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Compendium of Animal Rabies Prevention and Control, 2011

National Association of State Public Health Veterinarians, Inc.

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Front cover photo: Raccoons are a primary reservoir of rabies virus in the United States.

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Compendium of Animal Rabies Prevention and Control, 2011

National Association of State Public Health Veterinarians, Inc. (NASPHV)

Summary

Rabies has one of the highest case-fatality ratios of any infectious disease. This report provides recommendations for public health officials, veterinarians, animal control officials, and other parties engaged in rabies prevention and control activities and should serve as the basis for standardizing procedures among jurisdictions. The recommendations regarding domestic animal vaccination, management of animals exposed to rabies, and management of animals that bite humans are the core elements of animal rabies control and human rabies prevention. These updated 2011 guidelines include the national case definition for animal rabies and clarify the role of the CDC rabies laboratory in providing confirmatory testing of suspect animals. The table of rabies vaccines licensed and marketed in the United States has been updated, and additional references have been included to provide scientific support for information in this report.

Introduction

Rabies is a fatal viral zoonosis and a serious public health problem (*1*). All mammals (referred to as animals in this report) are believed to be susceptible to the disease. Rabies is an acute, progressive encephalitis caused by a lyssavirus. Worldwide, rabies virus is the most important lyssavirus. In the United States, multiple rabies virus variants are maintained in wild mammalian reservoir populations such as raccoons, skunks, foxes, and bats. Although the United States has been declared free of canine rabies virus variant transmission, reintroduction of this variant is always a risk (*2*–*6*).

Rabies virus usually is transmitted from animal to animal through bites. The incubation period is highly variable. In domestic animals, the incubation period is generally 3–12 weeks but can range from several days to months, rarely exceeding 6 months (*7*). Rabies is communicable during the period of salivary shedding of rabies virus. Experimental and historic evidence indicates that dogs, cats, and ferrets shed virus a few days before clinical onset and during illness. Clinical signs of rabies and include inappetance, dysphagia, cranial nerve deficits, abnormal behavior, ataxia, paralysis, altered vocalization, and seizures. Progression to death is rapid. There are currently no known effective rabies antiviral drugs.

The recommendations in this compendium serve as a basis for animal rabies prevention and control programs throughout the United States and facilitate standardization of procedures among jurisdictions, thereby contributing to an effective national rabies control program.* The most current version replaces all previous versions. These recommendations do not supersede state and local laws or requirements. Principles of rabies prevention and control are detailed in Part I; recommendations for parenteral vaccination procedures are presented in Part II; and all animal rabies vaccines licensed by the U.S. Department of Agriculture and marketed in the United States are listed and described in Part III.

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Methods

NASPHV periodically updates the recommendations to prevent and control animal rabies. The revision includes reviewing recent literature, updating licensed vaccine product information as provided by the manufacturers, and soliciting input from NASPHV members and stakeholder groups. During July 15–16, 2010, NASPHV members and external expert consultants met in Atlanta, Georgia. A committee consensus was required to add or modify existing language or recommendations. After the meeting, the updated draft was circulated via e-mail for final review by all voting committee members.

The 2011 guidelines include several updates. First, the national case definition for animal rabies was added to clarify how rabies cases are defined for public health surveillance purposes. Second, the diagnostics section was expanded to 1) clarify that the CDC rabies laboratory is available for confirmatory testing and on an emergency basis to expedite exposure management decisions, 2) include information on

*This compendium has been endorsed by the American Public Health Association, the American Veterinary Medical Association, the Association of Public Health Laboratories, CDC, the Council of State and Territorial Epidemiologists, and the National Animal Control Association.

testing methodology appropriate for field testing of surveillance specimens, and 3) clarify that no reliable antemortem rabies tests are available for use in animals. Third, the research section was expanded to include additional topics that warrant further study. Finally, the table of rabies vaccines licensed and marketed in the United States was updated, and additional references were included to provide scientific support for information provided in the recommendations.

Part I. Rabies Prevention and Control

A. Principles of Rabies Prevention and Control

1. **Case Definition.** An animal is determined to be rabid after diagnosis by a qualified laboratory as specified in Part I.A.9. The national case definition for animal rabies requires laboratory confirmation by either

   - a positive direct fluorescent antibody (DFA) test (preferably performed on central nervous system tissue); or
   - isolation of rabies virus (in cell culture or in a laboratory animal) (*8*).

2. **Rabies Virus Exposure.** Rabies virus is transmitted when the virus is introduced into bite wounds, into open cuts in skin, or onto mucous membranes from saliva or other potentially infectious material such as neural tissue (*9*). Questions regarding possible exposures should be directed promptly to state or local public health authorities.

3. **Public Health Education.** Essential components of rabies prevention and control include ongoing public education, responsible pet ownership, routine veterinary care and vaccination, and professional continuing education. The majority of animal and human exposures to rabies virus can be prevented by raising awareness concerning rabies virus transmission routes, avoiding contact with wildlife, and following appropriate veterinary care. Prompt recognition of possible exposure and prompt reporting to medical professionals and local public health authorities is critical.

4. **Human Rabies Prevention.** Rabies in humans can be prevented either by eliminating exposures to rabid animals or by providing persons who have been exposed with prompt local treatment of wounds combined with the appropriate administration of human rabies immune globulin and vaccine. Exposure assessment should occur before rabies postexposure prophylaxis (PEP) is initiated and should include discussions between medical providers and public health officials. The rationale for recommending preexposure prophylaxis and details of both preexposure and postexposureprophylaxis administration are available in the current recommendations of the Advisory Committee on Immunization Practices (ACIP) (*9,10*). These recommendations, in addition to information concerning the current local and regional epidemiology of animal rabies and the availability of human rabies biologics, are available from state health departments.

5. **Domestic Animal Vaccination.** Multiple vaccines are licensed for use in domestic animal species. Vaccines available include inactivated or modified live-virus vectored products, products for intramuscular and subcutaneous administration, products with durations of immunity from 1 to 4 years, and products with varying minimum age of vaccination. The recommended vaccination procedures and the licensed animal vaccines are specified in Parts II and III of this compendium, respectively. Local governments should initiate and maintain effective programs to ensure vaccination of all dogs, cats, and ferrets and to remove stray and unwanted animals. Such procedures in the United States have reduced laboratory-confirmed cases of rabies in dogs from 6,949 in 1947 to 93 in 2009 and are responsible for the elimination of the canine rabies virus variant (*2*). Because more rabies cases involving cats are reported annually (274 in 2009) than dogs, vaccination of cats should be required (*2*). Animal shelters and animal control authorities should establish policies to ensure that adopted animals are vaccinated against rabies.

6. **Rabies in Vaccinated Animals.** Rabies is rare in vaccinated animals (*11–13*). If suspected, the case should be reported to public health officials, the vaccine manufacturer, and the USDA Animal and Plant Health Inspection Service, Center for Veterinary Biologics (website: http://www.aphis.usda.gov/animal_health/vet_biologics/vb_adverse_event.shtml; telephone: 800-752-6255). The laboratory diagnosis should be confirmed and the virus variant characterized by the CDC rabies reference laboratory.

