**	**778**	**343**	**43**	**773**	**1,632**	**459**	**1,564**	**1,202**	**308**	**620**	**5,252**	**6,425**

* If at least one etiology was laboratory-confirmed, the outbreak was considered to have a confirmed etiology. If no etiology was laboratory-confirmed, but an etiology was reported based on clinical or epidemiologic features, the outbreak was considered to have a suspected etiology.

§ The denominator for the total etiology percentages is the known etiology total. The denominator for the known etiology, unknown etiology, and multiple etiologies percentages is the total.

¶ An etiologic agent was not confirmed or suspected based on clinical, laboratory, or epidemiologic information.

** Contributing factor definitions available in the appendix

Appendix. Number of foodborne disease outbreaks by etiology* and contributing factor, Foodborne Disease Outbreak Surveillance System, United States -- 1998-2008

Etiology	Contributing Factor Code: Proliferation Factors P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	Outbreaks in which proliferation factor reported	Outbreaks in which any contributing factor reported
Bacterial														
Bacillus cereus	90	51	59	27	1	37	.	.	3	.	.	1	165	183
Brucella spp	.	.	.	.	.	.	.	.	.	.	.	1	1	3
Campylobacter jejuni	15	1	8	6	1	4	.	.	1	.	2	9	33	100
Campylobacter spp	10	5	6	2	.	6	.	.	1	.	.	3	21	41
Clostridium botulinum	15	.	.	3	.	.	6	.	.	1	.	6	25	26
Clostridium perfringens	214	197	94	123	4	153	.	.	20	2	.	15	406	426
Escherichia coli, Enterotoxigenic	5	.	1	1	.	.	.	.	.	.	.	1	5	9
Escherichia coli, Shiga toxin-producing	19	6	13	8	1	10	.	.	3	.	.	6	46	143
Escherichia coli, other	1	1	1	.	.	1	.	.	.	.	.	.	1	1
Listeria	1	1	3	1	1	.	.	.	.	1	.	.	5	14
Salmonella	241	80	141	94	5	92	.	1	15	.	2	57	458	780
Shigella flexneri	1	1	3	.	.	.	.	.	.	.	.	.	4	8
Shigella sonnei	5	1	5	4	.	.	.	.	.	.	.	5	15	39
Shigella spp.	.	.	3	.	.	.	.	.	.	.	.	.	3	7
Staphylococcus enterotoxin	141	72	118	54	5	48	1	1	7	.	1	5	269	348
Vibrio parahaemolyticus	11	1	17	2	.	1	.	.	.	.	.	1	26	52
Vibrio spp	2	.	1	.	.	.	.	.	.	.	.	.	3	7
Yersinia enterocolitica	.	.	.	.	.	.	.	.	.	.	.	1	1	7
Other bacterial	11	8	15	7	.	6	.	.	2	.	.	4	32	43
Total Bacterial	**782**	**425**	**488**	**332**	**18**	**358**	**7**	**2**	**52**	**4**	**5**	**115**	**1,519**	**2,237**
Viral														
Astrovirus	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hepatitis A	.	.	.	.	.	.	.	.	.	.	.	1	1	39
Norovirus	78	39	90	29	2	32	1	.	4	1	1	8	199	1,770
Rotavirus	1	.	.	.	.	.	.	.	.	.	.	.	1	7
Other viral	5	1	2	.	.	1	.	.	1	.	.	.	9	39
Total Viral	**84**	**40**	**92**	**29**	**2**	**33**	**1**	**.**	**5**	**1**	**1**	**9**	**210**	**1,855**
Chemical and Toxin														
Ciguatoxin	.	.	.	.	.	.	.	.	.	.	.	2	2	138
Cleaning agents	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Heavy metals	.	.	.	.	.	.	.	.	.	.	.	.	.	9
Monosodium glutamate	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Mycotoxins	.	.	.	.	.	.	.	.	.	.	.	.	.	8
Neurotoxic shellfish poison	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Paralytic shellfish poison	.	.	.	.	.	.	.	.	.	.	.	.		8
Pesticides	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Plant/Herbal toxins	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Puffer fish tetrodotoxin	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Scombroid toxin/Histamine	43	2	62	3	2	1	.	.	5	.	.	13	108	238
Other chemical	5	3	8	.	.	2	.	.	1	.	.	.	13	61
Other natural toxins	.	1	.	.	.	1	.	.	.	.	.	.	2	7
Total Chemical	**48**	**6**	**70**	**3**	**2**	**4**	**.**	**.**	**6**	**.**	**.**	**15**	**125**	**487**
Parasitic														
Anisakiasis	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Cryptosporidium parvum	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Cryptosporidium spp	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Cyclospora cayetanensis	.	.	.	.	.	.	.	.	.	.	.	.	.	12
Giardia lamblia	.	.	.	.	.	.	.	.	.	.	.	.	.	7
Trichinella spiralis	.	.	.	.	.	.	.	.	.	.	.	.	.	8
Other parasitic	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Total Parasitic	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	32
Known Etiology §	**914**	**471**	**650**	**364**	**22**	**395**	**8**	**2**	**63**	**5**	**6**	**139**	**1,854**	**4,611**
Unknown Etiology ¶	**445**	**219**	**497**	**128**	**30**	**211**	**2**	**.**	**38**	**1**	**2**	**36**	**1,065**	**1,593**
Multiple Etiology	**81**	**45**	**64**	**41**	**5**	**36**	**1**	**.**	**8**	**1**	**.**	**10**	**163**	**221**
Total	**1,440**	**735**	**1,211**	**533**	**57**	**642**	**11**	**2**	**109**	**7**	**8**	**185**	**3,082**	**6,425**

