
Multistate Outbreak of Human *Salmonella* Typhimurium Infections Associated with Pet Turtle Exposure --- United States, 2008

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On September 4, 2008, the Philadelphia Department of Public Health (PDPH) and the Pennsylvania Department of Health (PADOH) notified CDC of an outbreak of possible turtle-associated human *Salmonella* Typhimurium infections detected by identifying strains with similar pulsed-field gel electrophoresis (PFGE) patterns in PulseNet. Turtles and other reptiles have long been recognized as sources of human *Salmonella* infections (1), and the sale or distribution of small turtles (those with carapace lengths <4 inches) has been prohibited in the United States since 1975 (2,3). CDC and state and local health departments conducted a multistate investigation during September--November 2008. This report summarizes the results of that investigation, which identified 135 cases in 25 states and the District of Columbia; 45% were in children aged ≤ 5 years. Among 70 patients with primary infection, 37% reported turtle exposure, of which 81% was to small turtles most commonly purchased from street vendors. A matched case-control study showed a significant association between illness and exposure to turtles (matched odds ratio [mOR] = 16.5). Increasing enforcement of existing local, state, and federal regulations against the sale of small turtles, increasing penalties for illegal sales, and enacting more state and local laws regulating the sale of small turtles (e.g., requiring *Salmonella* awareness education at the point-of-sale), could augment federal prevention efforts.

On July 9, 2008, a girl aged 2 years was brought to a Philadelphia physician's office after 3 days of diarrhea and fever. *S.* Typhimurium was isolated from her stool specimen. Three weeks before her illness began, the family had purchased two pet turtles with shell lengths <4 inches from a street vendor. The family reported that the child did not touch the turtles but touched the turtle aquarium. On July 28, PulseNet* was notified that stool specimens from five additional Pennsylvania patients yielded *S.* Typhimurium with a PFGE *Xba*I pattern indistinguishable from the girl's isolate (JPXX01.0416) or different by a single band (JPXX01.0006). Each of these PFGE patterns had been observed previously and comprised 1.1%--1.2% of the PulseNet *Salmonella* database. By mid-August, PulseNet had identified *S.* Typhimurium isolates matching the outbreak strain in 10 states.† Concomitantly, epidemiologic investigations led by PDPH and PADOH revealed that five of eight Philadelphia patients and two additional Pennsylvania patients reported exposure to a turtle in household settings.

Multistate Investigation

On September 4, 2008, after a turtle aquarium water sample from a Philadelphia patient's home was positive for the outbreak strain, CDC and state and local health partners initiated a multistate investigation to determine the source of infections. A case was defined as a laboratory-confirmed infection of *S.* Typhimurium with the outbreak strain (PFGE *Xba*I pattern JPXX01.0416 or JPXX01.0006) in a person with an illness onset date on or after March 13, 2008 (earliest reported illness onset date). A case of secondary infection (secondary case) was defined as illness in a person occurring within 2 weeks after

diarrheal illness in a household or day care contact, suggesting person-to-person transmission. All cases that were not identified as secondary cases were classified as primary cases.

A total of 135 cases in 25 states and the District of Columbia were identified in the national PulseNet database (Figure 1). Among 124 patients for whom demographic information was available, median age was 7 years (range: <1--94 years), and 54 (45%) patients were aged ≤5 years; 63 (51%) were female. Reported illness onset dates ranged from March 13 to October 7 (Figure 2); 78% of illnesses occurred during June--September.

Eighty-three (61%) of 135 patients were interviewed using a more extensive questionnaire that asked about clinical symptoms, day-care attendance, reptile exposure (turtle size, species, acquisition source, and type and extent of turtle contact), and awareness of the association between reptile contact and *Salmonella* infection. Of the 83 patients, 35 (42%) had bloody diarrhea, and 29 (35%) were hospitalized; no deaths were reported. Twenty (24%) of 83 patients attended day care. Nine of those 20 children attended three Pennsylvania day-care centers, and they acquired secondary *Salmonella* infections through contact with laboratory-confirmed index cases, one in each day-care center. All the index patients acquired their infections through turtle exposure, and all 12 children were aged <2 years.