A thorough epidemiologic investigation should be conducted, including documentation of the animal's vaccination history and a description of potential rabies exposures.

7. **Rabies in Wildlife.** Controlling rabies in wildlife reservoirs is difficult (*14*). Vaccination of free-ranging wildlife or selective population reduction is useful in some situations (*15*); however, the success of these procedures depends on the circumstances surrounding each rabies outbreak (see Part I. C.). Because of the risk for rabies in wild animals (especially raccoons, skunks, coyotes, foxes, and bats), the American Veterinary Medical Association, the American Public Health Association, the Council of State and Territorial Epidemiologists, the National Animal Control Association, and the National Association of State Public Health Veterinarians (NASPHV) strongly recommend the enactment and enforcement of state laws prohibiting the importation, distribution, translocation, and private ownership of these animals.

8. **Rabies Surveillance.** Enhanced laboratory-based rabies surveillance and variant typing are essential components of rabies prevention and control programs. Accurate and timely information and reporting is necessary to guide human PEP decisions, determine the management of potentially exposed animals, aid in discovery of emerging pathogens, describe the epidemiology of the disease, and assess the need for and effectiveness of vaccination programs for domestic animals and wildlife. Every animal submitted for rabies testing should be reported to CDC to evaluate surveillance trends. Electronic laboratory reporting and notification of animal rabies surveillance data should be implemented (*16*). Optimal information on animals submitted for rabies testing should include species, point location, vaccination history, rabies virus variant (if rabid), and human or domestic animal exposures. A case of rabies in an animal with a history of importation into the United States within 60 days is immediately notifiable by state health departments to CDC; reporting of indigenous cases should follow standard notification protocols (*17*). Integration with standard public health reporting and notification systems should facilitate the transmission of the data discussed in this paragraph.

9. **Rabies Diagnosis**

   a) **DFA.** The DFA test is the gold standard for rabies diagnosis. The test should be performed in accordance with the established national standardized protocol (available at http://www.cdc.gov/rabies/pdf/RabiesDFASPv2.pdf) by a qualified laboratory that has been designated by the local or state health department (*18,19*). Animals submitted for rabies testing should be euthanized (*20,21*) in a way that maintains the integrity of the brain and allows the laboratory to recognize the anatomical parts. Except for very small animals, such as bats, only the head or brain (including the brain stem) should be submitted to the laboratory. To facilitate prompt laboratory testing, submitted specimens should be stored and shipped under refrigeration (rather than frozen) without delay. Thawing frozen specimens will delay testing. Chemical fixation of tissues should be avoided because it can cause substantial testing delays and might preclude reliable testing. Questions about testing fixed tissues should be directed to the local rabies laboratory or public health department.

   b) **Emergency Rabies Testing.** Emergency rabies testing should be available to expedite exposure management decisions (*18*). When state health departments need confirmatory testing (e.g., for inconclusive results, unusual species, or mass exposures), the CDC rabies laboratory can provide results within 24 hours of submission (*22*).

   c) **Direct Rapid Immunohistochemical Test (DRIT).** DRITs are being used by trained field personnel in surveillance programs for specimens not involved in human or domestic animal exposures (*23–26*). All positive DRIT results need to be confirmed by DFA testing at a qualified laboratory.

   d) **Unlicensed Test Kits.** No USDA-licensed rapid test kits are commercially available for rabies diagnosis. Unlicensed tests should not be used for several reasons: the sensitivity and specificity are not known; the tests have not been validated against current standard methods; the excretion of virus in the saliva is intermittent and the amount varies over time; any test result would need to be

confirmed by more reliable methods such as DFA testing on brain tissue; and the interpretation of results might place exposed animals and persons at risk.

10. **Rabies Serology.** Certain jurisdictions require evidence of vaccination and rabies virus antibodies for animal importation. Rabies virus antibody titers are indicative of a response to vaccine or infection. Titers do not directly correlate with protection because other immunologic factors also play a role in preventing rabies, and the ability to measure and interpret those other factors is not well-developed. Therefore, evidence of circulating rabies virus antibodies in animals should not be used as a substitute for current vaccination in managing rabies exposures or determining the need for booster vaccinations (*27–30*).

11. **Rabies Research.** Information derived from well-designed studies is essential for the development of science-based recommendations. Data are needed in several areas, including viral shedding periods for domestic livestock and lagomorphs, potential shedding of virus in milk, earliest age at which rabies vaccination is effective and the protective effects of maternal antibodies, duration of immunity, PEP protocols for domestic animals, models for treatment of clinical rabies, extra label vaccine use in domestic animals and wildlife rabies reservoirs, host-pathogen adaptations and dynamics, and the ecology of wildlife rabies reservoir species, especially in relation to the use of oral rabies vaccines.

B. Prevention and Control Methods in Domestic and Confined Animals

1. **Preexposure Vaccination and Management.** Parenteral animal rabies vaccines should be administered only by or under the direct supervision of a licensed veterinarian on the premises. Rabies vaccinations may also be administered under the supervision of a licensed veterinarian to animals being held in animal control shelters before release. The veterinarian who signs the rabies vaccination certificate must ensure that the person administering vaccine is identified on the certificate and is appropriately trained in vaccine storage, handling, administration, and in the management of adverse events. This practice ensures that a qualified and responsible person is held accountable for properly vaccinating the animal. Within 28 days after initial vaccination, a peak rabies virus antibody titer is reached, and the animal can be considered immunized (*29,31–33*). An animal is currently vaccinated and is considered immunized if the initial vaccination was administered at least 28 days previously or booster vaccinations have been administered in accordance with this compendium.

   Regardless of the age of the animal at initial vaccination, a booster vaccination should be administered 1 year later (see Parts II and III for vaccines and procedures). No laboratory or epidemiologic data exist to support the annual or biennial administration of 3- or 4-year vaccines after the initial series. Because a rapid anamnestic response is expected, an animal is considered currently vaccinated immediately after a booster vaccination (*34*).

   a) **Dogs, Cats, and Ferrets.** All dogs, cats, and ferrets should be vaccinated against rabies and revaccinated in accordance with Part III of this compendium. If a previously vaccinated animal is overdue for a booster, the animal should be revaccinated. Immediately after the booster, the animal is considered currently vaccinated and should be placed on a booster schedule, depending on the labeled duration of the vaccine used.

   b) **Livestock.** All horses should be vaccinated against rabies (*35*). Livestock, including species for which licensed vaccines are not available, that have frequent contact with humans (e.g., in petting zoos, fairs, and other public exhibitions) should be vaccinated against rabies (*36,37*). Consideration also should be given to vaccinating particularly valuable livestock.

   c) **Captive Wild Animals and Hybrids**

      (1) Wild animals or hybrids (the offspring of wild animals crossbred to domestic animals) should not be kept as pets (*38–40*). No parenteral rabies vaccines are licensed for use in wild animals or hybrids (*41*).

