with not buying live poultry in 2010 (OR 0.34, 95% CI 0.19–0.60).

In contrast, rates of touching poultry during buying (5%) were unchanged (Table). Using a standardized estimate (*5*), we determined that purchasing households bought on average 11.4 live chickens/household/year in 2010 versus 14.4 in 2006 (Table). Purchase rate × touch rate gave an estimated average of 0.57 exposures/household/year in 2010, a 21% decline from 0.72 exposures/household/year in 2006 (p = 0.011) (Table).

Substantial improvement was noted for most personal hygiene practices, except frequencies for daily handwashing and covering the mouth when sneezing or coughing were each lower in 2010 than in 2006 (Table). Changed hygiene practices were independent of demographic factors except that male respondents more often reported less covering of the mouth when sneezing or coughing (OR 1.60, 95% CI 1.00–2.56) and less use of liquid soap for handwashing (OR 1.64, 95% CI 1.04–2.60); immigrants were more likely to have reduced daily handwashing frequency (OR 1.58, 95% CI 1.04–2.41). Only perceived declining worry about contracting avian influenza was significantly associated with declining frequency of handwashing after sneezing, coughing, or touching the nose (OR 1.61, 95% CI 1.04–2.47).

The 21% decline in exposure from less buying, but not touching, of live poultry suggests that limiting poultry availability, but not health education efforts, was responsible. Perceptions of avian influenza risk and worry also mostly declined, as did frequency of some personal hygiene practices, including handwashing, particularly among younger male and immigrant respondents. Although our previous studies suggest that public health education might have contributed to an ≈43% reduction in rate of touching when buying live poultry in Hong Kong from 2004 to 2006 (*5*,*6*), the prolonged warning that a future pandemic is likely to be sparked by influenza A (H5N1) viruses is likely to cause pandemic fatigue in the public and therefore would not change their perception of avian influenza risk and associated protective behavior. As exposure risk has declined (as a result of government policy), so has perceived infection risk also declined, paradoxically increasing population vulnerability to other influenza viruses through reductions in preventive hygiene behavior.

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References

1. Sims LD, Ellis TM, Liu KK, Dyrting K, Wong H, Peiris M, et al. Avian influenza in Hong Kong 1997–2002. Avian Dis. 2003;47:832–8. doi:10.1637/0005-2086-47.s3.832
2. Lau EH, Leung YH, Zhang LJ, Cowling BJ, Mak SP, Guan Y, et al. Effect of interventions on influenza A (H9N2) isolation in Hong Kong's live poultry markets, 1999–2005. Emerg Infect Dis. 2007;13:1340–7.
3. Government of Hong Kong; Agriculture, Fisheries and Conservation Department. Press releases [cited 2010 Dec 22]. http://www.afcd.gov.hk/english/publications/publications_press/publications_press.html
4. Government of Hong Kong. Prevention of avian influenza (press releases) [cited 2010 Dec 22]. http://www.info.gov.hk/info/flu/eng/news.htm
5. Fielding R, Bich TH, Quang LN, Lam WW, Leung GM, Tien TQ, et al. Live poultry exposure, Hong Kong and Hanoi, 2006. Emerg Infect Dis. 2007;13:1065–7.
6. Liao Q, Lam WW, Jiang CQ, Ho EY, Liu YM, Zhang WS, et al. Avian influenza risk perception and live poultry purchase in Guangzhou, China, 2006. Risk Anal. 2009;29:416–24. doi:10.1111/j.1539-6924.2008.01157.x
7. Hong Kong Census and Statistics Department. Statistical tables of the 2006 population by census [cited 2011 Jul 12]. http://www.bycensus2006.gov.hk/en/data/data3/index.htm

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Bat Rabies and Human Postexposure Prophylaxis, New York, USA

To the Editor: The New York State Department of Health (NYSDOH) assessed the effect of terrestrial rabies on human postexposure prophylaxis (PEP) during the first 10-year period of computerized reporting (1993–2002) (*1*). We assessed the effect of bat rabies during the same period, when guidelines for PEP were changing (*2*). NYSDOH developed local health department and public education programs to reduce bat encounters, increase testing of bats involved in

encounters, and improve reporting of bat encounters (*3*).

