

Serosurvey of Dogs for Human, Livestock, and Wildlife Pathogens, Uganda

To the Editor: Domestic dogs live in close association with humans and livestock, participating in the transmission of diseases of zoonotic, veterinary, and conservation interest (1,2). Most households in Uganda have traditionally kept dogs for hunting and for help with herding, security, and guarding livestock. Most dogs receive no prophylactic measures (e.g., vaccinations) and roam freely; this situation exposes them to pathogens from eating garbage, rodents, and stillborn animals and other carcasses and through inhalation during scent communication. Thus, dogs are a reservoir for

certain pathogens and a useful sentinel for others (3).

In 2011, serum samples were obtained from 116 mixed-breed dogs during a rabies vaccination campaign in and near 3 national parks in southwestern Uganda; the dogs were >4 months of age and were voluntarily brought in by their owners (Figure, Appendix, wwwnc.cdc.gov/EID/article/19/4/12-1143-F1.htm; Table). Two of the parks, Bwindi Impenetrable (BI) and Mgahinga Gorilla (MG), have some of the most biologically diverse tropical forests in eastern Africa and are home to mountain gorillas. The third park, Queen Elizabeth (QE), is home to populations of protected carnivores and ungulates. The parks lie within a densely populated rural landscape; in some areas, the population is as high as 500 persons/km².

Of the 116 sampled dogs, 4 had been vaccinated against rabies by the

authors in 2010 in QE (not included in rabies results), and 11 (all males) had been castrated by local animal healers before serum samples were obtained. The samples were used to test for seroprevalence rates to rabies virus (RABV), canine distemper virus (CDV), canine parvovirus (CPV), *Leptospira interrogans*, *Leishmania* sp., *Toxoplasma gondii*, and *Neospora caninum* (Table). Seroprevalence rates ranged from 20% to 100% (Table). CPV seroprevalence was higher in BI and QE than in MG ($\chi^2 \geq 12.6$, $p < 0.001$); *T. gondii* seroprevalence was higher in BI than in MG (Fisher $p = 0.002$); and RABV seroprevalence was higher in castrated than noncastrated dogs (50% vs. 10%; Fisher $p = 0.005$).

For humans, the domestic dog is the main source of exposure to RABV. The possibility that the presence of the rabies titers in the dog serum samples was due to a previous vaccination can

Table 1. Methodology and seroprevalence for selected pathogens in rural dogs in 3 national parks, Uganda, 2011*

Pathogen	Test, cutoff value, and (ref) or commercial kit	National park							
		All 3 parks		Queen Elizabeth†		Bwindi Impenetrable‡		Mgahinga Gorilla§	
		Sample size	Prevalence, % (95% CI)	Sample size	Prevalence, % (95% CI)	Sample size	Prevalence, % (95% CI)	Sample size	Prevalence, % (95% CI)
Rabies virus¶	FAVN, 0.24 IU/mL (4)	101	19.8 (12.7–28.6)	23	21.7 (9.0–43.3)	56	19.6 (11.0–32.0)	22	16.7 (5.9–37.2)
CDV	c-ELISA, Ingezim Moquillo IgG#	92	100.0 (95.9–100)	30	100 (88.8–100.0)	39	100 (91.4–100.0)	23	100 (85.4–100.0)
CPV	c-ELISA, Ingezim CPV#	92	65.2 (54.9–74.5)	26	80.8 (61.7–92.1)	43	76.7 (61.7–87.6)	23	26.1 (12.0–47.8)
<i>Leptospira interrogans</i> **	MAT, 1:200 (5)	105	26.7 (19.0–36.1)	27	25.9 (12.4–46.2)	55	29.1 (17.9–42.7)	23	21.7 (9.0–43.3)
<i>Leishmania</i> sp.††	c-ELISA, Ingezim Leishmania#	92	19.6 (12.3–29.2)	26	19.2 (7.9–38.3)	43	25.6 (14.6–40.6)	23	8.7 (1.6–27.8)
<i>Toxoplasma gondii</i>	MAT, 1:25 (3)	109	90.8 (83.6–95.1)	30	90.0 (73.7–97.2)	56	98.2 (90.5–99.9)	23	73.9 (52.2–88.0)
<i>Neospora caninum</i>	c-ELISA, 30% (3)	109	27.5 (19.6–36.6)	30	26.7 (13.1–45.0)	56	32.1 (21.2–45.5)	23	30.4 (14.5–52.2)

*ref, reference; FAVN, fluorescent antibody virus neutralization; CPV, canine parvovirus; c-ELISA, competitive ELISA; CDV, canine distemper virus; MAT, modified agglutination test.