      (2) Animals that live in exhibits and in zoological parks and are not completely excluded from all contact with rabies vectors can

become infected. Moreover, wild animals might be incubating rabies when initially captured. Therefore, wild-caught animals susceptible to rabies should be quarantined for a minimum of 6 months. Employees who work with animals at such facilities should receive preexposure rabies vaccine. The use of preexposure or postexposure rabies vaccinations for handlers who work with animals at such facilities might reduce the need for euthanasia of captive animals that expose handlers. Carnivores and bats should be housed in a manner that precludes direct contact with the public (*36,37*).

2. **Stray Animals.** Stray dogs, cats, and ferrets should be removed from the community. Local health departments and animal control officials can enforce the removal of strays more effectively if owned animals are required to have identification and are confined or kept on leash. Stray animals should be impounded for at least 3 business days to determine whether human exposure has occurred and to give owners sufficient time to reclaim animals.

3. **Importation and Interstate Movement of Animals**

   a) **International.** CDC regulates the importation of dogs and cats into the United States (*5*). Importers of dogs must comply with rabies vaccination requirements (42 CFR, Part 71.51[c] [http://www.cdc.gov/animalimportation/dogs.html]) and complete CDC form 75.37 (http://www.cdc.gov/animalimportation/pdf/dog-import.pdf). These regulations require dogs imported from rabies-endemic countries to be vaccinated for rabies and confined for varying periods depending on age and prior vaccination status. The appropriate health official of the state of destination should be notified within 72 hours of the arrival of any imported dog required to be placed in confinement under these regulations. Failure of the owner to comply with these confinement requirements should be reported promptly to the CDC Division of Global Migration and Quarantine (telephone: 404-639-4528 or 404-639-4537). For emergencies or after-hours calls, contact the CDC Emergency Operations Center (telephone: 770-488-7100). Federal regulations alone will not prevent the introduction of rabid animals into the United States (*3,4,42,43*). All imported dogs and cats are subject to state and local laws governing rabies and should be currently vaccinated against rabies in accordance with this compendium. Failure of an owner to comply with state or local requirements should be referred to the appropriate state or local official.

   b) **Areas with Dog-to-Dog Rabies Transmission.** Canine rabies virus variants have been eliminated in the United States (*2,6*). Rabid dogs have been introduced into the continental United States from areas with dog-to-dog rabies transmission (*3,4,42,43*). The movement of dogs for the purposes of adoption or sale from areas with dog-to-dog rabies transmission increases the risk for introducing canine-transmitted rabies to areas where the disease does not exist and should be prohibited.

   c) **Interstate.** Before interstate (including commonwealths and territories) movement, dogs, cats, ferrets, and horses should be currently vaccinated against rabies in accordance with the recommendations in this compendium (see Part I.B.1.). Animals in transit should be accompanied by a currently valid NASPHV Form 51 (Rabies Vaccination Certificate) (http://www.nasphv.org/Documents/RabiesVacCert.pdf). When an interstate health certificate or certificate of veterinary inspection is required, the inspection should contain the same rabies vaccination information as Form 51.

4. **Adjunct Procedures.** Methods or procedures that enhance rabies control include the following (http://www.rabiesblueprint.com/spip.php?article119):

   a) **Identification.** Dogs, cats, and ferrets should be identified (e.g., metal or plastic tags or microchips) to allow for verification of rabies vaccination status.

   b) **Licensure.** Registration or licensure of all dogs, cats, and ferrets is an integral component of an effective rabies control program. A fee frequently is charged for such licensure, and revenues collected are used to maintain rabies or animal

control activities. Evidence of current vaccination should be an essential prerequisite to licensure.

c) Canvassing. House-to-house canvassing by animal control officials facilitates enforcement of vaccination and licensure requirements.

d) Citations. Citations are legal summonses issued to owners for violations, including the failure to vaccinate or license their animals. The authority for officers to issue citations should be an integral part of each animal control program.

e) Animal Control. All local jurisdictions should incorporate stray animal control, leash laws, animal-bite prevention, and training of personnel in their programs.

f) Public Education. All local jurisdictions should incorporate education covering responsible pet ownership, bite prevention, and appropriate veterinary care in their programs.

5. Postexposure Management. This section refers to any animal exposed (see Part I.A.2.) to a confirmed or suspected rabid animal. Wild mammalian carnivores or bats that are not available or suitable for testing should be considered rabid.

a) Dogs, Cats, and Ferrets. Any illness in an animal that has been exposed to rabies should be reported immediately to the local health department. If signs suggestive of rabies develop (e.g., paralysis or seizures), the animal should be euthanized and the head shipped for testing as described in Part I.A.9.

(1) Dogs, cats, and ferrets that have never been vaccinated and are exposed to a rabid animal should be euthanized immediately. If the owner is unwilling to euthanize, the animal should be placed in strict isolation for 6 months. Isolation in this context refers to confinement in an enclosure that precludes direct contact with people and other animals. Rabies vaccine should be administered after entry into isolation or up to 28 days before release to comply with preexposure vaccination recommendations (see Part I.B.1.a.). No USDA-licensed biologics for postexposure prophylaxis of previously unvaccinated domestic animals exist, and evidence indicates that the use of vaccine alone does not reliably prevent the disease in these animals (*44*).

(2) Animals overdue for a booster vaccination should be evaluated on a case-by-case basis based on severity of exposure, time elapsed since last vaccination, number of previous vaccinations, current health status, and local rabies epidemiologic factors to determine need for euthanasia or immediate revaccination and observation with isolation.

(3) Dogs, cats, and ferrets that are currently vaccinated should be revaccinated immediately, kept under the owner's control, and observed for 45 days. The rationale for an observation period is based in part on the potential for overwhelming viral challenge, incomplete vaccine efficacy, improper vaccine administration, variable host immunocompetence, and immune-mediated fatality (i.e., early death phenomenon) (*12,45–47*).

b) Livestock. All species of livestock are susceptible to rabies; cattle and horses are the most frequently reported infected species (*2*). Any illness in an animal exposed to rabies should be reported immediately to the local health and agriculture officials. If signs suggestive of rabies develop, the animal should be euthanized and the head shipped for testing as described in Part I.A.9.

(1) Unvaccinated livestock should be euthanized immediately. For animals that are not euthanized, on a case-by-case basis, they should be observed and confined for 6 months.

(2) Livestock exposed to a rabid animal and currently vaccinated with a vaccine approved by USDA for that species should be revaccinated immediately and observed for 45 days.

(3) Multiple rabid animals in a herd or herbivore-to-herbivore transmission are uncommon (*48*); therefore, restricting the rest of the herd if a single animal has been exposed to or infected by rabies is usually not necessary.

(4) Handling and consumption of tissues from animals exposed to rabies might carry a risk for rabies virus transmission. Risk factors depend in part on the sites of exposure, the amount of virus present, the severity of the wounds, and whether sufficient contaminated tissue has been excised. If an exposed animal is to be custom- or home-slaughtered for consumption, the slaughter should occur immediately after the exposure, and all tissues should be cooked thoroughly. Persons handling animals, carcasses, and tissues that have been exposed should use barrier precautions (*49,50*). Historically, federal guidelines for meat inspectors required that any animal known to have been exposed to rabies within 8 months be rejected for slaughter (*51*). The USDA Food and Inspection Service (FSIS) and state meat inspectors should be notified when such exposures occur in food animals before slaughter.

