Human Rabies—Texas and New Jersey, 1997

MMWR. 1998;47:1-5
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On October 17 and October 23, 1997, a man in Texas and a man in New Jersey, respectively, died from rabies. This report summarizes the clinical features of these cases and the epidemiologic investigations by the Texas Department of Health and the New Jersey State Department of Health and Senior Services, which indicated that a bat-associated variant of the rabies virus was responsible for infection in both cases.

Case 1
On October 3, a 71-year-old man from Houston, Texas, developed malaise, anorexia, and sharp left-side face and ear pain that radiated to his chest. On October 7, his evaluation as an outpatient included a computerized tomography (CT) scan, which suggested left frontal and sphenoid sinusitis with normal brain parenchyma, and a laryngeal examination, which revealed left vocal-cord paralysis. On October 8, he was admitted to a hospital in Houston for further evaluation of generalized pruritus, agitation, confusion, and fever; treatment of sinusitis; and possible alcohol withdrawal. He was anxious and tremulous but mentally coherent and was treated empirically with antibiotics and benzodiazepines. During the next 2 days, he developed fever of 103.6°F (39.8°C), ocular motor paralysis, myoclonic tremors, and dysphagia, manifested by an inability to swallow his saliva. Notable laboratory findings included a peripheral white blood cell (WBC) count of 11,000/µL (normal: 4000-10,000/µL), cerebrospinal fluid (CSF) protein of 67 mg/dL (normal: <45 mg/dL), and CSF WBC count of 17/µL (normal: <5/µL). An electroencephalogram showed mild bilateral cerebral dysfunction.

On October 11, he became hypotensive and hypopneic, necessitating mechanical ventilation. On October 12, rabies was suspected; a sample of the patient’s serum was sent to a commercial laboratory for evaluation for rabies virus neutralizing antibodies, and he was placed in respiratory isolation. By October 16, he was comatose with flaccid extremities. On October 17, he was found to have absent brainstem reflexes, ventilator support was withdrawn, and the patient died.

After previous unsuccessful attempts by physicians to elicit from the patient and his wife a history of animal exposure, on October 12, the wife reported that the patient had had recent contact with a bat. On August 3, while sleeping in a motel in Harrison County, the patient had been awakened by a bat that had settled on his left shoulder. He removed and disposed of the bat. The patient’s wife had examined his skin immediately after removing the bat and had not detected a bite wound. She did not recall whether the bat had been clinging directly to the patient’s skin or to a shirt he may have been wearing. Investigation by state and local health officials revealed that, in the bathroom of the patient’s motel room, a separation between the wall and the ceiling connected the bathroom to the attic. In addition, several openings to the outside were noted in the attic, but there was no evidence of current or previous occupation by bats.

The serum sample sent to the commercial laboratory on October 12 did not demonstrate evidence of rabies virus neutralizing antibodies. However, on October 18, rabies was diagnosed by the direct fluorescent antibody (DFA) test from postmortem brain samples tested by the Houston Department of Health and Human Services. The diagnosis was confirmed at CDC using the DFA test and reverse transcriptase polymerase chain reaction (RT-PCR) on brain tissue samples. Nucleotide sequence analysis of viral RNA implicated a variant associated with the silver-haired (L. nocticavagans) and eastern pipistrelle (Pipistrellus sp.) bats. A total of 46 persons (four personal contacts and 42 health-care workers) received postexposure prophylaxis (PEP) because of possible percutaneous or mucous membrane exposure to the patient’s saliva or CSF.

Case 2
On October 12, a 32-year-old man from Warren County, New Jersey, developed an aching sensation in his right shoulder and neck. These symptoms persisted and progressed to include vomiting, chills, and a sore throat, prompting a visit on October 13 to an emergency department where he received oral antibiotics and an anesthetic throat spray. After presenting to his primary physician with additional complaints of fever, insomnia, agitation, and dysphagia, he was admitted to the hospital on October 14. The patient developed dysarthria, hallucinations, myalgias, and fever of 104°F (40°C) and was transferred to a referral hospital on October 15. At the referral hospital, laboratory findings included a peripheral WBC count of 10,800/µL, a creatine phosphokinase of 2500 U/L (normal: 35-185 U/L), CSF protein of 61 mg/dL, and a CSF WBC count of 1/µL. A CT scan was reported normal, and he was started on empiric broad-spectrum antibiotics for his febrile syndrome. The following day, he was electively intubated for airway protection and started on treatment for possible tetanus and herpes encephalitis.