Use of PEP for all New York counties was included in the study; PEP in New York, New York, and from other states was excluded. Analyses of reasonable probability exposures, age, and sex were conducted for 1998–2002. Population data from 2000 (www.factfinder.census.gov) were used to calculate rates. Epi Info (Centers for Disease Control and Prevention, Atlanta, GA, USA) and SAS (SAS Institute, Cary, NC, USA) were used for χ^2 statistical analyses. We considered p values ≤ 0.05 significant.

During 1993–2002, a total of 6,320 bat-associated rabies exposure incidents and 11,365 PEPs were reported (Table). Incidents increased 7-fold, and use of PEP increased 9-fold. More than three quarters of all incidents were reported in June, July, and August. The number of persons who received PEP per incident ranged from 1 to 40, with an increase in mean from 1.3 to 1.8.

Nonbite exposures (scratch, direct and indirect contact with saliva, reasonable probability of exposure, and other unspecified exposures) accounted for 88% of PEP, with a significant increasing trend. During 1998–2002, "reasonable probability" and "bat in the bedroom" accounted for 79% and 53% of bat-associated PEP, respectively.

Table. Bat-associated rabies exposure incidents, PEP, and bats received for testing, New York, USA, 1993–2002*

	No. (%)										
Incidence data	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
Total incidents†	137 (100.0)	116 (100.0)	290 (100.0)	527 (100.0)	672 (100.0)	764 (100.0)	964 (100.0)	924 (100.0)	973 (100.0)	953 (100.0)	6,320 (100.0)
Bats tested†	42 (30.7)	43 (37.1)	57 (19.7)	111 (21.1)	111 (16.5)	116 (15.2)	112 (11.6)	110 (11.9)	113 (11.6)	124 (13.0)	939 (14.9)
Bats not tested	95 (69.3)	73 (62.9)	233 (80.3)	416 (78.9)	561 (83.5)	648 (84.8)	852 (88.4)	814 (88.1)	860 (88.4)	829 (87.0)	5,381 (85.1)
Total PEP	184	131	440	968	1,326	1,512	1,755	1,641	1,735	1,673	11,365
Average/incident	1.3	1.1	1.5	1.8	2.0	2.0	1.8	1.8	1.8	1.8	1.8
Bat rabies status											
Positive†	49 (26.6)	17 (13.0)	34 (7.7)	74 (7.6)	88 (6.6)	111 (7.3)	110 (6.3)	110 (6.7)	99 (5.7)	98 (5.9)	790 (7.0)
Negative	6 (3.3)	24 (18.3)	17 (3.9)	37 (3.8)	36 (2.7)	33 (2.2)	22 (1.3)	32 (2.0)	21 (1.2)	23 (1.4)	251 (2.2)
Untestable	18 (9.8)	10 (7.6)	34 (7.7)	110 (11.4)	89 (6.7)	69 (4.6)	74 (4.2)	76 (4.6)	114 (6.6)	115 (6.9)	709 (6.2)
Not tested	111 (60.3)	80 (61.1)	355 (80.7)	747 (77.2)	1,113 (83.9)	1,299 (85.9)	1,549 (88.3)	1,423 (86.7)	1,501 (86.5)	1,437 (85.9)	9,615 (84.6)
Bat exposure type											
Bite†	43 (23.4)	71 (54.2)	124 (28.2)	160 (16.5)	188 (14.2)	134 (8.9)	186 (10.6)	163 (9.9)	150 (8.6)	145 (8.7)	1,364 (12.0)
Scratch or saliva contact	73 (39.7)	50 (38.2)	102 (23.2)	259 (26.8)	429 (32.4)	168 (11.1)	147 (8.4)	131 (8.0)	152 (8.8)	126 (7.5)	1,637 (14.4)
Reasonable probability	NA	NA	NA	NA	NA	1,145 (75.7)	1,365 (77.8)	1,299 (79.2)	1,382 (79.7)	1,367 (81.7)	6,558 (57.7)
Other	68 (37.0)	10 (7.6)	214 (48.6)	549 (56.7)	709 (53.5)	65 (4.3)	57 (3.2)	48 (2.9)	51 (2.9)	35 (2.1)	1,806 (15.9)
Bats received for rabies testing											
Total	420 (100.0)	419 (100.0)	386 (100.0)	764 (100.0)	741 (100.0)	868 (100.0)	923 (100.0)	1,220 (100.0)	1,421 (100.0)	1,487 (100.0)	8,649 (100.0)
By bat rabies status											
Positive‡	20 (4.8)	17 (4.1)	19 (4.9)	23 (3.0)	28 (3.8)	38 (4.4)	34 (3.7)	36 (3.0)	45 (3.2)	34 (2.3)	294 (3.4)
Negative	342 (81.4)	375 (89.5)	315 (81.6)	653 (85.5)	667 (90.0)	769 (88.6)	833 (90.2)	1,112 (91.1)	1,300 (91.5)	1,363 (91.7)	7,729 (89.4)
Untestable	58 (13.8)	27 (6.4)	52 (13.5)	88 (11.5)	46 (6.2)	61 (7.0)	56 (6.1)	72 (5.9)	76 (5.3)	90 (6.1)	626 (7.2)
By exposure type											
Bite†	77 (18.3)	106 (25.3)	103 (26.7)	118 (15.4)	98 (13.2)	139 (16.0)	141 (15.3)	131 (10.7)	131 (9.2)	148 (10.0)	1,192 (13.8)
Nonbite§	343 (81.7)	313 (74.7)	283 (73.3)	646 (84.6)	643 (86.8)	729 (84.0)	782 (84.7)	1,089 (89.3)	1,290 (90.8)	1,339 (90.0)	7,457 (86.2)