Rabies virus is widely distributed in tissues of rabid animals (*52–54*). Tissues and products from a rabid animal should not be used for human or animal consumption (*55,56*) or transplantation (*57*). Pasteurization and cooking inactivate rabies virus (*58*); therefore, inadvertently drinking pasteurized milk or eating thoroughly cooked animal products does not constitute a rabies exposure.

c) Other Animals. Other mammals exposed to a rabid animal should be euthanized immediately. Animals maintained in USDA-licensed research facilities or accredited zoological parks should be evaluated on a case-by-case basis in consultation with public health authorities. Options might include isolation, observation, or administration of rabies biologics (i.e., immune globulin or vaccine or both).

6. Management of Animals that Bite Humans

a) Dogs, Cats, and Ferrets. Rabies virus is excreted in the saliva of infected dogs, cats, and ferrets during illness and/or for only a few days before illness or death (*59–61*). Regardless of rabies vaccination status, a healthy dog, cat, or ferret that potentially exposes a person through a bite should be confined and observed daily for 10 days from the time of the exposure (*62*); administration of rabies vaccine to the animal is not recommended during the observation period to prevent confusion between signs of rabies and rare adverse reactions (*13*). Any illness in the animal should be reported immediately to the local health department. Animals should be evaluated by a veterinarian at the first sign of illness during confinement. If signs suggestive of rabies develop, the animal should be euthanized and the head submitted for testing as described in Part I.A.9. Any stray or unwanted dog, cat, or ferret that potentially exposes a person to rabies may be euthanized immediately and the head submitted for rabies examination.

b) Other Animals. Other animals that might have exposed a person to rabies should be reported immediately to the local health department. Management of animals other than dogs, cats, and ferrets depends on the species, the circumstances of the exposure, the epidemiology of rabies in the area, and the animals' history, current health status, and the potential for exposure to rabies. The shedding period for rabies virus is undetermined for most species. Previous vaccination of these animals might not preclude the necessity for euthanasia and testing.

7. Outbreak Prevention and Control. The emergence of new rabies virus variants or the introduction of nonindigenous viruses poses a significant risk to humans, domestic animals, and wildlife (*63–70*). A rapid and comprehensive response includes the following measures (*71*):

a) Characterize Virus. Characterize the virus at the national reference laboratory.

b) Identify and Control Source. Identify and control the source of the virus introduction.

c) Enhance Surveillance. Enhance laboratory-based surveillance in wild and domestic animals.

d) Increase Vaccination. Increase animal rabies vaccination rates.

e) **Restrict Animals.** Restrict the movement of animals.

f) **Evaluate Need to Reduce Vector Population.** Evaluate the need for vector population reduction.

g) **Coordinate Response.** Coordinate a multiagency response.

h) **Provide Outreach.** Provide public and professional outreach and education.

8. **Disaster Response.** Animals might be displaced during and after man-made or natural disasters and need emergency sheltering (http://www.bt.cdc.gov/disasters/petshelters.asp and http://www.avma.org/disaster/default.asp) (*72*). Animal rabies vaccination and exposure histories often are not available for displaced animals. Disaster response creates situations in which animal caretakers might lack appropriate training and preexposure vaccination. In such situations, implementing and coordinating rabies prevention and control measures is critical to reduce the risk for rabies transmission and the need for human PEP. Such measures include the following:

a) **Coordinate Relief**. Coordinate relief efforts of individuals and organizations with the local emergency operations center before deployment.

b) **Examine Animals.** Examine each animal at a triage site for possible bite injuries or signs of rabies.

c) **Isolate Animals.** Isolate animals exhibiting signs of rabies, pending evaluation by a veterinarian.

d) **Check Animal Identifiers.** Ensure that all animals have a unique identifier.

e) **Vaccinate.** Administer a rabies vaccination to all dogs, cats, and ferrets unless reliable proof of vaccination exists.

f) **Adopt Caretaker Standards.** Adopt minimum standards for animal caretakers as feasible, including personal protective equipment, preexposure rabies vaccination, and appropriate training in animal handling (*73*).

g) **Maintain Documentation.** Maintain documentation of animal disposition and location (e.g., returned to owner, died or euthanized, adopted, relocated to another shelter, and address of new location).

h) **Provide Facilities for Animals that Have Been Exposed.** Provide facilities to confine and observe animals involved in exposures (see Part I.B.6.).

i) **Report Human Exposures**. Report human exposures to rabies to appropriate public health authorities (see Part I.A.3.).

C. **Prevention and Control Methods Related to Wildlife.** The public should be warned not to handle or feed wild animals. Wild animals and hybrids that expose persons, pets, or livestock to rabies should be considered for euthanasia and rabies diagnosis. A person exposed by any wild animal should immediately report the incident to a health-care provider who, in consultation with public health authorities, can evaluate the need for PEP (*9,10*).

Translocation of infected wildlife has contributed to the spread of rabies (*63–68,74*); therefore, the translocation of known terrestrial rabies reservoir species should be prohibited. Whereas state-regulated wildlife rehabilitators and nuisance wildlife control operators might play a role in a comprehensive rabies control program, minimum standards for persons who handle wild animals should include rabies vaccination, appropriate training, and continuing education.

1. **Carnivores.** The use of oral rabies vaccines (ORV) for the mass vaccination of free-ranging wildlife should be considered in selected situations with the approval of the appropriate state agencies (*14,75*). Success has been documented using ORV to control rabies in wildlife in North America (*75–78*). The currently licensed vaccinia-vectored ORV is labeled for use in raccoons and coyotes. The distribution of ORV should be based on scientific assessments of the target species and followed by timely and appropriate analysis of surveillance data; such results should be provided to all stakeholders. In addition, parenteral vaccination (trap–vaccinate–release) of wildlife rabies reservoirs may be integrated into coordinated ORV programs to enhance their effectiveness. Continuous and persistent programs for trapping or poisoning wildlife do not reduce wildlife rabies reservoirs statewide. However, limited population control in high-contact areas (e.g., picnic grounds, camps, and suburban areas) might be indicated for the

removal of selected species of wildlife at high risk for having rabies. State agriculture, public health, and wildlife agencies should be consulted for planning, coordination, and evaluation of vaccination or population reduction programs (*14*).

2. **Bats.** From the 1950s through 2011, indigenous rabid bats have been reported from every state except Hawaii and have caused rabies in at least 43 humans in the United States (*79–92*). Bats should be excluded appropriately from houses, public buildings, and adjacent structures to prevent direct association with humans (*93,94*). Such structures should then be made bat-proof by sealing entrances used by bats. Controlling rabies in bats through programs designed to reduce bat populations is neither feasible nor desirable.