Investigators classified 70 of the 83 interviewed patients as having primary cases and 13 (16%) as secondary cases. The median age of these 70 patients was 8 years (range: <1--80 years); 43% were aged <5 years, and 36 (51%) were female. Of the 70 patients with primary cases, 26 (37%) reported exposure to turtles, and 21 reported exposures to small turtles. Among the 69% of patients who knew the source of the turtle, the majority of turtles were purchased from street vendors, flea markets, and nonpet stores (e.g., souvenir and gift shops) (Table). Seven (10%) of 70 primary patients reported other reptile exposures (e.g., snakes or iguanas). Three of six water samples from turtle habitats in patient households yielded the outbreak strain.

During September 18--October 10, 2008, a nationwide 1:1 matched case-control study was conducted to identify whether illness was associated with exposure to turtles or other reptiles. Data were collected through telephone interviews by local, state, and CDC epidemiologists using the outbreak questionnaire. For the case-control study, only primary cases with illness onset (or date of isolation of the outbreak strain, if the onset date was unknown) on or after March 13, 2008, were eligible. Controls were persons without diarrheal illness during August and were matched by case neighborhood (using reverse directory dialing) and age group (i.e., <1 year, 1--5 years, 6--17 years, ≥18 years). The questionnaire asked about history of reptile exposure for the week preceding illness onset for case-patients and during August for controls. Investigators chose August for controls to help decrease recall bias, reasoning that, without illness to delineate clearly a time period, controls might have more difficulty recalling the timing of exposures.

Thirty-seven cases and 47 controls were enrolled from 11 participating states. A total of 33 cases could not be enrolled in the case-control study because of refusal to participate, loss to follow-up, or inability to identify a matching control. Six cases had more than one matched control enrolled, and these were included in the analysis to increase study power. The median age of case-patients was 9 years (range: <1--80 years), compared with 14 years (range: <1--90 years) for controls ($p = 0.44$); 51% of case-patients were female, compared with 40% of controls ($p = 0.34$). Eighteen (49%) of 37 case-patients reported turtle exposure, compared with nine (19%) of 47 controls (mOR = 16.5) (Table). Sixteen (94%) of the 17 case-patients for whom information was available had exposure to a turtle with shell length <4 inches. Illness was not associated with exposure to nonturtle reptiles.

On October 20, 2008, PDPH issued a health advisory informing the public about the outbreak and providing recommendations for preventing illness.[¶] Attempts to trace back the source of the infected turtles were unsuccessful, partly because street or flea market vendors move frequently, complicating investigation efforts. In November 2008, the Food and Drug Administration reemphasized its warning to consumers against buying small turtles.**

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Editorial Note

This *S. Typhimurium* outbreak is the third multistate, turtle-associated *Salmonella* outbreak in the United States since 2006. Before 2006, no large multistate turtle-associated *Salmonella* outbreaks were identified. One reason for this apparent increase might be PulseNet, which has improved the ability to detect multistate outbreaks. Increased pet turtle ownership in the United States also might contribute to the recurrent outbreaks: the proportion of households in the United States owning pet turtles doubled during 1996--2006, from 0.5% to 1.0% (4). Together, the three recent *Salmonella* outbreaks account for 258 laboratory-confirmed cases of salmonellosis (5--7) and many more unreported illnesses likely occurred. As with past outbreaks, most ill persons reporting turtle exposure were exposed to turtles with shell lengths <4 inches; these turtles were mainly acquired from flea markets, street vendors, and souvenir shops. The case-control study found a significant association of *Salmonella* infection with turtle exposure; however, 63% of primary cases in the outbreak had no known turtle exposure, and 60% had no reptile exposure. This might have resulted, in part, from failure to recall a turtle exposure. Parents or guardians were interviewed as proxies for young children and they might have been unaware of their child's turtle exposure outside of the home. In addition, certain patients might have had unknown indirect turtle exposure through environmental cross-contamination or unrecognized person-to-person transmission or have been sporadic or background cases.