†0° 12' S, 30° 0' E (savannah).

‡1° 0' S, 29° 42' E (tropical forest).

§1° 16' S, 29° 40' E (tropical forest).

¶Four dogs vaccinated against rabies in Queen Elizabeth are not included in these results.

#Manufactured by Ingenasa, Madrid, Spain.

**Fourteen serovars were investigated. Of the dogs seropositive, 71.5% were seropositive to 1 serovar and 28.5% to 2 serovars. Reacting serovars were Icterohaemorrhagiae (42.8% of positive dogs), Canicola (39.2%), Pyrogenes (21.4%), Tarassovi (10.7%), and Gryppothiposa and Australis (7.2% each).

††Antibodies probably correspond to contact with *Leishmania donovani*.

be ruled out because the only previous recent campaign in the area was conducted by the authors. Antibodies against RABV in apparently healthy dogs have been reported in Africa (6), and rabies seems to be not invariably fatal in dogs. Dogs that have recovered from a rabies infection are prone to shed RABV in their saliva for long periods (7). Antibodies against RABV were more frequently found in castrated dogs. This finding may be due to an increase in virus-related deaths among noncastrated dogs; such dogs tend to be more aggressive and to roam, so they may come more frequently into contact with pathogenic RABV strains.

Results indicate that both CDV and CPV are actively circulating in the studied dog populations. High CDV seroprevalence rates have been reported among other rural dog populations in Africa (8). Sick, debilitated pups are at high risk for predation by wild carnivores, so spillover may take place. A dog population exhibiting similar characteristics to the population we studied was believed to be the origin of the 1994 CDV epidemic among Serengeti wildlife (8). Furthermore, carnivores use feces for scent communication, so the probability of infection by CPV in wild carnivores in the study area may also be high.

In developing countries, leptospirosis is emerging as a major public health problem and also causes enormous economic losses because of disease in livestock (9). The most commonly detected serovars in this study were those that have rats and dogs as reservoirs (Table). Visceral leishmaniasis in humans is also a major health problem in several areas of eastern Africa, where the number of cases has dramatically increased during the past 20 years. Transmission of *Leishmania donovani* in eastern Africa may take place through anthroponotic or zoonotic cycles, although, to our knowledge, no reservoir host had been identified (10).

The mean *T. gondii* seroprevalence detected during this survey appears to

be the highest reported for dogs worldwide. This protozoon has implications for human and animal health, and dogs, who probably become infected with *T. gondii* when eating raw meat, are a good sentinel for environmental contamination by this parasite. On the other hand, dogs serve as the definitive host for *N. caninum*, which is a major cause of abortions in cattle and causes economic losses wherever it is enzootic.

Some of these diseases may also have implications for the conservation of endangered mountain gorillas. Diseases such as leptospirosis, toxoplasmosis, and especially, rabies could be fatal for gorillas, and there are unpublished reports of fights between hunting dogs and gorillas.

Our work should serve as a first step toward the establishment of preventive strategies for improvements in the health of humans and domestic animals living in rural Uganda and for the health of the country's unique wildlife. Tracing the role of dogs in the cycle of the studied pathogens is crucial for the design of control programs.

Acknowledgments

We thank Steven Rubanga, Abdulhameed Kateregga, and all the staff of Conservation through Public Health; the Mgahinga Community Development Organization; Martin Esau; District Veterinary Officers from Kanungu, Kasese, and Kisoro local governments; and Vicky Ticó for help with field work. We are indebted to Ingenasa for contributing to this study by freely providing the ELISA kits.

This study received partial support from project CGL2010-17931. We are grateful to the John D. and Catherine T. MacArthur Foundation and the United States Agency for International Development (through the Wildlife Conservation Society) for providing financial support to the Conservation Through Public Health team during this study.

J.M. holds a Ramón y Cajal fellowship awarded by the Spanish MICINN and the European Social Fund.