Part II. Recommendations for Parenteral Rabies Vaccination Procedures

A. Vaccine Administration. All animal rabies vaccines should be restricted to use by or under the direct supervision of a veterinarian (*95*), except as recommended in Part I.B.1.

B. Vaccine Selection. Part III lists all vaccines licensed by USDA and marketed in the United States at the time of publication. New vaccine approvals or changes in label specifications made after publication of this report should be considered a part of this list. Any of the listed vaccines can be used for revaccination, even if the product is not the same as previously administered. Vaccines used in state and local rabies control programs should have at least a 3-year duration of immunity. This constitutes the most effective method of increasing the proportion of immunized dogs and cats in any population (*96*). No laboratory or epidemiologic data exist to support the annual or biennial administration of 3- or 4-year vaccines following the initial series.

C. Adverse Events. No epidemiologic association exists between a particular licensed vaccine product and specific adverse events (*13,97–99*); although rare, adverse events including vomiting, swelling at the injection site, lethargy, hypersensitivity, and rabies in a previously vaccinated animal have been reported. Adverse events should be reported to the vaccine manufacturer and to USDA, Animal and Plant Health Inspection Service, Center for Veterinary Biologics (http://www.aphis.usda.gov/animal_health/vet_biologics/vb_adverse_event.shtml; telephone: 800-752-6255). No contraindication to rabies vaccination exists. Animals with a previous history of anaphylaxis can be medically managed and observed after vaccination (*46*).

D. Wildlife and Hybrid Animal Vaccination. The safety and efficacy of parenteral rabies vaccination of wildlife and hybrids have not been established, and no rabies vaccines are licensed for these animals. Zoos or research institutions may establish vaccination programs to attempt to protect valuable animals; however, these programs should not replace appropriate public health activities that protect humans (see Part I.B.1.c.2).

E. Accidental Human Exposure to Vaccine. Human exposure to parenteral animal rabies vaccines listed in Part III does not constitute a risk for rabies virus infection. Human exposure to vaccinia-vectored ORVs should be reported to state health officials (*100,101*).

F. Rabies Certificate. All agencies and veterinarians should use NASPHV Form 51 (revised 2007), Rabies Vaccination Certificate, or an equivalent. This form can be obtained from vaccine manufacturers, NASPHV (available at http://www.nasphv.org/Documents/RabiesVacCert.pdf), or CDC (available at http://www.cdc.gov/rabies/pdf/nasphv_form51.pdf). The form must be completed in full and signed by the administering or supervising veterinarian. Computer-generated forms containing the same information also are acceptable.

Part III: Rabies Vaccines Licensed and Marketed in the United States and Rabies Vaccine Manufacturer Contact Information

Adverse events after receipt of vaccine should be reported to the vaccine manufacturer (Tables 1 and 2) and to USDA, Animal and Plant Health Inspection Service, Center for Veterinary Biologics (http://www.aphis.usda.gov/animal_health/vet_biologics/vb_adverse_event.shtml; telephone: 800-752-6255).

TABLE 1. Rabies vaccines licensed and marketed in the United States, 2011

Product name	Produced by	Marketed by	For use in	Dose	Age at primary vaccination*	Booster recommended	Route of vaccination
Monovalent (inactivated)							
Rabvac 1	Boehringer Ingelheim Vetmedica, Inc.† License no. 112	Boehringer Ingelheim Vetmedica, Inc.	Dogs	1 mL	3 mos§	Annually	IM or SC
			Cats	1 mL	3 mos	Annually	IM or SC
Rabvac 3	Boehringer Ingelheim Vetmedica, Inc. License no. 112	Boehringer Ingelheim Vetmedica, Inc.	Dogs	1 mL	3 mos	1 yr later and triennially	IM or SC
			Cats	1 mL	3 mos	1 yr later and triennially	IM or SC
			Horses	2 mL	3 mos	Annually	IM
Rabvac 3 TF	Boehringer Ingelheim Vetmedica, Inc. License no. 112	Boehringer Ingelheim Vetmedica, Inc.	Dogs	1 mL	3 mos	1 yr later and triennially	IM or SC
			Cats	1 mL	3 mos	1 yr later and triennially	IM or SC
			Horses	2 mL	3 mos	Annually	IM
Continuum Rabies	Intervet, Inc. License no. 165A	Intervet, Inc.	Dogs	1 mL	3 mos	1 yr later and triennially	SC
			Cats	1 mL	3 mos	1 yr later and quadrennially	SC
EquiRab	Intervet, Inc. License no. 165A	Intervet, Inc.	Horses	1 mL	4 mos	Annually	IM
Prorab 1	Intervet, Inc. License no. 165A	Intervet, Inc.	Dogs	1 mL	3 mos	Annually	IM or SC
			Cats	1 mL	3 mos	Annually	IM or SC
			Sheep	2 mL	3 mos	Annually	IM
Defensor 1	Pfizer, Inc. License no. 189	Pfizer, Inc.	Dogs	1 mL	3 mos	Annually	IM or SC
			Cats	1 mL	3 mos	Annually	SC
Defensor 3	Pfizer, Inc. License no. 189	Pfizer, Inc.	Dogs	1 mL	3 mos	1 yr later and triennially	IM or SC
			Cats	1 mL	3 mos	1 yr later and triennially	SC
			Sheep	2 mL	3 mos	Annually	IM
			Cattle	2 mL	3 mos	Annually	IM
Rabdomun	Pfizer, Inc. License no. 189	Schering-Plough Animal Health	Dogs	1 mL	3 mos	1 yr later and triennially	IM or SC
			Cats	1 mL	3 mos	1 yr later and triennially	SC
			Sheep	2 mL	3 mos	Annually	IM
			Cattle	2 mL	3 mos	Annually	IM
Rabdomun 1	Pfizer, Inc. License no. 189	Schering-Plough Animal Health	Dogs	1 mL	3 mos	Annually	IM or SC
			Cats	1 mL	3 mos	Annually	SC
Imrab 1	Merial, Inc. License no. 298	Merial, Inc.	Dogs	1 mL	3 mos	Annually	SC
			Cats	1 mL	3 mos	Annually	SC
Imrab 1 TF	Merial, Inc. License no. 298	Merial, Inc.	Dogs	1 mL	3 mos	Annually	SC
			Cats	1 mL	3 mos	Annually	SC
Imrab 3	Merial, Inc. License no. 298	Merial, Inc.	Dogs	1 mL	3 mos	1 yr later and triennially	IM or SC
			Cats	1 mL	3 mos	1 yr later and triennially	IM or SC
			Sheep	2 mL	3 mos	1 yr later and triennially	IM or SC
			Cattle	2 mL	3 mos	Annually	IM or SC
			Horses	2 mL	3 mos	Annually	IM or SC
			Ferrets	1 mL	3 mos	Annually	SC

See table footnotes on page 11.

