established between a toxigenic isolate cultured from a woman with clinical diphtheria and the same organism cultured from her asymptomatic cat (*2*). Toxigenic and nontoxigenic isolates of *C. diphtheriae* have been reported to cause the cutaneous form of this disease (*10*).

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References

1. Wagner KS, White JM, Crowcroft NS, De Martin S, Mann G, Efstratiou A. Diphtheria in the United Kingdom, 1986–2008: the increasing role of *Corynebacterium ulcerans.* Epidemiol Infect. 2010; 138:1519–30. http://dx.doi.org/10.1017/S0950268810001895
2. Berger A, Huber I, Merbecks S-S, Konrad R, Hormansdorfer S, Hogardt M, et al. Toxigenic *Corynebacterium ulcerans* in woman and cat. Emerg Infect Dis. 2011;17:1767–9. http://dx.doi.org/10.3201/eid1709.110391
3. Bergin IL, Chien C-C, Marini RP, Fox JG. Isolation and characterization of *Corynebacterium ulcerans* from cephalic implants in macaques. Comp Med. 2000;50:530–5.
4. Venezia J, Cassiday PK, Marini RP, Shen Z, Buckley EM, Peters Y, et al. Characterization of *Corynebacterium* species in macaques. J Med Microbiol. 2012;61:1401–8. http://dx.doi.org/10.1099/jmm.0.045377-0
5. Dewhirst FE, Chen T, Izard J, Paster BJ, Tanner ACR, Yu W-H, et al. The human oral microbiome. J Bacteriol. 2010;192:5002–17. http://dx.doi.org/10.1128/JB.00542-10
6. Khamis A, Raoult D, La Scola B. rpoB gene sequencing for identification of *Corynebacterium* species. J Clin Microbiol. 2004;42:3925–31. http://dx.doi.org/10.1128/JCM.42.9.3925-3931.2004
7. Schuhegger R, Lindermayer M, Kugler R, Heesemann J, Busch U, Sing A. Detection of toxigenic *Corynebacterium diphtheriae* and *Corynebacterium ulcerans* strains by a novel real-time PCR. J Clin Microbiol. 2008;46:2822–3. http://dx.doi.org/10.1128/JCM.01010-08
8. Funke G, Frodi R, Bernard KA. *Corynebacterium mustelae* sp. nov., isolated from a ferret with lethal sepsis. Int J Syst Evol Microbiol. 2010;60:871–3. http://dx.doi.org/10.1099/ijs.0.010942-0
9. Corti MAM, Bloemberg GV, Borelli S, Kutzner H, Eich G, Hoelzle L, et al. Rare human skin infection with *Corynebacterium ulcerans*: transmission by a domestic cat. Infection. 2012;40:575–8. http://dx.doi.org/10.1007/s15010-012-0254-5
10. Gordon CL, Fagan P, Hennessy J, Baird R. Characterization of *Corynebacterium diphtheriae* isolates from infected skin lesions in the Northern Territory of Australia. J Clin Microbiol. 2011;49:3960–2. http://dx.doi.org/10.1128/JCM.05038-11

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Bat Lyssaviruses, Northern Vietnam

To the Editor: Bats have been associated with a wide diversity of viruses, including lyssaviruses, which can cause rabies. Currently, 12 distinct species of lyssaviruses have been classified worldwide; 3 of these were isolated from bats in northern and central Asia (*1*). In addition, 3 putative novel bat lyssaviruses (Boklob, Ikoma, and Leida) have recently been described and are awaiting taxonomic assessment (*1*,*2*). Surveys for lyssaviruses in bat reservoirs in several countries in Southeast Asia, such as the Philippines, Cambodia, and Thailand, showed that bat lyssaviruses are naturally circulating in insectivorous and frugivorous bats (*3*–*5*).