On October 17, rabies was suspected, and serum, saliva, CSF, tears, and nuchal skin biopsy specimens were submitted to CDC for testing; serum and CSF samples were negative for rabies virus neutralizing antibodies. On October 20, the nuchal biopsy specimen tested positive for rabies antigen by the DFA test, which was later confirmed by nested RT-PCR. Saliva and tears also were positive by nested RT-PCR. Nucleotide sequence analysis of viral RNA implicated a variant associated with the silver-haired (L. nocticavagans) and eastern pipistrelle (Pipistrellus sp.) bats. The patient developed severe hypotension and renal failure, and he died on October 23.

On autopsy, brain tissue specimens collected for evaluation tested positive for rabies virus by RT-PCR.

On initial presentation, the patient reported exposure to his two pet parakeets but not to other animals. Additional history obtained from his wife revealed that on two separate occasions in early July, bats had been found in the living room of the patient’s home. The patient had captured the bats by hand using a cloth and had then released them outside. The
of health-care providers to respond to situations in which accurate exposure histories may not be obtainable and should minimize inappropriate PEP.

ACIP recently recommended a change in the administration of human rabies immune globulin (HRIG) for PEP: as much as possible of the full dose of HRIG should be thoroughly infiltrated into and around the wound(s). Any remaining volume should be administered intramuscularly at a site distant from vaccine inoculation.

Because bat rabies has been documented in the 49 continental United States and reduction of bat populations is not a feasible, practical, or desirable strategy for rabies control in bats, human and domestic animal contact with bats should be minimized. Bats should be physically excluded from houses and surrounding structures by sealing potential entrances. In addition, bats should never be handled by untrained and unvaccinated persons without safety precautions and should never be kept as pets.

In both of the cases in this report, many health-care workers received PEP. Strict adherence to universal precaution procedures should minimize the number of persons who need PEP because of exposures of mucous membranes or nonintact skin to potentially infectious body fluid.

References

Availability of New Rabies Vaccine for Human Use

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ON OCTOBER 20, 1997, the Food and Drug Administration licensed a new rabies vaccine for both pre-exposure and postexposure prophylactic use in humans. This purified chick embryo cell culture (PCEC) vaccine (RabAvert®) is manufactured by Chiron Behring GmbH and Company. The addition of PCEC to the current products available for preexposure and postexposure prophylactic use in humans allows for greater flexibility in treatment choices for the vaccination candidate who develops a sensitivity to one of the other available vaccines. Although derived from chick embryo cells, antibodies to chick cell proteins were not detected in recipients of the vaccine.1

Before introduction of the PCEC vaccine, two other products were licensed for use as rabies vaccines in the United States: human diploid cell vaccine (HDCV) and rabies vaccine adsorbed (RVA). HDCV uses the Pitman Moore strain of fixed rabies virus propagated in infected human diploid cells, and RVA uses a Kissling strain of rabies virus adapted to a diploid cell line of fetal rhesus lung.23

The PCEC vaccine has been shown to be safe and immunogenic when the current Advisory Committee on Immunization Practices guidelines are employed.24 These guidelines are as follows: pre-exposure vaccination for persons not previously vaccinated consists of three 1.0-mL doses delivered intramuscularly in the deltoid region for adults and in the anterolateral zone of the thigh for young children on days 0, 7, and 21 or 28 (day 0 indicates the start of treatment);
postexposure vaccination with PCEC in persons not previously vaccinated consists of five 1.0-mL doses delivered intramuscularly in the same regions as for pre-exposure vaccination on days 0, 3, 7, 14, and 28, plus one dose of human rabies immune globulin (HRIG) at 20 IU per kg of body weight on day 0. As much as possible of the full dose of HRIG should be thoroughly infiltrated into and around the wound(s). Any remaining volume should be administered intramuscularly at a site distant from the vaccine inoculation. Postexposure prophylaxis for those persons who have been previously vaccinated should consist of two 1.0-mL doses delivered intramuscularly, in the same regions as previously stated for adults and children, on days 0 and 3. HRIG should not be administered to previously vaccinated persons.

On the basis of information provided by the manufacturer RabAvert® is a sterile freeze-dried vaccine obtained by growing the fixed-virus strain Flury low egg passage (LEP) in primary cultures of chicken fibroblasts. The tissue culture fluid is harvested and filtered to remove cell debris. The virus is inactivated with β-propiolactone, then further purified and concentrated by zonal centrifugation. The vaccine is lyophilized after addition of a stabilizer solution in 1.0-mL amounts, which supplies at least 2.5 IU of rabies antigen. No preservative is contained in the vaccine, and the vaccine should be used immediately after reconstitution. The vaccine is designed for intramuscular use only.