TABLE 1. (*Continued*) Rabies vaccines licensed and marketed in the United States, 2011

Product name	Produced by	Marketed by	For use in	Dose	Age at primary vaccination*	Booster recommended	Route of vaccination
Imrab 3 TF	Merial, Inc. License no. 298	Merial, Inc.	Dogs Cats Ferrets	1 mL 1 mL 1 mL	3 mos 3 mos 3 mos	1 yr later and triennially 1 yr later and triennially Annually	IM or SC IM or SC SC
Imrab Large Animal	Merial, Inc. License no. 298	Merial, Inc.	Cattle Horses Sheep	2 mL 2 mL 2 mL	3 mos 3 mos 3 mos	Annually Annually 1 yr later and triennially	IM or SC IM or SC IM or SC
Monovalent (rabies glycoprotein, live canary pox vector)							
PureVax Feline Rabies	Merial, Inc. License no. 298	Merial, Inc.	Cats	1mL	3 mos	Annually	SC
Combination (inactivated rabies)							
Continuum DAP-R	Intervet, Inc. License no. 165A	Intervet, Inc.	Dogs	1 mL	3 mos	1 yr later and triennially	SC
Continuum Feline HCP-R	Intervet, Inc. License no. 165A	Intervet, Inc.	Cats	1 mL	3 mos	1 yr later and triennially	SC
Equine Potomavac + Imrab	Merial, Inc. License no. 298	Merial, Inc.	Horses	1 mL	3 mos	Annually	IM
Combination (rabies glycoprotein, live canary pox vector)							
PureVax Feline 3/ Rabies	Merial, Inc. License no. 298	Merial, Inc.	Cats	1 mL	8 wks 3 mos	Every 3 wks until 3 mos and annually 3 wks later and annually	SC
PUREVAX Feline 4/ Rabies	Merial, Inc. License no. 298	Merial, Inc.	Cats	1 mL	8 wks 3 mos	Every 3 wks until 3 mos and annually 3 wks later and annually	SC
Oral (rabies glycoprotein, live vaccinia vector): restricted to use in state and federal rabies control programs							
Raboral V-RG	Merial, Inc. License no. 298	Merial, Inc.	Coyotes Raccoons	N/A	N/A	As determined by local authorities	Oral

Abbreviations: IM = intramuscular; N/A = not applicable; SC = subcutaneous; TF = thimerosal free.
* Minimum age (or older) and revaccinated 1 year later.
† Fort Dodge Animal Health was recently acquired by Boehringer Ingelheim Vetmedica, Inc.
§ One month = 28 days.

TABLE 2. Rabies vaccine manufacturer contact information

Manufacturer	Phone number	Internet address
Boehringer Ingelheim Vetmedica, Inc.	800-638-2226	Not available
Intervet, Inc.	800-441-8272	http://www.intervetusa.com
Merial, Inc.	888-637-4251	http://us.merial.com
Pfizer, Inc.	800-366-5288	http://www.pfizerah.com

References

1. American Public Health Association. Rabies. In: Heymann D, ed. Control of communicable diseases manual. 19th ed. Washington, DC: American Public Health Association; 2008:498–508.
2. Blanton JD, Palmer D, Christian KA, Rupprecht CE. Rabies surveillance in the United States during 2009. J Am Vet Med Assoc 2010;237:646–57.
3. Castrodale L, Walker V, Baldwin J, Hofmann J, Hanlon C. Rabies in a puppy imported from India to the USA, March 2007. Zoonoses Public Health 2008;55:427–30.
4. CDC. Rabies in a dog imported from Iraq—New Jersey, June 2008. MMWR 2008;57:1076–8.
5. McQuiston JH, Wilson T, Harris S, et al. Importation of dogs into the United States: risks from rabies and other zoonotic diseases. Zoonoses Public Health 2008;55:421–6.
6. Velasco-Villa A, Reeder SA, Orciari LA, et al. Enzootic rabies elimination from dogs and reemergence in wild terrestrial carnivores, United States. Emerg Infect Dis 2008;14:1849–54.
7. Beran GW. Rabies and infections by rabies-related viruses. In: Beran GW, ed. Handbook of zoonoses section B: Viral, 2nd ed. Boca Raton, FL: CRC Press; 1994:307–57.
8. Council of State and Territorial Epidemiologists. Public health reporting and national notification for animal rabies. Infectious disease positions statements, June 2009. Atlanta, GA: Council of State and Territorial Epidemiologists. Available at http://www.cste.org/ps2009/09-ID-12.pdf. Accessed September 1, 2011.
9. CDC. Human rabies prevention—United States, 2008. Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2008;57(No. RR-3).
10. CDC. Use of reduced (4-dose) vaccine schedule for postexposure prophylaxis to prevent human rabies. Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2010;59(No. RR-2).
11. McQuiston J, Yager PA, Smith JS, Rupprecht CE. Epidemiologic characteristics of rabies virus variants in dogs and cats in the United States, 1999. J Am Vet Med Assoc 2001;218:1939–42.
12. Murray KO, Holmes KC, Hanlon CA. Rabies in vaccinated dogs and cats in the United States, 1997–2001. J Am Vet Med Assoc 2009;235:691–5.
13. Frana TS, Clough NE, Gatewood DM, Rupprecht CE. Postmarketing surveillance of rabies vaccines for dogs to evaluate safety and efficacy. J Am Vet Med Assoc 2008;232:1000–2.
14. Hanlon CA, Childs JE, Nettles VF, et al. Recommendations of the Working Group on Rabies. Article III: rabies in wildlife. J Am Vet Med Assoc 1999;215:1612–8.
15. Slate D, Algeo TD, Nelson KM, et al. Oral rabies vaccination in North America: opportunities, complexities, and challenges. PLoS Negl Trop Dis 2009;3:1–9
16. Council of State and Territorial Epidemiologists. Electronic laboratory reporting in the US: underfunded and under potential, or, recommendations for the implementation of ELR in the US. Policy Positions Statements. Atlanta, GA: Council of State and Territorial Epidemiologists; 2009. Available at http://www.cste.org/ps2009/09-SI-03.pdf. Accessed September 1, 2011.
17. Council of State and Territorial Epidemiologists. Process statement for immediately nationally notifiable conditions. Policy Positions Statements, Atlanta, GA: Council of State and Territorial Epidemiologists; 2009. Available at http://www.cste.org/ps2009/09-SI-04.pdf. Accessed September 1, 2011.
18. Hanlon CA, Smith JS, Anderson GR, et al. Recommendations of the Working Group on Rabies. Article II: laboratory diagnosis of rabies. J Am Vet Med Assoc 1999;215:1444–6.
19. Rudd RJ, Smith JS, Yager PA, et al. A need for standardized rabies-virus diagnostic procedures: effect of cover-glass mountant on the reliability of antigen detection by the fluorescent antibody test. Virus Res 2005;111:83–8.
20. American Veterinary Medical Association. AVMA guidelines on euthanasia. Schaumburg, IL: American Veterinary Medical Association; 2007. Available at http://www.avma.org/issues/animal_welfare/euthanasia.pdf. Accessed September 1, 2011.
21. Michigan Rabies Working Group. Humane euthanasia of bats for public health rabies testing. Lansing, MI: Michigan Rabies Working Group; 2008. Available at http://www.michigan.gov/documents/emergingdiseases/Humane_Euthanasia_of_Bats-Final_244979_7.pdf. Accessed September 1, 2011.
22. CDC. Public health response to a potentially rabid bear cub—Iowa, 1999. MMWR 1999;48:971–3.
23. Niezgoda M, Rupprecht CE. Standard operating procedure for the direct rapid immunohistochemistry test for the detection of rabies virus antigen. National Laboratory Training Network Course. Atlanta, GA: US Department of Health and Human Services, CDC; 2006:1–16. Available at http://www.rabiesblueprint.com/IMG/pdf/DRIT_SOP.pdf. Accessed September 1, 2011.
24. Lembo T, Niezgoda M, Velasco-Villa A, Cleaveland S, Ernest E, Rupprecht CE. Evaluation of a direct, rapid immunohistochemical test for rabies diagnosis. Emerg Infect Dis 2006;12:310–3.
25. Dürr S, Naïssengar S, Mindekem R, et al. Rabies diagnosis for developing countries. PLoS Negl Trop Dis 2008;26:e206.
26. Saturday GA, King R, Fuhrmann L. Validation and operational application of a rapid method for rabies antigen detection. US Army Med Dep J 2009;Jan–Mar:42–5.
27. Tizard I, Ni Y. Use of serologic testing to assess immune status of companion animals. J Am Vet Med Assoc 1998;213:54–60.
28. Greene CE, ed. Rabies and other lyssavirus infections. In: Infectious diseases of the dog and cat. 3rd ed. London, England: Saunders Elsevier; 2006:167–83.
29. Rupprecht CE, Gilbert J, Pitts R, Marshall K, Koprowski H. Evaluation of an inactivated rabies virus vaccine in domestic ferrets. J Am Vet Med Assoc 1990;196:1614–6.
30. Moore SM, Hanlon CA. Rabies-specific antibodies: measuring surrogates of protection against a fatal disease. PLoS Negl Trop Dis 2010;4:e595.
31. Aubert MF. Practical significance of rabies antibodies in cats and dogs. Rev Sci Tech 1992;11:735–60.
32. Muirhead TL, McClure JT, Wichtel JJ, et al. The effect of age on serum antibody titers after rabies and influenza vaccination in healthy horses. J Vet Intern Med 2008;22:654–61.
33. Shimazaki Y, Inoue S, Takahashi C, et al. Immune response to Japanese rabies vaccine in domestic dogs. J Vet Med B 2003;50:95–8.
34. Cliquet F, Verdier Y, Sagné L, et al. Neutralising antibody titration in 25,000 sera of dogs and cats vaccinated against rabies in France, in the framework of the new regulations that offer an alternative to quarantine. Rev Sci Tech 2003;22:857–66.

