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Address for correspondence: Attila D. Sándor, Department of Parasitology and Parasitic Diseases, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Calea Mănăştur 3-5, RO-400372, Cluj, Romania; email: adsandor@gmail.com

Serologic Survey of Plague in Animals, Western Iran

To the Editor: Plague has been one of the most devastating infectious diseases in human history. The etiologic agent, *Yersinia pestis*, primarily affects rodents and is usually transmitted to humans through infective flea bites. Endemic plague foci result from circulation of the plague bacillus in its rodent reservoir, the source of human plague cases (*1*). Carnivores such as dogs and foxes, which prey on rodents and eat their fresh carcasses, are valuable sentinel animals for plague serosurveillance in disease-endemic foci, although their infections are usually asymptomatic (*2*,*3*).

Plague epidemics have caused loss of human life in various parts of Iran. During 1947–1966 in western Iran, 9 human epidemics occurred and caused 156 deaths. The last case of human plague was reported in 1966 (*4*). Field investigations identified 4 *Meriones* rodent species as *Y pestis* reservoirs; 2 were resistant (*M. persicus* and *M. libycus*), and the other 2 (*M. tristrami* and *M. vinogradovi*) were susceptible to death from infection (*4*,*5*). The epidemiologic investigations demonstrated a 3–4 year plague epizootic cycle in Iran (*5*). The last official report of plague in rodents in Iran dates back to 1978, in Sarab County in the East Azarbaijan Province (*6*). Plague surveillance was ignored for more than 3 decades and then restarted in 2011 in Iran.

This study was designed to investigate plague among resident animals in western Iran, specificallyregion localities along the border between the Kurdistan and Hamadan Provinces, where plague in wildlife has been repeatedly reported (enclosed by 47.900° and 48.284° north latitude and 35.4616° and 35.7829° east longitude). The epidemiologic team was based at the Akanlu Research Center of the Pasteur Institute of Iran, in a village ≈100 km from Kabudar Ahang, Hamadan Province, at an altitude of ≈1,600 m. The study was conducted during June–September in 2011 and 2012. In 2011, a large area (2,000 km^2) was selected and, because only 1 *Y. pestis*–positive dog sample was found, in 2012, , the study area was reduced to 1,200 km^2 and confined to localities in which the *Y. pestis*–positive dog sample was identified the previous year; 3 additional *Y. pestis*–positive dogs and 1 *Y. pestis*–positive rodent were found in 2012.

The average number of traps used per night per locality was 13. A total of 46 rodents were entrapped from 26 localities in 998 traps (4.61% success) during the first year, and 52 rodents were captured in 30 localities in 1,164 traps (4.46% success) during the second year. They were mostly members of the *Meriones* genus, although a few *Microtus socialis irani* and 1 *Ellobius lutescens* rodents were also caught (Table). A total of 281 fleas were collected on 70.41% of trapped rodents (Table), corresponding to an average flea index of 4.10 for infested rodents. All fleas were *Xenopsylla* spp. ELISA was performed as described (*7*) to detect antibodies against *Y. pestis* F1 capsular antigen. Samples positive by ELISA were confirmed by using the inhibition ELISA method (*8*). Of 98 trapped rodents, 1 (1.02%) had IgG against F1 (Table), an *M. persicus* jird caught in 2012.

Sheepdogs that lived in the study areas were also used as sentinel animals. Blood samples were collected from 58 sheepdogs in 15 villages in 2011 and from 59 sheepdogs in 8 villages in 2012. Of 117 dog serum samples analyzed, 4 (3.42%) had IgG titers against F1, 1 in 2011 and the other 3 in 2012 (Table). Finally, wild animals such as jackals, foxes, rabbits, and hedgehogs were hunted in the study areas, and blood samples were taken immediately. None of the serum samples obtained from 3 foxes, 2 jackals, 8 rabbits, and 1 hedgehog had IgG against F1 (Table).

Because a well-established plague focus existed in Iranian Kurdistan, with animal cases occurring until 1978 (*9*), complete extinction of this focus is most unlikely. Our study demonstrates that animal reservoirs (*Meriones* rodents) and flea vectors (*Xenopsylla* spp.) shown to be central to the plague ecologic cycle in Iran still are found in high numbers in a previously active focus. The fact that 70% of trapped rodents were infested with fleas, with an average *Xenopsylla* spp. index of 4.10, may be considered as circumstances most favorable for the onset of plague epizootics. Furthermore, the detection of *Y. pestis*–specific IgG in 1.02% of trapped rodents and 3.42% of sentinel dogs is highly suggestive of active circulation of *Y. pestis* in its natural animal reservoir. Because *Y. pestis* antibodies last only for ≈6 months in dogs (*2*), seropositivity of these dogs indicates newly acquired infections.

This fact that *Y. pestis*–-positive animals were found over the 2-year surveillance period suggests that this area could be an active plague focus. Therefore, although no official reports of human plague in Iran have been made since 1966, this study indicates that the epidemiologic conditions needed to trigger an outbreak have been met. It is thus of utmost importance to maintain and strengthen the health system with plague surveillance in western Iran.