The manufacturer also reported the occurrence of a substantial anamnestic antibody response with no reports of IgE-mediated hypersensitivity when PCEC was used as a booster, regardless of the vaccine used for primary vaccination. As with the other available products (HDCV and RVA), local reactions such as swelling, induration, and reddening have been associated with administration of PCEC. Because the product contains trace amounts of animal by-products, antibiotics, and human serum albumin, systemic allergic reactions are possible and have been reported.

Reported by: Viral and Rickettsial Zoonoses Br, Div of Viral and Rickettsial Diseases, National Center for Infectious Diseases, CDC.

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*Use of trade names and commercial sources is for identification only and does not imply endorsement by CDC or the U.S. Department of Health and Human Services.

### Use of Unvented Residential Heating Appliances—United States, 1988-1994

Many heating appliances rely on combustion of carbon-based fuels and therefore are potential sources of health-threatening indoor air pollution. Most combustion heating appliances are vented to the outside of buildings to facilitate removal of the products of combustion, which include carbon monoxide (CO), carbon dioxide, nitrogen dioxide, and water vapor.

However, some combustion heating devices may be unvented (e.g., kerosene- and propane-fueled space heaters, some gas-fueled log sets, and cooking devices used improperly for heating), and the use of such unvented devices in closed settings may be associated with risks for exposure to toxic gases and other emissions. This report presents an analysis of data from the Third National Health and Nutrition Examination Survey (NHANES III) to estimate the number and regional distribution of adults using unvented residential heating appliances and stoves or ovens misused as heating devices in the United States during 1988-1994. The findings indicate that the percentage of adults using these devices was higher in the South, among low-income adults, among blacks, and among urban residents, and underscore the need for public education about the health risks associated with exposure to elevated levels of combustion by-products.

NHANES III collected data from approximately 20,000 adults about household characteristics, including the prevalence of various types of residential heating appliances, the use of unvented combustion space heaters, and use of stoves or ovens specifically for heating during the previous year. NHANES weights were used to obtain national estimates based on these responses. Because responses by race/ethnicity other than for whites and blacks were too small for reliable estimates, responses from all other races were combined.

### National Estimates

During 1988-1994, an unvented combustion space heater was used by an estimated 13.7 million adults, and electric space heaters were used by 23.1 million adults; space heaters were not used by 150.4 million adults. Unvented combustion space heaters were used more commonly by adults living in rural areas than by those living in urban areas (10.0 million [10.6%] compared with 3.7 million [4.0%]), by adults with an annual household income < $20,000 (low income) than by adults with an annual household income ≥ $20,000 (high income) [9.3% compared with 6.3%], and by black adults (11.0%) than by white adults (7.0%) or by adults of all other races (3.7%). In each income group, household use of these devices was reported more commonly by blacks than whites (low income: 12.2% compared with 9.1%; and high income: 9.6% compared with 6.1%).

Of the estimated 83.1 million adults who used a gas stove or oven for cooking, approximately 7.7 million (9.3%) had used the stove or oven for heat at least once during the previous year. Improper use of the stove or oven as a heating device was more common among rural than among urban residents (12.2% compared with 7.4%). Stoves or ovens were used for heating in approximately 14.5% of low-income households compared with 6.1% of high-income households. Use of gas stoves and ovens as heating devices was reported more commonly by black adults (15.6%) than by white adults (8.1%) or by adults of other races (9.2%).

### Regional Estimates

Unvented combustion space heaters were used by an estimated 13.2% of adults in the South; 5.9%, in the Midwest; 4.2%, in the Northeast; and 2.5%, in the West. The types of fuel used in combustion space heaters also varied by region, with propane being used predominantly in the South. Low-income households in the South and West used unvented combustion heating appliances more frequently.
than did high-income households in those regions (in the South: 16.3% compared with 11.2%; and in the West: 9.8% compared with 2.0%). Use of unvented combustion heating appliances was similar in low-income households and high-income households in the Midwest and Northeast (in the Midwest, 6.0% compared with 5.8%, and in the Northeast, 4.2% compared with 4.2%).

Use of a gas stove or oven as a heating device was higher among adults in the South (14.4%) than in any other region (West, 8.7%; Northeast, 7.6%; and Midwest, 5.9%). In all regions, the use of such devices in low-income households was approximately twice that in high-income households.