35. Rabies. In: Guidelines for the vaccination of horses. Lexington, KY: American Association of Equine Practitioners; 2009. Available at http://www.aaep.org/rabies.htm. Accessed September 1, 2011.
36. CDC. Compendium of measures to prevent disease and injury associated with animals in public settings, 2007. MMWR 2007;56(No. RR-5).
37. Bender J, Schulman S. Reports of zoonotic disease outbreaks associated with animal exhibits and availability of recommendations for preventing zoonotic disease transmission from animals to people in such settings. J Am Vet Med Assoc 2004;224:1105–9.
38. American Veterinary Medical Association. Private ownership of wild animals. Schaumburg, IL: American Veterinary Medical Association; 2006. Available at http://www.avma.org/issues/policy/wild_animal_ownership.asp. Accessed September 1, 2011.
39. American Veterinary Medical Association. Position on canine hybrids. Schaumburg, IL: American Veterinary Medical Association; 2008.
40. Siino BS. Crossing the line: the case against hybrids. New York City, NY: American Society for the Prevention of Cruelty to Animals, Animal Watch; 2000:22–9. Available at http://www.petfinder.com/before-pet-adoption/case-against-hybrids.html?page-index=1&query=hybrids. Accessed September 1, 2011.
41. Jay MT, Reilly KF, DeBess EE, Haynes EH, Bader DR, Barrett LR. Rabies in a vaccinated wolf-dog hybrid. J Am Vet Med Assoc 1994;205:1729–32.
42. CDC. An imported case of rabies in an immunized dog. MMWR 1987;36:94–6.
43. CDC. Imported dog and cat rabies—New Hampshire, California. MMWR 1988;37:559–60.
44. Hanlon CA, Niezgoda MN, Rupprecht CE. Postexposure prophylaxis for prevention of rabies in dogs. Am J Vet Res 2002;63:1096–100.
45. Rabies vaccine, killed virus. 9 C.F.R. Sect. 113.209 (2003).
46. Greene CE, ed. Immunoprophylaxis. In: Infectious diseases of the dog and cat. 3rd ed. London, England: Saunders, Elsevier; 2006;1069–119.
47. Willoughby, RE. "Early death" and the contraindication of vaccine during rabies treatment. Vaccine 2009;27:7173–7.
48. Mansfield K, McElhinney L, Hübschle O, et al. A molecular epidemiological study of rabies epizootics in kudu (*Tragelaphus strepsiceros*) in Namibia. BMC Vet Res 2006;2:2.
49. Viral agents. In: US Department of Health and Human Services. Biosafety in microbiological and biomedical laboratories. 5th ed. Washington, DC: U.S. Government Printing Office; 2007:234–5. Available at http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5_sect_VIII_e.pdf. Accessed September 1, 2011.
50. Wertheim HFL, Nguyen TQ, Nguyen KAT, et al. Furious rabies after an atypical exposure. PLoS Med 2009;6(3):0264–8.
51. Ante-mortem inspection. In: US Meat and Poultry Inspection Program. Meat and poultry inspection manual. Washington, DC: US Government Printing Office; 1973:314.
52. Debbie JG, Trimarchi CV. Pantropism of rabies virus in free-ranging rabid red fox (*Vulpes fulva*). J Wildl Dis 1970;6:500–6.
53. Fekadu M, Shaddock JH. Peripheral distribution of virus in dogs inoculated with two strains of rabies virus. Am J Vet Res 1984;45:724–729.
54. Charlton, KM. The pathogenesis of rabies and other lyssaviral infections: recent studies. Curr Top Microbiol Immunol 1994;187:95–119.
55. Afshar A. A review of non-bite transmission of rabies virus infection. Br Vet J 1979;135:142–8.
56. CDC. Mass treatment of humans who drank unpasteurized milk from rabid cows—Massachusetts, 1996–1998. MMWR 1999;48:228–9.
57. CDC. U.S. public health service guideline on infectious disease issues in xenotransplantation. MMWR 2001;50(No. RR–15).
58. Turner GS, Kaplan C. Some properties of fixed rabies virus. J Gen Virol 1967;1:537–51.
59. Vaughn JB, Gerhardt P, Paterson J. Excretion of street rabies virus in saliva of cats. J Am Med Assoc 1963;184:705.
60. Vaughn JB, Gerhardt P, Newell KW. Excretion of street rabies virus in saliva of dogs. J Am Med Assoc 1965;193:363–8.
61. Niezgoda M, Briggs DJ, Shaddock J, Rupprecht CE. Viral excretion in domestic ferrets (*Mustela putorius furo*) inoculated with a raccoon rabies isolate. Am J Vet Res 1998;59:1629–32.
62. Tepsumethanon V, Lumlertdacha B, Mitmoonpitak C, Sitprija V, Meslin FX, Wilde H. Survival of naturally infected rabid dogs and cats. Clin Infect Dis 2004;39:278–80.
63. Jenkins SR, Perry BD, Winkler WG. Ecology and epidemiology of raccoon rabies. Rev Infect Dis 1988;10(Suppl 4):S620–5.
64. CDC. Translocation of coyote rabies—Florida, 1994. MMWR 1995;44:580–7.
65. Rupprecht CE, Smith JS, Fekadu M, Childs JE. The ascension of wildlife rabies: a cause for public health concern or intervention? Emerg Infect Dis 1995;1:107–14.
66. Constantine DG. Geographic translocation of bats: known and potential problems. Emerg Infect Dis 2003;9:17–21.
67. Krebs JW, Strine TW, Smith JS, Rupprecht CE, Childs JE. Rabies surveillance in the United States during 1993. J Am Vet Med Assoc 1994;1695–709.
68. VF Nettles, JH Shaddock, RK Sikes, CR Reyes. Rabies in translocated raccoons. Am J Public Health 1979;69:601–2.
69. RM Engeman, KL Christensen, MJ Pipas, DL Bergman. Population monitoring in support of a rabies vaccination program for skunks in Arizona. J Wildl Dis 2003;39:746–50.
70. Leslie MJ, Messenger S, Rohde RE, et al. Bat-associated rabies virus in skunks. Emerg Infect Dis 2006;12:1274–7.
71. Rupprecht CE, Hanlon CA, Slate D. Control and prevention of rabies in animals: paradigm shifts. Dev Biol (Basel). 2006;125:103–11.
72. Pets Evacuation and Transportations Standards Act of 2006. P.L. 109-308, 109th Cong., 120 Stat. 1725 (2006).
73. National Animal Control Association. National Animal Control Association guidelines. Kansas City, MO: National Animal Control Association. Available at http://www.nacanet.org/guidelines.html. Accessed September 1, 2011.
74. Chipman R, Slate D, Rupprecht C, Mendoza M. Downside risk of translocation. In: Dodet B, Fooks AR, Muller T, Tordo N; Scientific & Technical Department of the OIE, eds: Towards the elimination of rabies in Eurasia. Dev Biol 2008;131:223–32.
75. Slate D, Rupprecht CE, Rooney JA, Donovan D, Lein DH, Chipman RB. Status of oral rabies vaccination in wild carnivores in the United States. Virus Res 2005;111:68–76.
76. Sidwa TJ, Wilson PJ, Moore GM, et al. Evaluation of oral rabies vaccination programs for control of rabies epizootics in coyotes and gray foxes: 1995–2003. J Am Vet Med Assoc 2005;227:785–92.
77. MacInnes CD, Smith SM, Tinline RR, et al. Elimination of rabies from red foxes in eastern Ontario. J Wildl Dis 2001;37:119–32.
78. Rosatte RC, Power MJ, Donovan D, et al. Elimination of arctic variant of rabies in red foxes, metropolitan Toronto. Emerg Infect Dis 2007;1325–27.