Rabies is endemic to Vietnam, and ≈100 human deaths caused by rabies are reported annually; most are attributable to canine rabies (*6*). Although bat-associated rabies cases have not been reported in humans or animals in Vietnam, this finding might be caused by lack of a suitable reporting system. The limited understanding of the extent of lyssavirus circulation in Vietnam and its potential effect on public and animal health prompted this surveillance study.

This study was approved by the ethics committee of The National Institute of Hygiene and Epidemiology, and all capture and experimental procedures complied with institute guidelines for bat capture and use. During May–September 2011, a total of 926 bats were collected from 6 northern provinces in Vietnam (online Technical Appendix Figure, wwwnc.cdc.gov/EID/article/20/1/13-0813-Techapp1.pdf). Bats were classified by using a gross morphology key (*7*). Blood and brain samples were obtained after anesthetizing bats by intramuscular injection with 0.05–0.1 mg ketamine hydrochloride.

All bat brains were tested for lyssavirus by using reverse transcription

PCR (*8*) and for lyssavirus antigens by using a direct fluorescence antibody test (*9*) using fluorescein isothiocyanate–conjugated monoclonal antibodies (Fujirebio Diagnostic, Inc, Malvern, PA, USA). The mouse inoculation test was conducted by using brains of 13 bats that died during capture and transport (*9*).

A total of 789 bat serum samples were of sufficient quality and quantity to be screened for neutralizing antibodies against rabies virus (RABV) strain CVS-11, European bat lyssavirus-1 (EBLV-1), and Duvenhage virus (DUVV). We also tested for neutralizing antibodies against Lagos bat virus (LBV) and Mokola virus in 535 samples by using a modified rapid fluorescent focus inhibition test (*10*). A sample was defined as positive for neutralizing antibodies if at a serum dilution of 1:10 a ≥90% reduction was observed in the number of infectious fields in comparison with the virus control.

All 926 bats collected were identified to 25 species. Of these species, 23 were Microchiropteran species and 2 were Megachiropteran species (Table). None of the 926 bat brain samples showed evidence of lyssavirus antigens or virus RNA by direct fluorescence antibody test and reverse transcription PCR, respectively. No virus was isolated by the mouse inoculation test.

Of the 789 bat serum samples tested, 193 (24.5%) were positive for neutralizing antibodies against lyssaviruses. Ninety (11.4%) of 789 bat serum samples had neutralizing antibodies against RABV, 71 (9.0%) against DUVV, 142 (18.0%) against EBLV-1, and 4 (0.75%) against LBV. No bat serum was positive for neutralizing antibodies against Mokola virus. Neutralizing antibodies against the 5 lyssavirus genotypes tested were found in 16 Microchiropteran and 1 Megachiropteran species (Table).

Of the 193 serum samples positive for neutralizing antibodies against lyssaviruses, 65 (33.7%) also neutralized ≥1 of the remaining viruses tested. Twenty-five samples that were positive for RABV were negative for the other viruses; 103 samples were negative for RABV but positive for ≥1 of EBLV-1, DUVV, and LBV. Different titers of neutralizing antibodies against different lyssaviruses were found in some bats (online Technical Appendix Table).

This study provides serologic evidence of lyssavirus-neutralizing antibodies in bats in northern Vietnam. Because no virus was isolated, we could not conclude to which virus or viruses these bats had been exposed. Positive results for antibodies to multiple lyssaviruses, including RABV, found in some bats might have been caused by cross-neutralization of other viruses. The absence of consistent reactivity patterns suggests exposure of these bats to the tested lyssaviruses

Table. Screening of bat serum samples for neutralizing antibodies against lyssaviruses, northern Vietnam*

