

Reptile-associated salmonellosis

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A family of 4 (2 parents and 2 children, 3 and 4 years old) attended a reptile swap-meet in Illinois at which reptiles of all types were bought and sold by members of the public and fanciers, respectively. The family purchased six 1-in map, painted, and red-eared turtles. Within 2 weeks of the purchase, the 4-year-old child developed diarrhea, vomiting, fever, dehydration, and abdominal cramps. *Salmonella stanley* was isolated from the child's stool. Aquarium water, a swab specimen from the turtle, and aquarium sediment were cultured for *Salmonella* sp. The aquarium water and turtle swab specimen yielded *S stanley*, and the sediment yielded *S oranienburg*.

Q: How common is salmonellosis in the United States?

A: Salmonellosis is the second most common cause of bacterial diarrhea in people in the United States. Each year, approximately 35,000 to 45,000 human cases are reported to the Centers for Disease Control and Prevention (CDC); however, it is estimated that only 1 to 5% of all salmonellosis cases are reported to the appropriate officials.¹ Salmonellosis can be transmitted through consumption of *Salmonella* organisms in undercooked meat, from contact with uncooked food items, through person-to-person contact, and through contact with animals infected with *Salmonella* sp. Recent reports have reemphasized the importance of reptiles as a source of salmonellosis in people.^{2,3}

Q: How many serotypes of *Salmonella* are there?

A: There are more than 2,300 serotypes of *Salmonella* classified into 6 subspecies (I to VI). Certain subspecies and serotypes have been identified by the CDC as being commonly associated with reptiles.³

Q: What types of reptiles transmit *Salmonella* sp to people?

A: It is likely that all reptiles (turtles, lizards, and snakes) carry *Salmonella* sp. Reptile-associated salmonellosis in people has been reported from contact with turtles, iguanas, corn snakes, savanna monitor lizards, komodo dragons, bearded dragon lizards, and boa constrictors.^{4,8} A high proportion (> 90%) of reptiles carry *Salmonella* sp, yet do not manifest signs of disease. The organism is carried in the gastrointestinal tract and may be shed intermittently during times of stress.⁹

Q: How is salmonellosis diagnosed, and why is it useful to determine the serotype of the *Salmonella* organism?

A: Salmonellosis is diagnosed by isolating *Salmonella* sp in culture from a patient's specimen.

Determination of the serotype may prove useful when attempting to link the patient's isolate to possible sources of infection.

Q: Are there any regulations governing the sale of reptiles in the United States?

A: Regulations governing the sale of reptiles are few. Some states prohibit ownership of poisonous reptiles or reptiles exceeding a certain length. In 1975, the FDA prohibited sale or distribution of turtles less than 4 inches in diameter. The FDA's decision was based on the assumption that larger turtles would seldom be purchased for young children. This regulatory action led to an estimated annual decrease of 100,000 cases of salmonellosis in children 1 to 9 years old.¹⁰

Q: How popular are reptiles as pets in the United States?

A: An estimated 2 million pet reptiles are owned by 2% of US households.¹¹ Importation of green iguanas into the United States has increased markedly in the past 10 years, peaking in 1993 at 713,234. During the past 5 years, 31% of imported reptiles were iguanas.⁴

Q: What are the typical symptoms and types of complications in humans beings with salmonellosis?

A: People with salmonellosis usually have diarrhea, fever, vomiting, and abdominal cramps. The incubation period is from 6 to 73 hours, and symptoms can last from 24 hours to 12 days. Individuals most susceptible are children less than 1 year old, elderly, people taking medications that increase gastric pH, and those whose immune systems are suppressed. Complications that may result in hospitalization, include dehydration, sepsis, meningitis, and osteomyelitis.^{4,5}

Q: How is salmonellosis transmitted from reptiles?

A: Transmission of *Salmonella* sp from reptiles to people is typically through the fecal-oral route. This may be as simple as touching a reptile or its cage, then touching contaminated fingers to the mouth or food item. Indirect transmission is possible and often occurs when an infant becomes infected. Cases of salmonellosis in infants have occurred, although, the infant did not have direct contact with a reptile.^{5,6} Rather, the child's caretaker had handled the reptile or cleaned its cage. *Salmonella marina* is a serotype frequently associated with iguanas. In 1 recent studies³ of *S marina* infections reported in the United States, 81% of cases were infants, 34% were hospitalized, and only 14% had touched the household reptile directly. These studies underscore the relevance of indirect transmission and the important role of veterinarians in educating the public about proper reptile handling techniques.

Q: How do reptiles become infected?

A: Reptiles become infected through direct contact with other infected reptiles or their feces. Reptiles also can become infected through transovarial transmis-

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sion.^{8,12} Typical behavior of hatchling iguanas and other lizards is to eat feces of adults to establish the hindgut flora necessary for digestion.¹³

Q: Can reptiles be treated to eliminate salmonellae?

A: Treating reptiles or their eggs with antibiotics to eliminate *Salmonella* sp has generally been unsuccessful and may lead to increased antibiotic resistance.¹⁴

Q: What precautions should be taken with regard to pet reptiles and salmonellosis?

A: The CDC recommends that people at increased risk for infection or serious complications of salmonellosis (eg, pregnant women, children less than 5 years old, and immunocompromised people) avoid contact with reptiles, reptiles should not be kept in child-care centers and may not be appropriate pets in households in which people at increased risk for infection reside, veterinarians and pet store owners should provide information to prospective and actual reptile owners about increased risk for salmonellosis transmission, to prevent contamination of food preparation areas, reptiles should not be kept in these areas and reptile dishes, cages, or aquariums should not be washed in the kitchen sink.^{4,5}

It is not advisable to clean a reptile's cage or other equipment in bathtubs or containers where infants will be bathed. Cleaning supplies, such as scrub brushes and buckets, should be designated for cleaning reptile housing and not used for any other purpose. Reptiles should not be allowed to roam the house. Most importantly, thorough hand washing with soap and water should follow any contact with reptiles or their equipment. Because some outbreaks of salmonellosis have occurred in situations where the public is allowed to have close contact with reptiles, it might be advisable to discourage direct contact in a petting zoo or educational exhibit. If contact is allowed, a large sign recommending hand washing should be prominently displayed and a sink and soap should be available.

In conclusion, the most likely source of the *Salmonella* sp infection in this child was the turtles purchased by the family that had a carapace size < 4 in in diameter. Because it is illegal to sell this size of tur-

tle in the United States, the matter was referred to the FDA for investigation. The ban on sales of small turtles has reduced the number of human infections with reptile-associated serotypes, but illegal sales deter this progress.^{10,15}

*Striegler T, US Department of the Interior, Fish and Wildlife Service, Arlington, Va: Personal communication, 1997.

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