The federal government prohibited sales of turtles with shell lengths <4 inches in 1975 (2,3), after investigations demonstrated that small turtles were a major source of human *Salmonella* infections, particularly in children (1). Implementation of the prohibition resulted in a substantial decline in turtle-associated human salmonellosis, preventing an estimated 100,000 *Salmonella* infections annually in U.S. children (8). However, because the prohibition is not fully enforced and contains exceptions (e.g., sales for bona fide scientific, educational, or exhibition purposes), turtle-associated human salmonellosis cases continue to occur. Street vendors and flea markets are a common source of illegal sales; these were common sources reported in this outbreak.

Despite recommendations from CDC to prevent turtle-associated salmonellosis in humans (Box),^{††} recent outbreaks suggest public education efforts have not been successful. In this outbreak, <30% of respondents knew about the association between reptiles and *Salmonella*; this proportion has not increased substantially compared with the 20%--29% observed in the 2007--2008 outbreak (5). Although many reptiles carry *Salmonella*, small turtles pose a greater risk to young children because they are perceived as safe pets, are small enough to be placed in the mouth, or otherwise can be handled inappropriately. Persons having contact with reptiles, reptile habitats (including tank water), and other surfaces contaminated with reptile feces are at risk for *Salmonella* infection; direct reptile

contact is not necessary (9). This outbreak documents that young children without direct turtle exposure are at risk for turtle-associated salmonellosis through person-to-person transmission in child-care settings. Direct or indirect reptile contact is associated with an estimated 6% of *Salmonella* infections in the United States and 11% of infections among persons aged <21 years (10).

Because of the particular hazard associated with small turtles, continuing federal prohibition against sales and distribution of small turtles is needed to prevent turtle-associated salmonellosis. Few states have laws regulating small turtles, and most of these laws prohibit turtles in day-care centers or require sellers to provide educational material. Increasing enforcement of existing local, state, and federal regulations against the sale of small turtles, increasing penalties for illegal sales, and enacting more state and local laws regulating the sale of small turtles (e.g., requiring *Salmonella* awareness education at the point-of-sale), could augment federal prevention efforts and facilitate a more rapid public health response.

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* A national molecular subtyping network for foodborne disease surveillance.

† Alabama, Illinois, New York, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Vermont, and Virginia.

§ Date of outbreak strain isolation minus 3 days (account for the incubation period of *Salmonella*) was used to estimate illness onset date if that date was unknown.

¶ Available at https://hip.phila.gov/xv/portals/o/hip/health_alerts/2008/pdph-han_advisory_5_salmonellaturtleoutbreak_10202008.pdf

** Available at <http://www.fda.gov/forconsumers/consumerupdates/ucmo48081.htm>

†† Also available at http://www.cdc.gov/healthypets/spotlight_an_turtles.htm.

What is already known on this topic?

A federal prohibition against sales of turtles with shell lengths <4 inches was enacted in 1975, after investigations demonstrated that small turtles were a major source of human *Salmonella* infections, particularly in children; despite this, outbreaks of *Salmonella* infection continue to be linked to these small turtles, in part due to illegal sales.