Table. Number of fleas and serum samples with *Yersinia pestis* F1 antibody collected from various animals during field investigations, Iran, 2011–2012*

Animal/species	No. serum samples	No. serum samples with antibodies against F1	No. fleas collected
Rodents			
2011			
Meriones persicus	39	0	33
Meriones vinogradovi	3	0	0
Microtus socialis irani	4	0	1
2012			
Meriones persicus	24	1	146
Meriones libycus	26	0	101
Microtus socialis irani	1	0	0
Ellobius lutescens	1	0	0
Total	98	1	281
Sheepdogs			
2011			
ND	58	1	ND
2012			
ND	59	3	ND
Total	117	4	
Miscellaneous			
Jackals			
2011			
Canis aureus	2	0	ND
2012			
C. aureus	0	0	ND
Foxes			
2011			
Vulpes vulpes	1	0	ND
2012			
V. vulpes	1	0	ND
Rabbits			
2011			
Lepus capensis	1	0	ND
2012			
L. capensis	7	0	ND
Hedgehogs			
2011	0	0	
ND			ND
2012	1	1	
ND			ND
Total	14	0	

*ND, not determined.

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Saber Esamaeili, Kayhan Azadmanesh, Saied Reza Naddaf, Minoarisoa Rajerison, Elisabeth Carniel, and Ehsan Mostafavi

Author affiliations: Pasteur Institute of Iran, Tehran, Iran (S. Esamaeili, K. Azadmanesh, S.R. Naddaf, E. Mostsfavi); Institut Pasteur of Madagascar, Antananarivo, Madagascar (M. Rajerison); and Institut Pasteur, Paris, France (E. Carmiel)

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Address for correspondence: Ehsan Mostafavi, No. 69, Pasteur Ave., Department of Epidemiology, Pasteur Institute of Iran, Postal Code: 1316943551, Tehran, Iran; email: mostafavi@pasteur.ac.ir

Livestock Density as Risk Factor for Livestock-associated MRSA, the Netherlands

To the Editor: We challenge the conclusions of Feingold et al. that "regional density of livestock is a notable risk factor for nasal carriage of LA-MRSA for persons with and without direct contact with livestock" (*1*). They did not study nasal carriage of methicillin-resistant *Staphylococcus aureus* (MRSA), but they retrospectively analyzed 87 culture-confirmed MRSA cases reported to a reference laboratory. These were a mixture of clinical disease isolates and screening (nose, throat, and perineum) isolates that were unevenly distributed between the groups (*2*). Because their analysis aimed to assess exposure risk by residential location, they should have excluded the 5 persons who acquired MRSA outside the Netherlands.

Table. Pig density in the Netherlands, United States (excluding Alaska), and major pig-producing states

Location	No. pigs	Area, km^2	Pig density, pigs/km^2	Relative pig density*
The Netherlands	12,100,000†	41,518	291.4	1
United States	67,500,000†	8,108,782‡	8.3	35.0
Iowa	19,700,000	145,744	135.2	2.2
North Carolina	8,600,000	139,393	61.7	4.7
Minnesota	7,600,000	225,174	33.8	8.6

*Pig density in the Netherlands divided by pig density in other locations.
†US data were obtained from a quarterly US Department of Agriculture report (http://usda01.library.cornell.edu/usda/nass/HogsPigs//2010s/2012/HogsPigs-09-28-2012.pdf).
‡Alaska was excluded because of minimal swine industry.

Retrospective case–control studies preclude direct estimation of incidence, prevalence, or risk. However, because of the symmetric property of odds ratios, disease odds ratios can be inferred indirectly from the estimated exposure odds ratios in case–control studies (*3*). However, this case–case study design has no true controls, precluding valid inferences of absolute or relative risks. The higher ratio of livestock-associated (LA)–MRSA to a typeable strain of MRSA (T-MRSA) in rural cases could be attributable to higher risk for LA-MRSA in rural areas, lower risk for T-MRSA in rural areas, or both.

To illustrate this point, suppose urban dwellers had equal prevalence rates of LA-MRSA and T-MRSA of 5%, and rural dwellers had prevalence rates of 2% for LA-MRSA and 1% for T-MRSA. The ratio approach used would indicate that rural dwellers had twice the risk for LA-MRSA than urban dwellers, when the absolute risk is 2.5 times higher in the urban group. At best, their conclusion could be viewed as a hypothesis that should be tested.

Three large community-based studies with better methods collectively refute this hypothesis. Across these studies, LA-MRSA prevalence (44%) was >180 times higher in 352 occupationally exposed persons than in 2,094 rural residents without farm exposure (0.24%) (*4–6*). Prevalence in family members of livestock workers was intermediate (5.2%). These consistent observations indicate that exposure to LA-MRSA in livestock-dense regions is a common occupational risk for livestock workers, a lesser indirect risk to their family members, and a negligible risk to persons without livestock or farm contact.

Finally, the contention of Feingold et al. that pig production in the Netherlands is "greatly overshadowed by the density of pig-farming operations in the United States" is mistaken (*1*) (Table). Pig density in the Netherlands is 35 times higher than in the United States, and more than twice that in Iowa.

Peter R. Davies, Bruce H. Alexander, Jeffrey B. Bender, John Deen, Catherine E. Dewey, Julie A. Funk, Claudia A. Munoz-Zanzi, M. Gerard O'Sullivan, Randall S. Singer, Srinand Sreevatsan, Katharina D. Stärk, and Mark A. Stevenson

Author affiliations: University of Minnesota College of Veterinary Medicine, St. Paul, Minnesota, USA (P.R. Davies, J.B. Bender, J. Deen, M.G. O'Sullivan, R.S Singer, S. Sreevatsan); University of Minnesota School of Public Health, Minneapolis, Minnesota, USA (B.H. Alexander, C. A. Munoz-Zanzi); Ontario Veterinary College, Guelph, Ontario, Canada (C.E. Dewey); Michigan State University College of Veterinary Medicine, East Lansing, Michigan, USA (J.A. Funk); Royal Veterinary College, London, United Kingdom (K.D. Stärk); and Massey University, Palmerston North, New Zealand (M.A. Stevenson)

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