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REPTILE-ASSOCIATED SALMONELLOSIS IN OREGON

ONCE UPON A TIME, Raphael, Michaelangelo, and Donatello were famous artists, and turtles were great pets for kids. Little "sliders" (aka red-eared turtles; *Pseudemys scripta)* sold in pet and variety stores for a buck or so and the dish, food, and plastic palm tree added only a few dollars to the experience. Not only cheap, turtles needed little room; they were quiet, and they didn't bite. It seemed too good to be true, and it was.

The skein began to unravel in 1965 with the publication of a landmark article[1]* that first linked reptile handling to an increased risk of developing salmonellosis. Turtles, like most reptiles, often (indeed, usually) carry and excrete one or more *Salmonella* serotypes in their droppings, and in hundreds of thousands of households, *Salmonella*-contaminated hands held peanut butter and jelly sandwiches; turtle dish water contaminated the kitchen sink, and children—some refusing to bathe without their little friends—slurped contaminated bath water.

Follow-up studies found that 10-25% of all *Salmonella* cases occurring in 1970-71 were due to turtle association—as many as 280,000 cases in just those two years.[2] Infected turtles were found in pet shops, prior to sale and in air freight boxes coming off planes arriving from Mississippi, Louisiana, and Arkansas.[1] Researchers learned that baby turtles were infected both transovarially and from their environment; adult turtles became infected in breeding ponds by consuming contaminated feed (often bits of what once were chickens), or from the fecally contaminated environment.[3] At first, attempts were made to control this problem by feeding the turtles antibiotics so that they would be "*Salmonella*-free." This proved a qualified success. While *Salmonella* recovery rates from culturing turtle stools fell dramatically, colonization rates fell only slightly, and many children continued to be infected from these "*Salmonella*-free" turtles—only now often with antibiotic resistant organisms.[4,5]

Oregon banned the sale of turtles with less than a 6-inch carapace in 1972, and the FDA banned the sale of turtles with less than a 4-inch carapace three years later.[5] These larger animals sold for $4 to $7, required larger, more expensive terraria, and therefore were presumably only a risk to rich kids. The domestic pet turtle industry weathered the collapse of the domestic market by expanding sales overseas, with predictable consequences.[4,6]

NOT JUST TURTLES

Nature abhors a vacuum, and in recent decades large and/or more exotic reptiles have gained a toehold as pets in many American households. Since at least the 1980's we have seen a number of otherwise rare *Salmonella* serotypes in persons who had contact with snakes, tortoises, iguanas, and other reptiles. Iguana contact** in particular has been recognized as an important source of salmonellosis in the U. S.[5,7]

Examples From the OHD Casefiles

- *Salmonella* subspecies II*** was isolated from a two-month-old Clackamas County infant with diarrhea, and subsequently from the father's white boa constrictor. The family dog, parakeets, and a pet lizard were "negative."
- In 1986, premature triplets were placed in a neonatal intensive care unit until their conditions stabilized. After several weeks, they were moved to intermediate neonatal care where the parents could handle and feed them. Within a few days, one infant developed diarrhea and was found to be culture-positive for a rare *Salmonella* subspecies (IIIa). His two siblings soon also became ill; the same organism was recovered from their stools. No other infants on either ward were affected. After an initial investigation by the health department, stool was collected from one of the black rat snakes owned by the father. The specimen grew out *Salmonella* (both IIIa and IIIb subspecies).
- *S.* Javiana was recovered from the stool of a two-year-old female Marion County resident, as well as the resident iguana. Interestingly, a stool survey of the household menagerie turned up six other *Salmonella* serotypes (Give, Hvittingfoss, Welikade, Poona, Wassenaar, and subspecies II) from four other animals (a turtle, a dog, another iguana, and a good sized caiman). The frog and goat were negative.
- A very rare serotype, *S.* Kintambo, was isolated from a 63-year-old Linn County woman with a history of protracted diarrhea. She had not traveled out of the U.S., and there were no household pets. After extensive and repeated questioning, she confessed that her adult son was an exotic reptile fancier. A stool survey of his boa constrictor, iguana, and (big!) monitor lizard that had the run of the house proved fruitful. *S.* Kintambo and *S.* Widemarsh were isolated from the monitor and boa; the iguana carried *S.* Glostrup.

Twenty other reptile-associated cases reported since 1986 are listed in the table. At least 10 other Oregonians (including nine infants) were probably infected via reptile exposure, although corresponding pet isolates were a different serotype. Five were exposed to iguanas, two to snakes, and one each to a turtle and exotic lizard.