*PEP, human rabies postexposure prophylaxis; NA, data not collected for this time period.
†Test for trend, p<0.0001.
‡Test for trend, p<0.005.
§Includes scratch, saliva, and reasonable probability.

Rabies-positive bats accounted for 7% of PEP, with a significant decreasing trend. Untested bats accounted for 89% of the increase in PEP. Three quarters of PEP was administered for nonbite exposures to untested bats.

Of 8,244 PEPs since 1998, a total of 4,384 (53.2%) were for female patients, for whom the age-adjusted rate was 15.6 PEPs per 100,000 persons per year, compared with 14.3 for male patients ($p = 0.0003$). Persons ≤14 years of age received PEP twice as often as did persons ≥15 years of age. More persons ≤14 years of age (86%) received PEP for reasonable probability of exposure than did persons ≥15 years of age (76%) ($p = 0.001$).

During the study period, a total of 8,649 bats were received for rabies testing with concerns reported at the time of submission about the possibility of human contact, although further epidemiologic review would not classify them all as exposure incidents (Table). The number of bats submitted increased almost 4-fold. Similar to the seasonal pattern of exposure incidents, three quarters of bats were received for testing during June through August, with most (40%) received during August. Three percent of submitted bats were rabies positive, 89% were rabies negative, and 7% were unsatisfactory for testing. There was a significant decreasing trend in the proportion of tested bats that were rabid.

Bats for which nonbite contacts were reported accounted for 86% of those received for testing and 93% of the increase in bats received. There was a significant increasing trend in the proportion of bats reported with nonbite contacts.

For bats not tested, encounters resulted in an average of 1.8 PEP per incident, at an estimated cost for biologics of $10.9 million based on an average of $1,136 per PEP (*4*). Capturing and testing the 7,729 rabies-negative bats precluded the need for ≈14,000 PEP at an estimated savings for biologics of $15.8 million.

Encounters with bats are fairly common in New York State. Eidson et al. reported that one-third of survey respondents reported a bat in their house, including 10% who had seen a bat in their bedroom (*3*). Less than 20% knew a bat found indoors should not be released until rabies exposure is ruled out.

Similar rabies patterns have been reported from other states and Canada. In Massachusetts the number of bats submitted for rabies testing increased substantially during 1985–2009 (*5*). South Carolina reported an increase in administration of bat-associated PEP during the same period as this study (*6*). The seasonal pattern of bat encounters in New York was similar to those reported in Colorado (*7*), Minnesota (*8*), and Quebec, Canada (*9*), reflecting the pattern of bat hibernation and reproduction (*10*). As in New York, "bat in bedroom" was the most common exposure in Minnesota and 1 of the more frequent exposures in Colorado and Quebec.