Javier Millán, Andrea D. Chirife, Gladys Kalema-Zikusoka, Oscar Cabezón, Jesús Muro, Ignasi Marco, Florence Cliquet, Luis León-Vizcaíno, Marine Wasniewski, Sonia Almería, and Lawrence Mugisha

Author affiliations: Universitat Autònoma de Barcelona, Bellaterra, Spain (J. Millán, A.D. Chirife, O. Cabezón, I. Marco, S. Almería); Conservation through Public Health, Kampala, Uganda (G. Kalema-Zikusoka); Ministry of Agriculture, Andorra la Vella, Andorra (J. Muro); Nancy Laboratory for Rabies and Wildlife, Malzéville, France (F. Cliquet, M. Wasniewski); University of Murcia, Murcia, Spain (L. León-Vizcaíno); Centre de Recerca en Sanitat Animal, Bellaterra, Spain (S. Almería); Makerere University, Kampala (L. Mugisha); and Conservation and Ecosystem Health Alliance, Kampala (L. Mugisha)

DOI: <http://dx.doi.org/10.3201/eid1904.121143>

References

1. Baker PJ, Soulsbury CD, Iossa G, Harris S. Domestic cat (*Felis catus*) and domestic dog (*Canis familiaris*). In: Gehrt SD, Riley SPD, Cypher BL, editors. Urban carnivores: ecology, conflict, and conservation. Baltimore (MD): The John Hopkins University Press; 2010. p. 157–72.
2. Butler JRA, Bingham J. Demography and dog-human relationships of the dog population in Zimbabwean communal lands. *Vet Rec.* 2000;147:442–6. <http://dx.doi.org/10.1136/vr.147.16.442>
3. Cabezón O, Millán J, Gomis M, Dubey JP, Ferroglio E, Almería S. Kennel dogs as sentinels of *Leishmania infantum*, *Toxoplasma gondii*, and *Neospora caninum* in Majorca Island, Spain. *Parasitol Res.* 2010;107:1505–8. <http://dx.doi.org/10.1007/s00436-010-2015-7>
4. Cliquet F, Sagne L, Schereffer JL, Aubert MF. ELISA test for rabies antibody titration in orally vaccinated foxes sampled in the fields. *Vaccine.* 2000;18:3272–9. [http://dx.doi.org/10.1016/S0264-410X\(00\)00127-4](http://dx.doi.org/10.1016/S0264-410X(00)00127-4)
5. Dikken H, Kmety E. Serological typing methods of leptospire. *Methods Microbiol.* 1978;11:259–307. [http://dx.doi.org/10.1016/S0580-9517\(08\)70493-8](http://dx.doi.org/10.1016/S0580-9517(08)70493-8)
6. Mebatsion T, Sillero-Zubiri C, Gottelli D, Cox JH. Detection of rabies antibody by ELISA and RFFIT in

- unvaccinated dogs and in the endangered Simien jackal (*Canis simensis*) of Ethiopia. *Journal of Veterinary Medicine Series B*. 1992;39:233–5. <http://dx.doi.org/10.1111/j.1439-0450.1992.tb01162.x>
7. Zhang YZ, Fu ZF, Wang DM, Zhou JZ, Wang ZX, Lv TF, et al. Investigation of the role of healthy dogs as potential carriers of rabies virus. *Vector Borne Zoonotic Dis*. 2008;8:313–20. <http://dx.doi.org/10.1089/vbz.2007.0209>
 8. Cleaveland S, Appel MGJ, Chalmers WSK, Chillingworth C, Kaare M, Dye C. Serological and demographic evidence for domestic dogs as a source of canine distemper virus infection for Serengeti wildlife. *Vet Microbiol*. 2000;72:217–27. [http://dx.doi.org/10.1016/S0378-1135\(99\)00207-2](http://dx.doi.org/10.1016/S0378-1135(99)00207-2)
 9. Evangelista KV, Coburn J. *Leptospira* as an emerging pathogen, a review of its biology, pathogenesis and host immune responses. *Future Microbiol*. 2010;5:1413–25. <http://dx.doi.org/10.2217/fmb.10.102>
 10. Kolaczinski JH, Reithinger R, Worku DT, Ocheng A, Kasimiro J, Kabatereine N, et al. Risk factors of visceral leishmaniasis in east Africa, a case-control study in Pokot territory of Kenya and Uganda. *Int J Epidemiol*. 2008;37:344–52. <http://dx.doi.org/10.1093/ije/dym275>