* If at least one etiology was laboratory-confirmed, the outbreak was considered to have a confirmed etiology. If no etiology was laboratory-confirmed, but an etiology was reported based on clinical or epidemiologic features, the outbreak was considered to have a suspected etiology.

§ The denominator for the total etiology percentages is the known etiology total. The denominator for the known etiology, unknown etiology, and multiple etiologies percentages is the total.

¶ An etiologic agent was not confirmed or suspected based on clinical, laboratory, or epidemiologic information.

** Contributing factor definitions available in the appendix

Appendix. Number of foodborne disease outbreaks by etiology* and contributing factor, Foodborne Disease Outbreak Surveillance System, United States -- 1998-2008

Etiology	Contributing Factor Code: Survival Factors S1	S2	S3	S4	S5	Outbreaks in which survival factor reported	Outbreaks in which any contributing factor reported
Bacterial							
Bacillus cereus	10	25	1	5	13	45	183
Brucella spp	1	.	.	.	1	2	3
Campylobacter jejuni	21	4	.	1	18	41	100
Campylobacter spp	15	2	.	.	1	17	41
Clostridium botulinum	8	2	4	.	11	21	26
Clostridium perfringens	99	175	.	14	17	244	426
Escherichia coli, Enterotoxigenic	.	.	.	1	1	2	9
Escherichia coli, Shiga toxin-producing	47	3	.	6	7	57	143
Escherichia coli, other	1	.	.	.	.	1	1
Listeria	2	1	.	.	.	3	14
Salmonella	242	66	2	16	52	337	780
Shigella flexneri	1	1	.	.	.	1	8
Shigella sonnei	.	1	.	.	7	8	39
Shigella spp.	.	.	.	.	.	.	7
Staphylococcus enterotoxin	29	32	1	4	33	89	348
Vibrio parahaemolyticus	8	.	.	.	7	15	52
Vibrio spp	2	.	.	1	.	2	7
Yersinia enterocolitica	.	.	.	.	1	1	7
Other bacterial	2	7	.	.	1	11	43
Total Bacterial	**488**	**319**	**8**	**48**	**170**	**896**	**2,237**
Viral							
Astrovirus	.	.	.	.	.	.	.
Hepatitis A	.	.	.	.	.	.	39
Norovirus	30	19	.	4	39	85	1,770
Rotavirus	.	.	.	.	.	.	7
Other viral	1	2	.	.	.	3	39
Total Viral	**31**	**21**	**.**	**4**	**39**	**88**	**1,855**
Chemical and Toxin							
Ciguatoxin	.	.	.	.	1	1	138
Cleaning agents	.	.	.	.	1	1	5
Heavy metals	.	.	.	.	.	.	9
Monosodium glutamate	.	.	.	.	.	.	1
Mycotoxins	.	.	.	.	.	.	8
Neurotoxic shellfish poison	.	.	.	.	.	.	5
Paralytic shellfish poison	.	.	.	.	.	.	8
Pesticides	.	.	.	.	.	.	2
Plant/Herbal toxins	.	.	.	.	.	.	3
Puffer fish tetrodotoxin	.	.	.	.	.	.	2
Scombroid toxin/Histamine	2	.	.	1	10	13	238
Other chemical	.	.	.	.	1	1	61
Other natural toxins	1	.	.	.	.	1	7
Total Chemical	**3**	**.**	**.**	**1**	**13**	**17**	**487**
Parasitic							
Anisakiasis	.	.	.	.	.	.	1
Cryptosporidium parvum	.	.	.	.	.	.	2
Cryptosporidium spp	.	.	.	.	.	.	1
Cyclospora cayetanensis	.	.	.	.	.	.	12