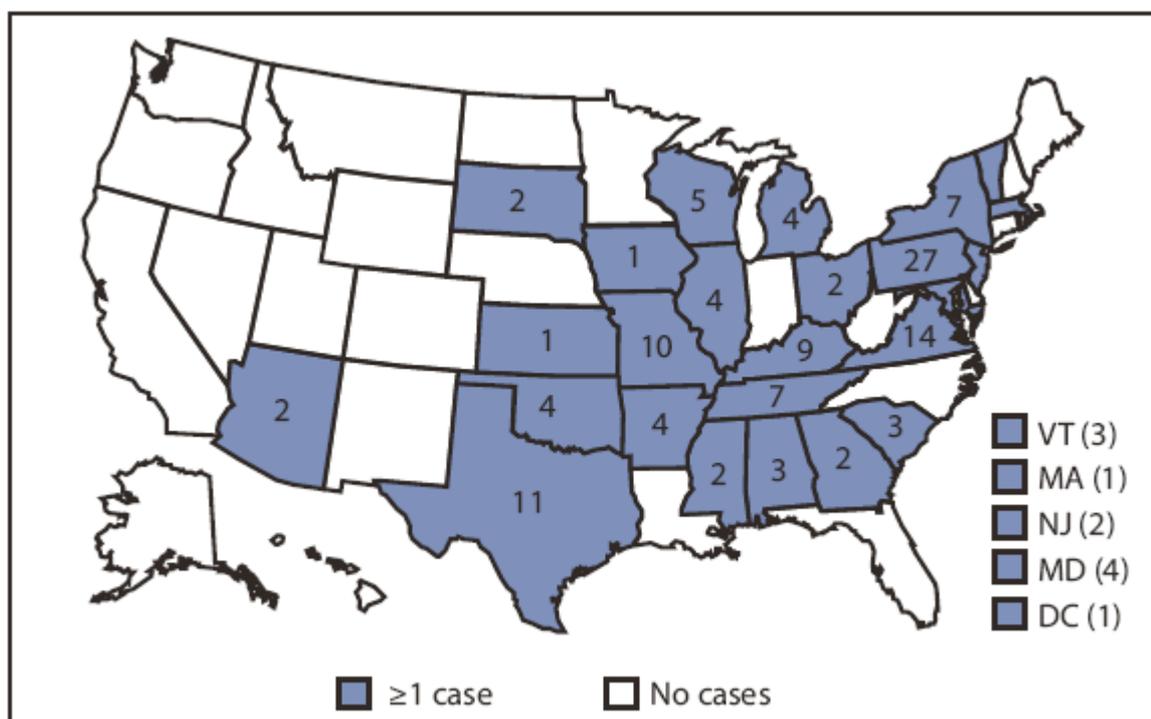
What is added by this report?

This report documents the third multistate *Salmonella* outbreak in the United States since 2006 associated with turtles, primarily those turtles with shell lengths <4 inches that were acquired through illegal sales; it also highlights that young children without direct turtle exposure are at risk for turtle-associated salmonellosis through person-to-person transmission in child-care settings.

What are the implications for public health practice?

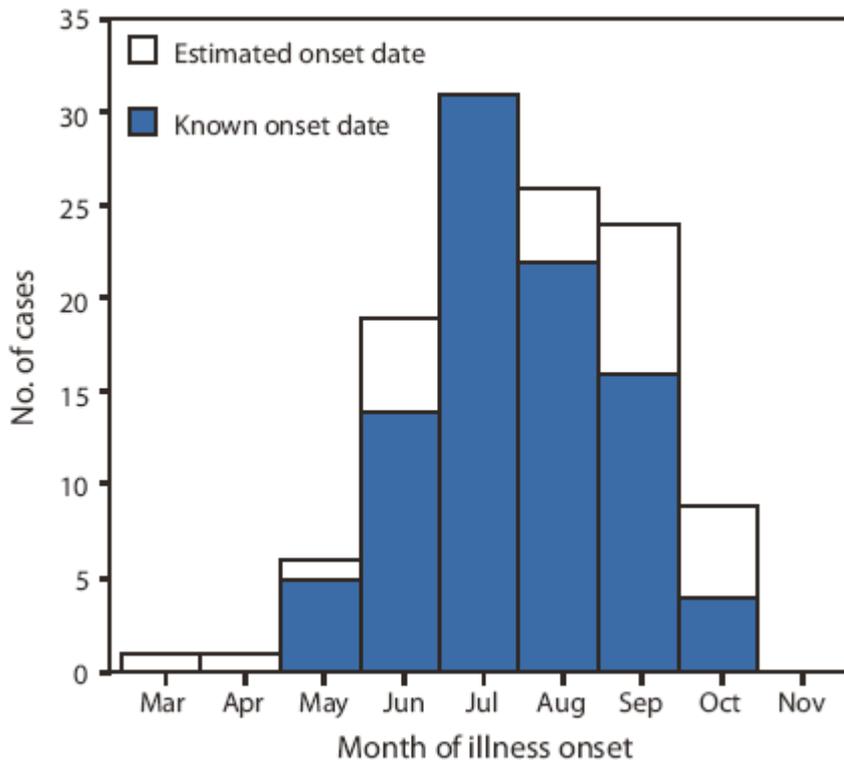
Increasing enforcement of existing local, state, and federal regulations against the sale of small turtles, increasing penalties for illegal sales, and enacting more state and local laws regulating the sale of small turtles (e.g., requiring *Salmonella* awareness education [Box] at the point-of-sale), could augment federal prevention efforts and facilitate a more rapid public health response.