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CDC Editorial Note: Unvented combustion appliances and gas stoves or ovens improperly used as heating devices often produce levels of combustion by-products that exceed acceptable limits, and degrade indoor air quality, and may cause unnecessary exposure to toxic gases such as CO. Unintentional, nonfire, nonautomobile poisonings from CO exposure in permanent dwellings result in approximately 200 deaths and 5,800 injuries (treated in emergency departments) annually (K. Long, U.S. Consumer Product Safety Commission, memorandum to E. Leland, September 4, 1996). Symptoms characteristic of CO poisoning include headache, nausea, fatigue, weakness, abdominal pain, and confusion. Severe poisoning may result in seizures, coma, and death.

The findings in this report indicate that, although the use of unvented combustion heating appliances is common throughout the United States, the percentage of adults using these devices is higher in the South, among low-income groups, among blacks, and among rural residents. Because these estimates are based on adults reporting usage of these appliances and may not reflect the true prevalence of household use, the number of persons potentially exposed may be underestimated. The increased race-specific usage among blacks reflects, in part, a higher percentage of blacks living in the South (18.2%) compared with the Northeast (9.9%), Midwest (9.4%) and West (5.4%). These findings also indicate that the use of gas stoves and ovens as heating devices is common, especially among low-income and rural residents, even though these appliances were not designed or intended for such purposes.

Since 1992, use of unvented combustion heaters has increased because in many states, regulations prohibiting the use of these devices have been rescinded. As of November 1997, five states prohibit the use of unvented gas-fueled or liquid-fueled heaters (Alaska, Massachusetts, and Minnesota; and Colorado and Utah at high altitude only) (M. Carson, Vent-Free Gas Products Association, personal communication, December 2, 1997). Manufacturers recommend that these devices be used for short periods of time with a nearby window open for ventilation (5; M. Carson, Vent-Free Gas Products Association, personal communication, December 2, 1997). Failure to follow these instructions could result in elevated levels of combustion by-products.

Both unvented and vented heating appliances must be properly maintained to reduce the risk for associated health hazards. Persons who use unvented combustion space heaters should follow manufacturers’ recommendations and use these devices only for short periods in well-ventilated areas to prevent the accumulation of toxic gases in living spaces. Other prevention strategies include conducting media campaigns detailing the potential hazards of unvented combustion space heaters during the colder months and encouraging the proper use of CO detectors in homes.

References


Filter Ventilation Levels in Selected US Cigarettes, 1997

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1 figure, 1 table omitted
CIGARETTE BRANDS that deliver ≤15 mg of tar in official smoking-machine tests accounted for 72.7% of total cigarette sales in 1995. Many of these brands use ventilated filters—a system with small perforations around the filter that are designed to draw in additional air during smoking. In brands with ventilated filters, air introduced through the vents dilutes the amounts of tar, nicotine, carbon monoxide (CO), and other hazardous constituents of cigarette smoke. This report summarizes results of tests conducted by researchers at The Pennsylvania State University during July 1997 to measure the percentage of air drawn through the filter vents of 32 brands of U.S. cigarettes that have tar yields rated by the Federal Trade Commission (FTC) as ranging from 1 mg-18 mg; the report also examines the correlation between the degree of filter ventilation and tar yield. The findings indicate that 30 (94%) of 32 brands tested were ventilated and that percentage filter ventilation varied inversely with standard tar, nicotine, and CO yields.

Testing conditions simulated actual consumer use of a freshly opened pack of cigarettes. One pack each of 32 commercially available cigarette brands was purchased from retail stores in State College, Pennsylvania, during July 1997. Each pack was opened, and 20 unlit cigarettes were tested within 10 minutes with an FDT Ventilation Tester (Fidus Instrument Corporation, Richmond, Virginia), which measured the percentage of additional air drawn into a puff through the filter vents (i.e., percentage filter ventilation). The testing conditions were maintained at an ambient air temperature of 72 F (22 C) (range: 68 F-75 F [20 C-24 C]) and a relative humidity of 60% (range: 55%-65%). Because of the potential for smokers to knowingly or inadvertently block filter ventilation holes with their lips or fingers, the location of these holes was
determined for each of the 32 brands by selecting one cigarette from each pack to be measured to the nearest 0.5 mm by two technicians.

The ventilation percentage for the 32 brands ranged from 0 to 83%. Based on four categories of tar yield, there was a linear association between ventilation percentage and tar yield. Standard tar yields varied inversely with percentage filter ventilation ($r = -0.93$ [degrees of freedom=31]). In addition, ventilation percentage varied inversely with nicotine yield ($r = -0.90$) and CO yield ($r = -0.95$ [degrees of freedom=29]).