Bat species (no.captured)	Virus strains				Total, no. positive/no. tested†
	RABV	DUVV	EBLV-1	LBV	
Microchiropteran				0	NA
Aselliscus stoliczkanus (45)	0	0	1	0	1/29
Hipposideros alongensis sungi (19)	0	3	2	0	5/16
Hipposideros armiger (11)	0	0	3	0	3/9
Hipposideros larvatus (138)	26	55	53	0	63/126
Hypsugo sp. 1 (16)	0	0	3	0	3/12
Hypsugo sp. 2 (17)	0	7	2	0	7/15
Ia io (46)	4	1	6	0	8/44
Miniopterus cf. *fuliginosus* (27)	0	0	2	0	2/23
Miniopterus sp. (13)	0	0	0	0	0/10
Myotis sp. 1 (13)	1	0	2	0	3/8
Myotis sp. 2 (11)	0	0	0	0	0/9
Pipistrellus sp. (19)	0	0	0	0	0/10
Rhinolophus affinis (11)	0	0	0	0	0/7
Rhinolophus cf. microglobosus (40)	0	1	2	0	2/34
Rhinolophus cf. *pearsonii* (21)	0	0	0	0	0/16
Rhinolophus cf. *pusillus* (9)	0	0	0	0	0/6
Rhinolophus macrotis (large) (18)	0	0	0	0	0/14
Rhinolophus macrotis (small) (16)	0	3	1	0	3/6
Rhinolophus pusillus (24)	0	1	2	0	2/19
Tadarida plicata (65)	17	0	9	1	19/55
Taphozous cf. *melanopogon* (223)	9	0	22	0	22/203
Taphozous sp. (25)	0	0	1	0	1/19
Taphozous theobaldi (74)	30	0	31	3	45/74
Megachiropteran					NA
Eonycteris spelaea (9)	3	0	1	0	4/9
Rousettus sp. (16)	0	0	0	0	0/16
Total	90	71	142	4	193/789
No. positive/no. tested (%)	90/789 (11.4)	71/789 (9)	142/789 (18)	4/535 (0.75)	193/789 (24.5)

*RABV, rabies virus CVS 11; DUVV, Duvenhage virus; EBLV-1, European bat lyssavirus-1; LBV, Lagos bat virus; NA, not applicable.
†Values in rows may be higher than those in the total because of reactivity of individual serum samples against >1 lyssavirus.

or another unknown lyssavirus. These findings are similar to findings reported from other parts of Asia (*3*–*5*).

Information on lyssavirus circulation in bat populations in Vietnam should be made available to public health authorities, clinicians, and the general public to increase awareness of the risk for rabies transmission from bats; improve recognition, documentation, and reporting of bat exposure to rabies surveillance systems; and increase consideration of the need for post exposure prophylaxis after receiving a bat bite. Our data suggest that several lyssaviruses are circulating among bats in northern Vietnam, and a substantial proportion have neutralizing antibodies to RABV. Further investigations are required, particularly of sick and dying bats, to determine the implications of these findings for human health.