FIGURE 1. Number of laboratory-confirmed cases (N = 135) of *Salmonella* Typhimurium infection with the outbreak strain --- United States, March 13--November 17, 2008



Alternate Text: The figure above shows the number of laboratory-confirmed cases (N = 135) of Salmonella Typhimurium infection with the outbreak strain during March 13–November 17, 2008, in the United States. A total of 135 cases in 25 states and the District of Columbia were identified in the national PulseNet database.

FIGURE 2. Number of laboratory-confirmed cases (N = 135)* of Salmonella Typhimurium infection with the outbreak strain, by month of illness onset and known (n = 94) or estimated† (n = 30) onset date --- United States, 2008



* Excludes 11 cases for which both onset date and isolation date were unknown.

† Onset date estimated by outbreak strain isolation date minus 3 days, if onset date not reported.

Alternate Text: The figure above shows the number of laboratory-confirmed cases (N = 135) of Salmonella Typhimurium infection with the outbreak strain, by month of illness onset and known (n = 94) or estimated (n = 30) onset date in the United States during an outbreak in 2008. Reported illness onset dates ranged from March 13 to October 7.

TABLE. Characteristics of primary cases,* and of cases and controls in a matched case-control study, during an investigation of a multistate outbreak of Salmonella Typhimurium infections --- United States, 2008

Characteristic	Outbreak primary cases (n = 70)		Case-control study†						
			Cases (n = 37)		Controls (n = 47)		mOR§	95% CI¶	p value
	No.	(%)	No.	(%)	No.	(%)			
Reptile exposure**									

Turtles	26	(37)	18	(49)	9	(19)	16.5	(2.4-- 723.2)	<0.01
Nonturtle reptiles	7	(10)	3	(8)	4	(9)	1.0	(0.1-- 13.8)	1.00
Any reptiles	28	(40)	19	(51)	10	(21)	8.5	(1.8-- 79.3)	<0.01
Turtle size									
Carapace length <4 inches	21	(81)	16	(89)	5	(56)	1.0	(0.03-- >999)	1.00
Carapace length ≥4 inches	2	(8)	1	(6)	3	(33)	---	---	---
Unknown/not reported	3	(12)	1	(6)	1	(11)	---	---	---
Turtle species									
Red-eared slider	7	(27)	6	(33)	0	---	5.9	(0.5-- >999)	0.17
Other species ^{††}	6	(23)	5	(28)	4	(44)	---	---	---
Unknown/Not reported	13	(50)	7	(39)	5	(56)	---	---	---
Kind of turtle exposure^{**}									
Touch	13	(50)	10	(56)	2	(22)	3.2	(0.33-- >999)	0.33
Kiss	1	(4)	1	(6)	0	---	1.0	(0.03-- >999)	1.00
Feed	13	(50)	11	(61)	0	---	6.5	(0.80-- >999)	0.08
Environment contact	14	(54)	12	(67)	4	(44)	3.2	(0.33-- >999)	0.33
Turtle roamed house	7	(27)	5	(28)	2	(22)	1.0	(0.33-- >999)	1.00
Unknown/Not reported	0	---	0	---	1	(11)	---	---	---
Location of turtle exposure^{**}									