DISCUSSION

Salmonella spp. are essentially normal flora for many reptiles, particularly those bred or reared in captivity.[3,5] Carriage rates as high as 90% have been reported in some surveys. Colonized reptiles are

*This pioneering study was done by a young CDC trainee, now (30 years later) retiring after 17 years as Oregon's Public Health Veterinarian. Join us in wishing Dr. L. Paul Williams, Jr. a happy retirement.

**A polite euphemism for consumption of lizard feces.

***The nomenclatural protocols for salmonellae have gone through many revisions. Space considerations preclude an expansive discussion of this fascinating topic.

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usually asymptomatic, although "diarrhea" in a creature that normally defecates once a week can be hard to assess. Restrictions on turtle sales had a dramatic effect on reptile-associated salmonellosis in the 1970s and 1980s.[5] Today's reptile owners may be a different breed from the turtle fanciers of "Leave it to Beaver" days, but the concerns are similar. Reptile ownership is increasingly popular. According to U.S. Fish & Wildlife Service data, 27,806 iguanas were imported in 1986. By 1993, that number had risen to 798,405.[7] It may only be the higher costs of today's preferred species that limit the magnitude of this problem.

Although there is undoubtedly considerable bias in diagnosis and reporting, infants in reptile-owning households seem to be at particular risk. These little hosts may have fewer competing gut flora, lower stomach acidity (a natural barrier to infection), and small mass, therefore requiring a smaller dose.[5] Handling or cleaning up after pets, followed by only cursory (if any) hand washing by parents or siblings, can readily translate into fecal organisms stuck in nail beds or on fingers, and from there it is only a short hop to an open mouth.

Reptile-Associated Salmonellosis in Oregon, 1986-1995*

County	Age	Sex	Year	Patient Serotype(s)	Reptile Pet	Reptile Serotype(s)
Multnomah	5 mo.	F	1986	Adelaide Durban Uganda	small lizard	Adelaide
Douglas	adult	M	1987	Wangata	four tortoise	Wangata Chireke IIb,61...
Clackamas	2	F	1988	Enteritidis	large turtle	Enteritidis Newport
Polk	1, 2, 13	M,F	1990	Panama II,50...	iguana	II,50... Abaetetuba
Clackamas	1	M	1991	Typhimurium	snake	Typhimurium
Douglas	2	F	1992	Heidelberg	turtle	Heidelberg
Washington	13	F	1993	Ituri	lizard	Ituri
Lane	29	M	1993	Sandiego	monitor lizard	Sandiego Chichiri Uzaramo IIb...
Marion	4 mo.	M	1994	Poona	3 iguanas	Poona Abaetetuba
Washington	50	F	1994	Poona	3 iguanas	Poona II,58...
Columbia	3 mo.	M	1994	Poona	iguana	Poona
Klamath	2 mo.	M	1994	Poona	iguana	Poona
Multnomah	3 mo.	F	1994	Flint	iguana	Flint
Multnomah	2 mo., 3, 27	M,F	1995	Typhimurium	iguana	Typhimurium
Multnomah	2	M	1995	Typhimurium	iguana	Typhimurium
Multnomah	1	M	1995	Poona	iguana	Poona

*does not include the 6 cases detailed in text/identifications courtesy Steve Mauvais, CPHL

Official statistics undoubtedly grossly underestimate the magnitude of this problem. In some cases, household reptiles may have died, been returned to pet stores or given away, or owners may refuse access to their pet. The vagaries of sample collection and culture also play a part. The reptile cloaca is often difficult to find, and a certain sangfroid is necessary when swabbing the occasional python or crocodile. Droppings recovered from cages or floors, while sometimes culturable, may not be fresh enough. Only 3 or 4 colonies may be picked (and eventually serotyped) from a culture plate containing several hundred colonies, and some serotypes may overgrow others. Many reptiles simultaneously carry two or three (or more!) serotypes.

PREVENTION MESSAGES

Physicians and other health care providers may not get a chance to register opinions on pet selection, but a general message about the importance of hand washing after handling pets or humans is always apt. Specific recommendations with respect to reptile-associated salmonellosis have been developed.[7]

- Reptiles should not be kept in child-care centers or in households with persons at increased risk for severe infection (immunocompromised, pregnant, children <5 years).
- Veterinarians and pet store owners should warn persons of the increased risk of salmonellosis associated with reptiles.
- Reptile owners should be advised always to wash their hands thoroughly after handling their pet or its cage—and not to bathe with them for Pete's sake.
- Reptiles and their cages, water dishes, or other paraphernalia should not be kept in food-preparation areas. Kitchen sinks should not be used to bathe reptiles or to wash associated equipment.

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