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References

1. World Health Organization. WHO expert consultation on rabies: second report [cited 2013 Jul 30]. http://apps.who.int/iris/bitstream/10665/85346/1/9789241209823_eng.pdf
2. Aréchiga Ceballos N, Vázquez Morón S, Berciano JM, Nicolás O, Aznar López C, Juste J, et al. Novel lyssavirus in bat, Spain. Emerg Infect Dis. 2013;19:793–5. http://dx.doi.org/10.3201/eid1905.121071
3. Reynes JM, Molia S, Audry L, Hout S, Ngin S, Walston J, et al. Serologic evidence of lyssavirus infection in bats, Cambodia. Emerg Infect Dis. 2004;10:2231–4. http://dx.doi.org/10.3201/eid1012.040459
4. Arguin PM, Murray-Lillibridge K, Miranda ME, Smith JS, Calaor AB, Rupprecht CE. Serologic evidence of lyssavirus infections among bats, the Philippines. Emerg Infect Dis. 2002;8:258–62. http://dx.doi.org/10.3201/eid0803.010330
5. Lumlertdacha B, Boongird K, Wanghongsa S, Wacharapluesadee S, Chanhome L, Khawplod P, et al. Survey for bat lyssaviruses, Thailand. Emerg Infect Dis. 2005;11:232–6. http://dx.doi.org/10.3201/eid1102.040691
6. Nguyen TT, Hoang VT, Nguyen TH. Epidemiology of rabies in Vietnam, 2009–2011 [in Vietnamese]. Journal of Preventive Medicine. 2013;7:29–37.
7. Csorba G, Ujhelyi P, Thomas N. Horseshoe bats of the world (Chiroptera: Rhinolophidae). Shrewsbury (MA): Alana Books; 2003. p. 25–28.
8. Dantas Junior JV, Kimura LM, Ferreira MS, Fialho AM, Almeida MM, Grégio CR, et al. Reverse transcription–polymerase chain reaction assay for rabies virus detection. Arquivo Brasiliero de Medicina Veterinária e Zootecnia. 2004;56:398–400. http://dx.doi.org/10.1590/S0102-09352004000300017
9. Meslin FX, Kaplan MM, Koprowski H, editors. Laboratory techniques in rabies. 4th ed. Geneva: World Health Organization; 1996. p. 80–95.
10. Kuzmin IV, Niezgoda M, Franka R, Agwanda B, Markotter W, Beagley JC, et al. Lagos bat virus in Kenya. J Clin Microbiol. 2008;46:1451–61. http://dx.doi.org/10.1128/JCM.00016-08

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Co-Production of NDM-1 and OXA-232 by *Klebsiella pneumoniae*

To the Editor: New Delhi metallo-β-lactamase 1 (NDM-1) and OXA-48-group β-lactamase have been increasingly reported as carbapenemases responsible for carbapenem resistance in *Enterobacteriaceae* worldwide (*1*). However, in the United States, *Klebsiella pneumoniae* carbapenemase (KPC)–type β-lactamase is the most common carbapenemase among *Enterobacteriaceae*, especially *K. pneumoniae*. Isolates producing NDM-1 were first reported in the United States in 2010 (*2*), followed by several case reports and most recently a hospital outbreak in Colorado (*3*–*6*). As for OXA-48-group β-lactamase, 2 cases of infection with OXA-48–producing *K. pneumoniae* were recently reported from Virginia (*7*). We report *K. pneumoniae* co-producing NDM-1 and OXA-232, a variant of OXA-48, and *Escherichia coli* producing NDM-1 that were isolated from the same patient.

A 69-year-old woman was hospitalized in India for subarachnoid hemorrhage in January 2013. Her hospitalization was complicated by unsuccessful coil embolization and subsequent hydrocephalus. A ventriculoperitoneal shunt was inserted, and she was transferred to an acute care hospital in Pittsburgh, Pennsylvania, USA, for further management in February 2013. She underwent reinsertion of the shunt and was discharged to a long-term care facility (LTCF 1). She was readmitted to the same hospital because of fever in March 2013.

A urine culture collected at the time of readmission grew carbapenem-resistant *K. pneumoniae* and extended-spectrum β-lactamase–producing *E. coli*. Although production of KPC-type β-lactamase was initially suspected in *K. pneumoniae*, the unusually