79. Messenger SL, Smith JS, Rupprecht CE. Emerging epidemiology of bat-associated cryptic cases of rabies in humans in the United States. Clin Infect Dis 2002;35:738–47.
80. CDC. Human rabies—California, 2002. MMWR 2002;51:686–8.
81. CDC. Human rabies—Tennessee, 2002. MMWR 2002;51:828–9.
82. CDC. Human rabies—Iowa, 2002. MMWR 2003;52:47–8.
83. CDC. Human death associated with bat rabies—California, 2003. MMWR 2004;53:33–5.
84. CDC. Recovery of a patient from clinical rabies, Wisconsin, 2004. MMWR 2004;53:1171–3.
85. CDC. Human rabies—Mississippi, 2005. MMWR 2006;55:207–8.
86. CDC. Human rabies—Indiana and California, 2006. MMWR 2007;56:361–5.
87. CDC. Human rabies—Minnesota, 2007. MMWR 2008;57:460–2.
88. CDC. Human rabies—Missouri, 2008. MMWR 2009;58:1207–9.
89. CDC. Human rabies—Kentucky/Indiana, 2009. MMWR 2010;59:393–6.
90. CDC. Human rabies—Virginia, 2009. MMWR 2010;591236–8.
91. CDC. Presumptive abortive human rabies—Texas, 2009. MMWR 2010;59:185–90.
92. CDC. Human rabies—Michigan, 2009. MMWR 2011;60:437–40.
93. Greenhall AM. House bat management. US Fish and Wildlife Service, Resource Publication 143;1982. Jamestown, ND: Northern Prairie Wildlife Research Center Online; 1982. Available at http://www.npwrc.usgs.gov/resource/mammals/housebat/index.htm. Accessed September 1, 2011.
94. Greenhall AM, Frantz SC. Bats. In: Hygnstrom SE, Timm RM, Larson GE, eds. Prevention and control of wildlife damage. Cooperative Extension Division Institute of Agriculture and Natural Resources University of Nebraska—Lincoln; United States Department of Agriculture Animal and Plant Health Inspection Service Animal Damage Control; Great Plains Agricultural Council Wildlife Committee; 1994. Available at http://icwdm.org/handbook/mammals/bats.asp. Accessed September 1, 2011.
95. American Veterinary Medical Association. Model rabies control ordinance. Schaumburg, IL: American Veterinary Medical Association; 2008. Available at http://www.avma.org/issues/policy/AVMA-Model-Rabies-Ordinance.pdf. Accessed September 1, 2011.
96. Bunn TO. Canine and feline vaccines, past and present. In Baer GM, ed. The natural history of rabies. 2nd ed. Boca Raton, FL: CRC Press; 1991:415–25.
97. Macy DW, Hendrick MJ. The potential role of inflammation in the development of postvaccinal sarcomas in cats. Vet Clin North Am Small Anim Pract 1996;26:103–9.
98. Gobar GM, Kass PH. World wide web-based survey of vaccination practices, postvaccinal reactions, and vaccine site-associated sarcomas in cats. J Am Vet Med Assoc 2002;220:1477–82.
99. Kass PH, Spangler WL, Hendrick MJ, et al. Multicenter case-control study of risk factors associated with development of vaccine-associated sarcomas in cats. J Am Vet Med Assoc 2003;223:1283–92.
100. Rupprecht CE, Blass L, Smith K, et al. Human infection due to recombinant vaccinia-rabies glycoprotein virus. N Engl J Med 2001;345:582–6.
101. CDC. Human vaccinia infection after contact with a raccoon rabies vaccine bait—Pennsylvania, 2009. MMWR 2009;58:1204–7.

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