In conclusion, during PEP guideline revision, which expanded the recommendation for PEP beyond persons with known bite exposures, numbers of bats submitted for testing, reported exposure incidents, and instances of PEP administration increased significantly in New York. Although the cause of the increases cannot be definitively determined, the increases were consistent with changes in guidelines and public education. With 89% of bats confirmed as rabies negative that were submitted because of possible human contact, improving bat capture and testing should be considered as a strategy for excluding rabies exposures and thus reducing the number of PEPs administered.

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References

1. Eidson M, Bingman AK. Terrestrial rabies and human postexposure prophylaxis, New York, USA. Emerg Infect Dis. 2010;16:527–9. doi:10.3201/eid1603.090298
2. Centers for Disease Control and Prevention. Human rabies prevention—United States, 1999. Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep. 1999;48(RR-1):1–21.
3. Eidson M, Schmit K, Keegan M, Trimarchi CV, Tserenpuntsag B, Willsey A. Development and evaluation of bat rabies education materials. Evidence-based Preventive Medicine. 2004;1:85–91.
4. Chang HG, Eidson M, Noonan-Toly C, Trimarchi CV, Rudd R, Wallace BJ, et al. Public health impact of reemergence of rabies, New York. Emerg Infect Dis. 2002;8:909–13.
5. Wang X, DeMaria A, Smoke S, Brown CM, Han L. Bat rabies in Massachusetts, USA, 1985–2009. Emerg Infect Dis. 2010;16:1285–8. doi:10.3201/eid1608.100205
6. O'Bell SA, McQuiston J, Bell LJ, Ferguson SC, Williams LA. Human rabies exposures and postexposure prophylaxis in South Carolina, 1993–2002. Public Health Rep. 2006;121:197–202.
7. Pape WJ, Fitzsimmons TD, Hoffman RE. Risk for rabies transmission from encounters with bats, Colorado, 1977–1996. Emerg Infect Dis. 1999;5:433–7. doi:10.3201/eid0503.990315
8. Liesener AL, Smith KE, Davis RD, Bender JB, Danila RN, Neitzel DF, et al. Circumstances of bat encounters and knowledge of rabies among Minnesota residents submitting bats for rabies testing. Vector Borne Zoonotic Dis. 2006;6:208–15. doi:10.1089/vbz.2006.6.208

9. Huot C, De Serres G, Duval B, Maranda-Aubut R, Ouakki M, Skowronski DM. The cost of preventing rabies at any cost: post-exposure prophylaxis for occult bat contact. Vaccine. 2008;26:4446–50. doi:10.1016/j.vaccine.2008.06.076
10. Frantz SC, Laniewicz BR. Comprehensive management of commensal bats. In: Brittingham MC, Kays J, McPeake R, editors. The ninth wildlife damage management conference proceedings. Lincoln (NE): Digital Commons@University of Nebraska—Lincoln; 2000. p. 172–86 [cited 2011 May 2]. http://digitalcommons.unl.edu/icwdm_wdmconfproc/27

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Chrysosporium sp. Infection in Eastern Massasauga Rattlesnakes

To the Editor: During 2008, the ninth year of a long-term biologic monitoring program, 3 eastern massasauga rattlesnakes (*Sistrurus catenatus catenatus*) with severe facial swelling and disfiguration died within 3 weeks after discovery near Carlyle, Illinois, USA. In spring 2010, a similar syndrome was diagnosed in a fourth massasauga; this snake continues to be treated with thermal and nutritional support and antifungal therapy. A keratinophilic fungal infection caused by *Chrysosporium* sp. was diagnosed after physical examination, histopathologic analysis, and PCR in all 4 snakes. The prevalence of clinical signs consistent with *Chrysosporium* sp. infection during 2000–2007 was 0.0%, and prevalence of *Chrysosporium* sp.–associated disease was 4.4% (95% confidence interval [CI] 1.1%–13.2%) for 2008 and 1.8% (95% CI 0.0%–11.1%) for 2010.