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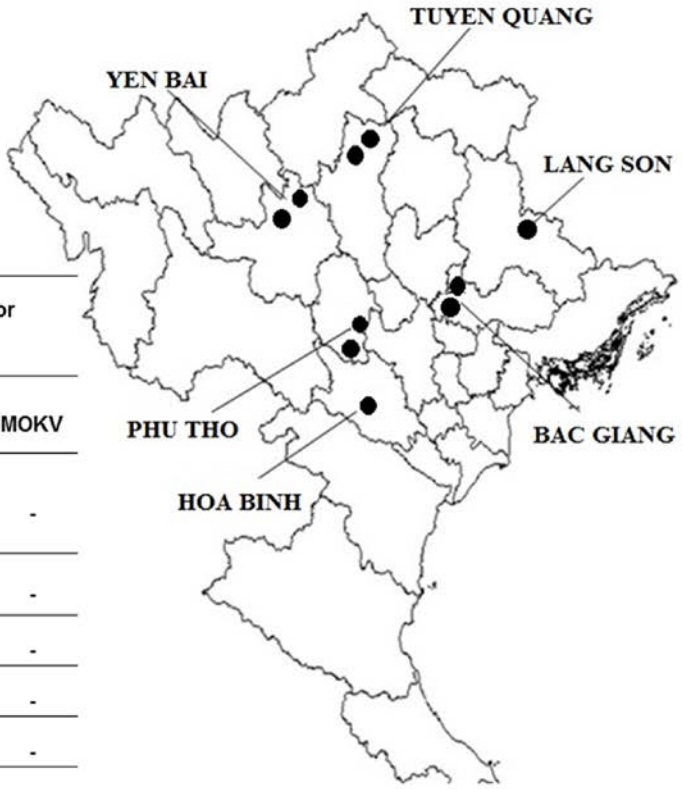
Technical Appendix

Technical Appendix Table. Neutralization antibody titers against lyssaviruses in bats, by bat species and location, northern Vietnam*

Location	Bat species	Neutralizing antibody titer†			
		RABV	DUVV	EBLV-1	LBV
Tuyen Quang	*Eonycteris spelaea*	20	0	0	0
	Eonycteris spelaea	0	0	20	0
	Ia Io	20	0	0	0
	Ia Io	0	20	0	0
	Ia Io	0	20	0	0
	Ia Io	10	0	20	0
	Ia Io	10	10	40	0
Lang Son	*Taphozous* cf. *melanopogon*	20	0	10	0
	Taphozous cf. *melanopogon*	10	0	20	0
	Taphozous cf. *melanopogon*	10	0	20	0
	Taphozous cf. *melanopogon*	0	0	20	0
	Taphozous cf. *melanopogon*	10	0	20	0
	Tadarida plicata	20	0	40	0
	Tadarida plicata	0	0	20	0
Bac Giang	*Taphozous theobaldi*	10	0	20	10
	Taphozous theobaldi	20	0	40	0
	Taphozous theobaldi	0	0	20	10
	Taphozous theobaldi	20	0	0	0
	Taphozous theobaldi	0	0	0	10
	Taphozous theobaldi	20	0	40	0
	Taphozous theobaldi	0	0	20	0
	Taphozous theobaldi	0	0	0	10
	Tadarida plicata	20	0	10	0
Phu Tho	*Hipposideros larratus*	0	0	0	0
	Hipposideros larratus	20	10	40	0
	Hipposideros larratus	10	20	0	0
	Rhinolophus macrotis (small)	0	0	20	0
Hoa Binh	*Taphozous* cf. *melanopogon*	20	0	40	0
	Taphozous cf. *melanopogon*	0	0	20	0

*RABV, rabies virus; DUUV, Duvenhage virus; EVLV-1, European bat lyssavirus-1; LBV, Lagos bat virus.
†Titer of neutralizing antibodies was calculated as the initial serum volume plus an equal volume of challenge virus that showed ≥90% reduction in number of infectious fields compared with virus control.

Place of bat collection	Bat serum samples positive for neutralizing antibodies				
	RABV	DUVV	EBLV-1	LBV	MOKV
Tuyen Quang	+	+	+	-	-
Yen Bai	+	+	+	-	-
Lang Son	+	-	+	-	-
Bac Giang	+	-	+	+	-
Phu Tho	+	+	+	-	-
Hoa Binh	+	-	+	-	-



Technical Appendix Figure. Bat collection sites and serum samples tested for lyssavirus, northern Vietnam. RABV, rabies virus; DUUV, Duvenhage virus; EBLV-1, European bat lyssavirus-1; LBV, Lagos virus; MOKV, Mokola virus; +, positive; –, negative.