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Since publication of their article, the authors report no further potential conflict of interest.

1. Vece TJ, Watkin LB, Nicholas S, et al. Copa syndrome: a novel autosomal dominant immune dysregulatory disease. *J Clin Immunol* 2016;36:377-87.

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More on Autochthonous Leprosy in the United States

TO THE EDITOR: In a recent letter to the editor, Belzer et al. (June 29 issue)¹ note that armadillos as a maintenance host cannot account for all current cases of autochthonous leprosy in the United States. Armadillos also die from the disease, and whether the pathogen is maintained permanently in wild populations of armadillos is undetermined. In addition to armadillos, other animal hosts have been discovered^{2,3} (Table 1). In particular, new findings in rodent species in Brazil indicate that still other potential hosts await discovery.⁴

Primary infections from the environment and potential insect and tick vectors should be considered in addition to zoonotic infection. Water and soil should be considered as potentially important environmental reservoirs.³ *Mycobacterium leprae* can survive in the laboratory for 7 to 90 days, but amebas can sustain bacteria for up to 35 days, and cysts of amebas can keep *M. leprae* alive for up to 8 months. The environmental reservoir of *M. lepromatosis*, the second species that causes leprosy, remains to be elucidated. Dual infections in humans have been reported in Brazil, Mexico, and Southeast Asia.⁵

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No potential conflict of interest relevant to this letter was reported.

1. Belzer A, Ochoa MT, Adler BL. Autochthonous leprosy in the United States. *N Engl J Med* 2023;388:2485-7.

2. Schilling A-K, McCurdy K, Fish A, et al. Diagnosing and categorizing leprosy in live Eurasian red squirrels (*Sciurus vulgaris*)

for management, surveillance, and translocation purposes. *J Zoo Wildl Med* 2021;52:648-59.

3. Ploemacher T, Faber WR, Menke H, Rutten V, Pieters T. Reservoirs and transmission routes of leprosy; a systematic review. *PLoS Negl Trop Dis* 2020;14(4):e0008276.

4. de Lima MF, Silvestre MPSA, Dos Santos EC, et al. The presence of *Mycobacterium leprae* in wild rodents. *Microorganisms* 2022;10:1114.

5. Deps P, Collin SM. *Mycobacterium lepromatosis* as a second agent of Hansen's disease. *Front Microbiol* 2021;12:698588.

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THE AUTHORS REPLY: Pieters et al. detail a broad array of sources, including organic matter, microorganisms, arthropods, and mammals, that could in theory serve as reservoirs, vectors, or host species for *M. leprae* and, to a lesser extent, *M. lepromatosis*. We would emphasize that, overall, evidence ranges from limited to hypothetical in support of transmission to humans from most of these sources, although the detection of shared *M. leprae* strains between humans and armadillos does suggest zoonotic transmission.^{1,2} At this time, the greatest evidence exists for human-to-human aerosol transmission during extended close contact.³ In light of these important unanswered questions about transmission, we believe that further studies incorporating genomic analyses are necessary for a determination of clinically relevant nonhuman sources of leprosy. Therefore, we plan to genotype specimens obtained from our U.S. patients and others with autochthonous leprosy. Curtailing the transmission of leprosy should be prioritized in regions where it is endemic as well as in those where it is nonendemic, given the negative quality-of-life effect of this infection, which may be further exacerbated by delayed diagnosis.⁴

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Table 1. Environmental Reservoirs and Hosts of *Mycobacterium leprae* and *M. lepromatosis*.*