Home	13	(50)	12	(67)	4	(44)	2.0	(0.1--118.0)	1.00
Friend/Relative	6	(23)	3	(17)	1	(11)	1.0	(0.01--78.5)	1.00
Outdoors	5	(19)	2	(11)	1	(11)	1.0	(0.03-->999)	1.00
Store	3	(12)	1	(6)	0	---	---	---	---
School	1	(4)	0	---	0	---	---	---	---
Zoo	0	---	0	---	1	(11)	---	---	---
Day care	0	---	0	---	0	---	---	---	---
Other ^{§§}	1	(4)	1	(6)	3	(33)	0.4	(0.01--7.8)	0.83
Person cleaning turtle habitat**									
Parent	9	(35)	8	(44)	3	(33)	1.0	(0.01--78.5)	1.00
Case-patient	3	(12)	3	(17)	0	---	---	---	---
Other ^{¶¶}	7	(27)	4	(22)	7	(78)	0.2	(<0.01--39)	1.00
Where turtle acquired									
Street vendor	7	(27)	7	(39)	1	(11)	---	---	---
Flea market	2	(8)	2	(11)	0	---	---	---	---
Nonpet store	4	(15)	2	(11)	1	(11)	---	---	---
Gift	1	(4)	1	(6)	0	---	---	---	---
Pet store	1	(4)	0	---	0	---	---	---	---
Outdoors	1	(4)	1	(6)	1	(11)	---	---	---
Other (not specified)	2	(8)	2	(11)	0	---	---	---	---
Unknown/Not reported	8	(31)	3	(17)	6	(67)	---	---	---
Salmonella knowledge***									

Yes	19	(27)	9	(24)	13	(28)	0.8	(0.2--2.7)	0.89
No	47	(67)	26	(70)	31	(66)	---	---	---
Unknown/Not reported	4	(6)	2	(5)	3	(6)	---	---	---

* All cases that were not identified as secondary cases were classified as primary cases. A case of secondary infection (secondary case) was defined as illness in a person occurring within 2 weeks after diarrheal illness in a household or day-care contact, suggesting person-to-person transmission.

† Cases and controls were excluded from the analysis when questions were not answered or data were missing.

§ Matched odds ratio.

¶ Confidence interval.

** Percentages might not sum to 100% because categories are not mutually exclusive.

†† Other species include the Florida cooter turtle, painter turtle, yellow-bellied slider, flat box turtle, and snapping turtle.

§§ Other locations of turtle exposure include a camp, a park, a tourist attraction, and a pool.

¶¶ Other relatives include grandparent, sibling, niece, aunt, and uncle.

*** Whether the respondent was aware of the association between *Salmonella* infection and reptile exposure.

BOX. Existing recommendations to prevent turtle-associated *Salmonella* infections

- Do not have a turtle in any household that includes children aged <5 years, the elderly, or persons who have lowered natural resistance to disease due to pregnancy, cancer, chemotherapy, organ transplants, diabetes, liver problems, or certain other diseases. A family expecting a child should remove any pet reptile or amphibian from the home before the infant arrives.
- Wash hands thoroughly with soap and water immediately after handling turtles or their cages, or after contact with pet feces. Do not touch your face, other persons, or any surface until hands are washed.
- Handle all turtles and surfaces that have come in contact with turtles as if they are contaminated with *Salmonella*, because they likely are.
- Wash surfaces that the turtle or its cage has contacted. Kitchen sinks should not be used to bathe turtles or to wash their dishes, cages, or aquariums. If bathtubs are used for these purposes, they should be cleaned thoroughly and disinfected with bleach before use.
- Separate the turtle from possible contact with food intended for humans. Do not allow turtles to roam freely about a home or living area, and especially do not allow them in food preparation areas. Do not allow food and drink to be present in animal contact areas. Do not use kitchen sinks to bathe turtles or to wash their dishes, cages, or aquariums. If bathtubs are used for these purposes, they should be cleaned thoroughly and disinfected with bleach.

SOURCE: CDC. Is a turtle the right pet for your family? Available at http://www.cdc.gov/healthypets/spotlight_an_turtles.htm.

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