Giardia lamblia	.	.	.	.	1	1	7
Trichinella spiralis	5	.	.	.	.	5	8
Other parasitic	.	.	.	.	.	.	1
Total Parasitic	**5**	**.**	**.**	**.**	**1**	**6**	**32**
Known Etiology §	**527**	**340**	**8**	**53**	**223**	**1,007**	**4,611**
Unknown Etiology ¶	**122**	**116**	**3**	**12**	**86**	**300**	**1,593**
Multiple Etiology	**29**	**33**	**1**	**3**	**12**	**60**	**221**
Total	**678**	**489**	**12**	**68**	**321**	**1,367**	**6,425**

* If at least one etiology was laboratory-confirmed, the outbreak was considered to have a confirmed etiology. If no etiology was laboratory-confirmed, but an etiology was reported based on clinical or epidemiologic features, the outbreak was considered to have a suspected etiology.

§ The denominator for the total etiology percentages is the known etiology total. The denominator for the known etiology, unknown etiology, and multiple etiologies percentages is the total.

¶ An etiologic agent was not confirmed or suspected based on clinical, laboratory, or epidemiologic information.

** Contributing factor definitions available in the appendix

Contamination Factors:[1]

C1 - Toxic substance part of tissue (e.g., ciguatera)
C2 - Poisonous substance intentionally added (e.g., cyanide or phenolphthalein added to cause illness)
C3 - Poisonous or physical substance accidentally/incidentally added (e.g., sanitizer or cleaning compound)
C4 - Addition of excessive quantities of ingredients that are toxic under these situations (e.g., niacin poisoning in bread)
C5 - Toxic container or pipelines (e.g., galvanized containers with acid food, copper pipe with carbonated beverages)
C6 - Raw product/ingredient contaminated by pathogens from animal or environment (e.g., *Salmonella* Enteriditis in egg, Norwalk in shellfish, *E. coli* in sprouts)
C7 - Ingestion of contaminated raw products (e.g., raw shellfish, produce, eggs)
C8 - Obtaining foods from polluted sources (e.g., shellfish)
C9 - Cross-contamination from raw ingredient of animal origin (e.g., raw poultry on the cutting board)
C10 - Bare-handed contact by handler/worker/preparer (e.g., with ready-to-eat food)
C11 - Glove-handed contact by handler/worker/preparer (e.g., with ready-to-eat food)
C12 - Handling by an infected person or carrier of pathogen (e.g., *Staphylococcus*, *Salmonella*, Norwalk agent)
C13 - Inadequate cleaning of processing/preparation equipment/utensils B leads to contamination of vehicle (e.g., cutting boards)
C14 - Storage in contaminated environment B leads to contamination of vehicle (e.g., store room, refrigerator)
C15 - Other source of contamination (*please describe in Comments*)