Reservoir or Host	<i>Mycobacterium</i> Species	Status†	Region
Water	<i>M. leprae</i>	Potential reservoir	Brazil and India
Soil	<i>M. leprae</i>	Potential reservoir	England, Bangladesh, India, and Suriname
Sphagnum with or without soil	<i>M. leprae</i>	Potential reservoir	Norway, Portugal, Brazil, Peru, United States, India, and Ivory Coast
Ameba (<i>Acanthamoeba castellanii</i> , <i>A. lenticulata</i> , <i>A. polyphaga</i> , <i>Hartmannella vermiformis</i>)	<i>M. leprae</i>	Potential vector	United States
Kissing bug (<i>Rhodnius prolixus</i>)	<i>M. leprae</i>	Potential experimental vector	
Hard tick (<i>Amblyomma sculptum</i>)	<i>M. leprae</i>	Potential experimental vector	
Hairy-tailed bolo mouse (<i>Necomys lasiurus</i>)	<i>M. leprae</i>	Host	Brazil
Roberto's spiny rat (<i>Proechimys roberti</i>)	<i>M. leprae</i>	Host	Brazil
Black rat (<i>Rattus rattus</i>)	<i>M. lepromatosis</i>	Unknown, PCR-positive	Mexico (unknown status) and Brazil (PCR-positive)
Margay (<i>Leopardus wiedii</i>)	<i>M. leprae</i>	PCR-positive	Brazil‡
Lowland tapir (<i>Tapirus terrestris</i>)	<i>M. leprae</i>	PCR-positive	Brazil‡
Water buffalo (<i>Bubalus bubalis</i>)	<i>M. leprae</i>	Potential host	Indonesia
Eurasian red squirrel (<i>Sciurus vulgaris</i>)	<i>M. leprae</i> , <i>M. lepromatosis</i>	Host	England and Wales (<i>M. leprae</i>); England, Scotland, and Ireland (<i>M. lepromatosis</i>)
Nine-banded armadillo (<i>Dasypus novemcinctus</i>)	<i>M. leprae</i>	Host	United States, Argentina, Brazil, Colombia, Mexico, and French Guiana
Six-banded armadillo (<i>Euphractus sexcinctus</i>)	<i>M. leprae</i>	Host	Brazil
Western chimpanzee (<i>Pan troglodytes verus</i>)	<i>M. leprae</i>	Host	Guinea-Bissau, Ivory Coast, and Sierra Leone‡
Sooty mangabey (<i>Cercocebus atys</i>)	<i>M. leprae</i>	Host	West Africa‡
Cynomolgus macaque (<i>Macaca fascicularis</i>)	<i>M. leprae</i>	Host	Philippines‡
Owl monkey (<i>Aotus trivirgatus</i>)	<i>M. leprae</i>	PCR-positive	Brazil
Tufted capuchin (<i>Sapajus apella</i>)	<i>M. leprae</i>	PCR-positive	Brazil

* Information in the table is from Schilling et al.,² Ploemacher et al.,³ and Lima et al.⁴ Experimental infections leading to systemic infection in nonimmunocompromised animals have occurred in the hedgehog (*Erinaceus europaeus*), Korean chipmunk (*Tamias sibiricus asiaticus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), Llanos long-nosed armadillo (*Dasypus sabanicola*), southern long-nosed armadillo (*D. hybridus*), white-handed gibbon (*Hylobates lar*), rhesus macaque (*Macaca mulatta*), and African green monkey (*Chlorocebus aethiops*).

† A status of polymerase chain reaction (PCR)-positive indicates that members of the species have been found to be PCR-positive for mycobacterium.

‡ Some of the known cases occurred in captivity, but it is assumed that the animals had been infected in the wild.

Since publication of their letter, the authors report no further potential conflict of interest.

- Sharma R, Singh P, Loughry WJ, et al. Zoonotic leprosy in the southeastern United States. *Emerg Infect Dis* 2015;21:2127-34.
- Truman RW, Singh P, Sharma R, et al. Probable zoonotic leprosy in the southern United States. *N Engl J Med* 2011;364:1626-33.

- Araujo S, Freitas LO, Goulart LR, Goulart IM. Molecular evidence for the aerial route of infection of *Mycobacterium leprae* and the role of asymptomatic carriers in the persistence of leprosy. *Clin Infect Dis* 2016;63:1412-20.

- Barcelos RMFM, de Sousa GS, de Almeida MV, Palacio FGL, Gaíva MAM, Ferreira SMB. Leprosy patients quality of life: a scoping review. *Rev Esc Enferm USP* 2021;55:e20200357.

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