Clinical and gross necropsy abnormalities were limited to the heads of affected animals. In each case, a unilateral subcutaneous swelling completely obstructed the nasolabial pits (Figure, panel A). In the most severely affected snake, swelling extended to the cranial aspect of the orbit and maxillary fang (Figure, panel B). Notable histologic lesions were restricted to skin, gingiva, and deeper tissues of the head and cervical region and consisted of cutaneous ulcers with granulomas in deeper tissues (Figure, panel C). Ulcers had thick adherent serocellular crusts and were delineated by small dermal accumulations of heterophils and fewer macrophages. Crusts contained numerous 4–6-μm diameter right-angle branching fungal hyphae with terminal structures consistent with spores. In 1 snake, infection was associated with retained devitalized layers of epidermis consistent with dysecdysis. In the same snake, the eye and ventral periocular tissues were effaced by inflammation, but the spectacle and a small fragment of cornea remained; the corneal remnant contained few fungal hyphae.

In all snakes, in addition to deep cutaneous ulceration, the dermis, hypodermis and skeletal muscle of the maxillary and or mandibular region contained multiple granulomas, centered on variable numbers of fungal hyphae (Figure, panel D). In 1 snake, similar granulomas were also observed in maxillary gingival submucosa and subjacent maxillary bone.

Five frozen skin biopsy samples from 4 snakes were thawed and plated on Sabaroud agar; however, no fungal growth was recovered. Genomic DNA was extracted from tissue, and PCR was performed by using 2 sets of fungus-directed rRNA gene primers. The DNA was sequenced, and the 4 amplicons showed >99% homology with *C. ophiodiicola* (GenBank accession no. EU715819.1).

Fungal pathogens have been increasingly associated with free-ranging epidemics in wildlife, including the well-known effects of

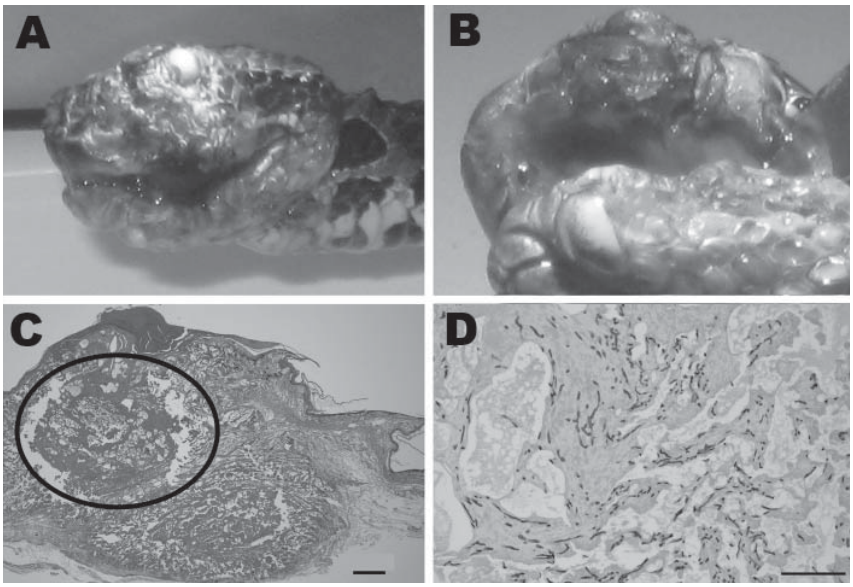

Figure. *Chrysosporium* sp. fungal infection in eastern massasagauga rattlesnake (*Sistrurus catenatus catenatus*). A) Facial dermatitis and cellulitis caused by *Chrysosporium* sp. infection in rattlesnake from Carlyle, Illinois, USA; B) close-up showing maxillary fang destruction. C) Maxillary dermal and subcutaneous fungal granuloma (circled area). Hematoxylin and eosin stain, original magnification ×2, scale bar = 500 μm. D) Granuloma center with large numbers of fungal hyphae. Grocott methenamine silver stain, original magnification ×10, scale bar = 100 μm. A color version of this figure is available online (wwwnc.cdc.gov/EID/article/17/12/11-0240-F1.htm).