Proliferation/Amplification Factors:[1]

P1 - Allowing foods to remain at room or warm outdoor temperature for several hours (e.g., during preparation or holding for service)
P2 - Slow cooling (e.g., deep containers or large roasts)
P3 - Inadequate cold-holding temperatures (e.g., refrigerator inadequate/not working, iced holding inadequate)
P4 - Preparing foods a half day or more before serving (e.g., banquet preparation a day in advance)
P5 - Prolonged cold storage for several weeks (e.g., permits slow growth of psychrophilic pathogens)
P6 - Insufficient time and/or temperature during hot holding (e.g., malfunctioning equipment, too large a mass of food)
P7 - Insufficient acidification (e.g., home canned foods)
P8 - Insufficiently low water activity (e.g., smoked/salted fish)
P9 - Inadequate thawing of frozen products (e.g., room thawing)
P10 - Anaerobic packaging/Modified atmosphere (e.g., vacuum packed fish, salad in gas flushed bag)
P11 - Inadequate fermentation (e.g., processed meat, cheese)
P12 - Other situations that promote or allow microbial growth or toxic production (*please describe in Comments*)

Survival Factors:[1]

S1 - Insufficient time and/or temperature during initial cooking/heat processing (e.g., roasted meats/poultry, canned foods, pasteurization)
S2 - Insufficient time and/or temperature during reheating (e.g., sauces, roasts)
S3 - Inadequate acidification (e.g., mayonnaise, tomatoes canned)
S4 - Insufficient thawing, followed by insufficient cooking (e.g., frozen turkey)
S5 - Other process failures that permit the agent to survive (*please describe in Comments*)

Method of Preparation:[2]

M1 - Foods eaten raw or lightly cooked (e.g., hard shell clams, sunny side up eggs)
M2 - Solid masses of potentially hazardous foods (e.g., casseroles, lasagna, stuffing)
M3 - Multiple foods (e.g., smorgasbord, buffet)
M4 - Cook/serve foods (e.g., steak, fish fillet)
M5 - Natural toxicant (e.g., poisonous mushrooms, paralytic shellfish poisoning)
M6 - Roasted meat/poultry (e.g., roast beef, roast turkey)
M7 - Salads prepared with one or more cooked ingredients (e.g., macaroni, potato, tuna)
M8 - Liquid or semi-solid mixtures of potentially hazardous foods (e.g., gravy, chili, sauce)
M9 - Chemical contamination (e.g., heavy metal, pesticide)
M10 - Baked goods (e.g., pies, éclairs)
M11 - Commercially processed foods (e.g., canned fruits and vegetables, ice cream)
M12 - Sandwiches (e.g., hot dog, hamburger, Monte Cristo)
M13 - Beverages (e.g., carbonated and non-carbonated, milk)
M14 - Salads with raw ingredients (e.g., green salad, fruit salad)
M15 - Other, does not fit into above categories *(please describe in Comments)*
M16 - Unknown, vehicle was not identified

[1] Frank L. Bryan, John J. Guzewich, and Ewen C. D. Todd. Surveillance of Foodborne Disease III. Summary and Presentation of Data on Vehicles and Contributory Factors; Their Value and Limitations. Journal of Food Protection, 60; 6:701-714, 1997.

[2] Weingold, S. E., Guzewich JJ, and Fudala JK. Use of foodborne disease data for HACCP risk assessment. Journal of Food Protection, 57; 9:820-830, 1994.