The distance of filter vents from the mouth end of the filter ranged from 11 mm-15 mm.

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**CDC Editorial Note:** From 1954 to 1994, sales-weighted tar yields of cigarettes declined from an estimated average of 37 mg tar to 12 mg tar, respectively.2 Despite this decline in tar yields—attributable, in part, to the increased use of filter ventilation—the relative risk for lung cancer has increased, even when accounting for the delayed onset of mortality from tobacco-linked lung cancer.5 Factors potentially associated with the increase in smoking-related mortality are an increase in the number of cigarettes smoked (and therefore, tar exposure) by persons who use reduced-tar brands, inhaling more deeply, and an increased frequency of puffing.2 In addition, smokers who use reduced-tar cigarettes may be blocking some of the filter vents with their fingers or lips, thereby increasing their exposure to the carcinogens in cigarette smoke.6 Compensatory changes in smoking behaviors among persons who smoke reduced-tar cigarettes could be associated with changes in the risk, histology, and site of lung cancers.s

Blocking even a portion of the filter vents can markedly increase a smoker’s exposure to the harmful components of cigarette smoke. Smokers can inadvertently block filter vents because filter vents often are invisible to the unaided eye and the filters do not include a marking (e.g., a colored band) to indicate the presence of vents. Blocking with the lips would more likely occur with the brands with filter vents closer to the mouth end of the filter and blocking with the filters would more likely occur with brands with filter vents further away from the mouth end of the filter. One study has estimated that 58% of persons who smoke cigarettes with ≤4 mg tar are blocking some filter vents.3 In tests conducted on cigarette smoking machines, blocking half of the ventilation holes on a cigarette with standard yields of 4 mg tar, 0.5 mg nicotine, and 5 mg CO increased FTC-rated tar yields by 60%, nicotine by 62%, and CO by 73%.4 In addition, one study by the tobacco industry estimated that, when smoking an ultra-light cigarette (2.2 mg tar), 45% of smokers blocked vents to some degree with their lips: 21% of smokers (or nearly half of those who blocked vents) increased tar yields to at least 3.3 mg tar (i.e., by ≥50%); overall, approximately one in 10 smokers (approximately 25% of those who blocked vents) were estimated to at least double their tar yields from blocking with their lips alone.

This study is subject to at least four limitations. First, although the cigarette brands tested reflected the range of tar yields for filter cigarettes, the analysis did not use a sales-weighted or representative sample of all available brands. For example, although cigarettes with ≤3 mg of tar were included in this study, such cigarettes accounted for only approximately 2% of sales in 1995. Second, the findings for any specific brand could have been affected by factors unique to the sample of cigarettes delivered to the State College area, including, for example, manufacturing dates and retailers’ storage conditions (e.g., temperature and humidity). Third, cigarettes were not maintained at standard temperature and humidity conditions for 24 hours before testing; this was done to simulate use of a freshly opened pack of cigarettes by a consumer. Finally, although the analysis used 1994 data on tar yields (the most recent available), brand formulations may have changed since 1994.

Many smokers who block filter vents probably are exposed to substantially higher levels of hazardous smoke than the FTC-rated levels for those brands. The FTC recognizes that their machine-measured yields of tar and nicotine are poor predictors of exposure to toxic smoke products by smokers and invites comments (until January 20, 1998) on proposed changes to its testing and reporting system (FTC file number P944509; additional information is available from the FTC’s Bureau of Consumer Protection by contacting C. Lee Peeler, telephone [202] 326-3090, or Shira Modell, telephone [202] 326-3116). To identify cigarette brands in which vent-blocking probably is a problem, all cigarette testing should include measurement of filter ventilation.

An estimated two thirds of U.S. smokers either are unaware of the presence of vents on cigarettes or do not know that tar yields increase when vents are blocked.9 Filter vents can be difficult to see, which may account for the high proportion of smokers (80%) of “light” (6-15 mg tar) and “ultra-light” (1-5 mg tar) cigarettes who are unaware of the presence of vents on the brands they smoke. These findings underscore the need for intensified efforts to educate smokers about the risks associated with smoking reduced-tar cigarettes.

**References**


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*Use of trade names and commercial sources is for identification only and does not imply endorsement by CDC or the U.S. Department of Health and Human Services.

†The percentage of a standard puff (35-mL volume and 2-sec duration) that is air taken into the puff through the filter vents. A cigarette with no filter ventilation would produce a puff undiluted by air from filter vents; a cigarette with 80% filter ventilation would produce a puff that is 80% air from vents and 20% smoke undiluted by air from vents.

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