Address for correspondence: Javier Millán, Servei d'Ecopatologia de Fauna Salvatge (SEFaS) (Wildlife Diseases Research Group), Departament de Medicina i Cirurgia Animals, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain; email: syngamu@trachea.com

Iatrogenic Creutzfeldt-Jakob Disease from Commercial Cadaveric Human Growth Hormone

To the Editor: Iatrogenic Creutzfeldt-Jakob disease (iCJD) is an acquired form of prion disease that has been declining in incidence since the mid-1990s (1). Worldwide, at least 226 cases of iCJD, including 29 US cases, have been associated with administration of contaminated

human growth hormone (hGH) from cadavers. Reported incubation periods ranged from 5 to 42 years (mean 17 years) (2). Commercially produced cadaveric hGH has been associated with only 1 previously reported case of iCJD: CJD developed in a 39-year-old Austrian man \approx 22 years after he received commercial cadaveric hGH (Crescormon, Kabivitrüm, Stockholm, Sweden) during 1984–1985 (3). We report a second case of probable iCJD acquired through treatment with commercial cadaveric hGH.

The patient was born at 32 weeks' gestation with subsequent developmental delay, agenesis of the corpus callosum, and panhypopituitarism. He demonstrated clinical and laboratory signs of growth hormone deficiency but was denied treatment with hGH through the US government-supported National Hormone and Pituitary Program (NHPP) because he did not meet the height requirement. Treatment with commercial cadaveric hGH began when he was 5.8 years of age and continued for 23 months (1983–1985). He received 1.5 units intramuscularly 3 \times per week and was primarily treated with Asellacrin (Ares-Serono, Geneva, Switzerland). In early 1984, for an unspecified duration, he received Crescormon (Kabivitrüm) because of an Asellacrin shortage. Treatment was halted in 1985 because of iCJD concerns and resumed 2 years later with recombinant hGH.

At age 33, 26.5 years (range 25.5–28 years) after the midpoint of commercial cadaveric hGH treatment, dizziness and gait imbalance developed, causing a fall. The patient's mental status also began declining, and he never returned to his baseline status. Six months after illness onset, he experienced hallucinations, weakness of lower extremities, and limb ataxia. Seven months after the fall, he entered a state of akinetic mutism; he died 9 months after symptom onset. A lumbar puncture,

performed 8 months after illness onset, demonstrated 14-3-3 proteins and an elevated cerebrospinal fluid (CSF) tau level of 14,111 pg/mL (decision point 1,150 pg/mL) (4), although the specimen was contaminated with blood (39,375 erythrocytes/ μ L). Electroencephalogram demonstrated severe diffuse encephalopathy. Two brain magnetic resonance imaging studies performed 8 months after illness onset indicated probable CJD, given lack of prior metabolic and anoxic insults (Figure). The patient was discharged from a referral hospital with this diagnosis; no postmortem analysis was conducted.

On the basis of World Health Organization criteria, we conclude that this patient had probable iCJD as a result of hGH treatment (5). The patient's condition was treated with 2 different formulations of commercial cadaveric hGH, including one of the same brands in the same year as that of the first reported patient with iCJD associated with commercial cadaveric hGH (3). The patient's incubation period (25.5–28 years) is well within expectations (1).

Despite an ongoing active surveillance program that identified \approx 3,500 of \approx 4,500 post-1977 cadaveric hGH recipients in the US NHPP, all 29 CJD infections in NHPP recipients occurred among the estimated \approx 2,700 pre-1977 recipients (1,2). This significant reduction in iCJD was attributed to the 1977 introduction of a highly selective, column chromatography step in the hormone purification protocol that can markedly reduce prion infectivity (1,2). As shown by the many iCJD cases linked to hGH in France, the efficacy of column chromatography purification steps may vary (1). Commercially derived cadaveric hGH was produced in different laboratories from those that produced NHPP-distributed hGH, and sufficient details regarding sourcing and production methods of