Feline Vaccine
Selection and Administration*

The 1998 Report of the American Association of Feline Practitioners and Academy of Feline Medicine Advisory Panel on Feline Vaccines was developed to help veterinary practitioners formulate vaccination protocols for cats. The current panel report updates information as well as addresses questions and concerns raised by the 1998 report. In addition, this report reviews vaccine licensing, labeling, and liability issues and suggests ways to successfully incorporate vaccination protocols into private practice settings.

The guidelines incorporated in this report were developed on the basis of the best research information, clinical experience, and technical judgments available at the time of preparation. Although intended to be accurate, thorough, and comprehensive, this information is subject to change in light of developments in research, technology, and experience. These guidelines are not exclusive, and other techniques and procedures may be available. The American Association of Feline Practitioners (AAFP) and Academy of Feline Medicine (AFM) expressly disclaim any warranties or guarantees, express or implied, and shall not be liable for any damages of any kind in connection with the material, information, techniques, or procedures set forth in these guidelines. For more information regarding the AAFP and the AFM, please contact them at 530 Church Street, Suite 700, Nashville, TN 37219, 615-254-3687.

The overall objectives of vaccination are to vaccinate the largest possible number of at-risk cats, vaccinate each animal only when necessary, and vaccinate only against infectious agents to which animals have a realistic risk of exposure and subsequent development of disease. Kittens younger than 16 weeks of age are generally more susceptible to infection than adult cats and typically develop more severe disease. Thus they represent the principal target population for vaccination.[1] Maternal antibody interference is the most common reason why some animals are not immunized following vaccination and is the reason why a series of vaccinations is necessary for kittens younger than 12 weeks of age.[2] The vaccination needs of adult cats should be assessed at least once yearly and, if necessary, modified on the basis of an assessment of their risk.

It is recommended that administration sites for parenteral vaccines be chosen in accordance with the guidelines established by the AAFP and adopted by the Vaccine-Associated Feline Sarcoma Task Force (see Table I; Vaccination Site Recommendations). Use of multiple-dose vials is discouraged because inadequate mixing may result in unequal distribution of antigen and adjuvant, possibly resulting in decreased efficacy or increased likelihood of adverse events; iatrogenic contamination is an additional risk. The panel discourages the use of polyvalent vaccines other than those containing combinations of feline panleukopenia (FPL) virus, feline herpesvirus-1 (FHV-1), and feline calicivirus (FCV), exclusively. This opinion is based on the belief that as the number of antigens in a vaccine increases, the probability of associated ad-

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*Editor’s Note: This is part I of the 2000 Report of the American Association of Feline Practitioners and Academy of Feline Medicine Advisory Panel on Feline Vaccines. Panelists included James Richards, DVM (Co-Chair); Ilona Rodan, DVM (Co-Chair); Thomas Elston, DVM; Duane Flemming, DVM, JD; Richard Ford, DVM, MS; Steven Henry, DVM; David Hustead, DVM; Michael Lappin, DVM, PhD; Michael Paul, DVM; David Rosen, DVM; Margie Scherk, DVM; Fred Scott, DVM, PhD; and Link Welborn, DVM. Reviewers included Sue Cotter, DVM; Philip Kass, DVM, PhD; Ronald Schulz, PhD; Alice Wolf, DVM; Douglas DeBoer, DVM; and Karen Morio, DVM. This report has received the endorsement of the Board of Regents of the American College of Veterinary Internal Medicine and the Board of Directors of the American Animal Hospital Association. The report was also reviewed and approved by the Feline Practice Guidelines Committee of the American Association of Feline Practitioners (AAFP), the Academy of Feline Medicine (AFM) Board of Directors, and the AAFP Board of Directors. It has been adapted with permission from the AAFP and AFM.

These guidelines were also adapted for publication in the August (Vol. 20, No. 8) 1998 issue of Compendium.
TABLE I
AAFP/AFM Recommended Guidelines for Vaccination of Cats

<table>
<thead>
<tr>
<th>Antigen</th>
<th>Vaccine Types</th>
<th>Primary Vaccination</th>
<th>Cats &lt;12 Wk of Age</th>
<th>Cats ≥12 Wk of Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feline parvovirus&lt;sup&gt;a&lt;/sup&gt;</td>
<td>MLV vaccine for parenteral administration; MLV vaccine for topical administration; adjuvanted inactivated virus vaccine for parenteral administration</td>
<td>If ≥6 wk of age, vaccinate at initial visit and every 3–4 wk until ≥12 wk&lt;sup&gt;6&lt;/sup&gt;</td>
<td>Administer two doses, 3–4 wk apart</td>
<td></td>
</tr>
<tr>
<td>Feline herpesvirus-1 and feline calicivirus</td>
<td>Combined MLV vaccine for parenteral administration; combined adjuvanted inactivated virus vaccine for parenteral administration</td>
<td>If ≥6 wk of age, vaccinate at initial visit and every 3–4 wk until ≥12 wk&lt;sup&gt;6&lt;/sup&gt;</td>
<td>Administer two doses, 3–4 wk apart</td>
<td></td>
</tr>
<tr>
<td>Feline herpesvirus-1 and feline calicivirus</td>
<td>Combined MLV vaccine for topical administration</td>
<td>If ≥6 wk of age, vaccinate at initial visit and every 3–4 wk until ≥12 wk&lt;sup&gt;7&lt;/sup&gt;</td>
<td>Administer one dose</td>
<td></td>
</tr>
<tr>
<td>Rabies</td>
<td>Adjuvanted inactivated virus vaccine for parenteral administration every year&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Not eligible for vaccination</td>
<td>Administer one dose</td>
<td></td>
</tr>
<tr>
<td>Rabies</td>
<td>Adjuvanted inactivated virus vaccine for parenteral administration every 3 yr&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Not eligible for vaccination</td>
<td>Administer one dose</td>
<td></td>
</tr>
<tr>
<td>Rabies</td>
<td>Canarypox virus–vectored recombinant vaccine for parenteral administration</td>
<td>Administer one dose to cats as young as 8 wk of age</td>
<td>Administer one dose</td>
<td></td>
</tr>
<tr>
<td>FeLV</td>
<td>Adjuvanted and non-adjuvanted inactivated virus vaccines for parenteral administration</td>
<td>Administer two doses 3–4 wk apart to cats as young as 8 wk of age&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Administer two doses, 3–4 wk apart</td>
<td></td>
</tr>
<tr>
<td>Chlamydia psittaci infection</td>
<td>MLV vaccine for parenteral administration; adjuvanted inactivated vaccine for parenteral administration</td>
<td>If ≥29 wk of age, administer two doses 3–4 wk apart</td>
<td>Administer two doses, 3–4 wk apart</td>
<td></td>
</tr>
<tr>
<td>Feline infectious peritonitis virus</td>
<td>MLV vaccine for topical administration</td>
<td>Not approved for cats &lt;16 wk of age</td>
<td>Administer two doses, 3–4 wk apart up to cats ≥16 wk of age</td>
<td></td>
</tr>
<tr>
<td>Microsporum canis infection</td>
<td>Adjuvanted inactivated vaccine for parenteral administration</td>
<td>Not approved for cats &lt;16 wk of age</td>
<td>First dose administered SC to cats ≥16 wk of age; second dose SC 12–16 days after first dose; third dose SC 26–30 days after second dose</td>
<td></td>
</tr>
<tr>
<td>Bordetella bronchiseptica infection</td>
<td>MLV vaccine for topical administration&lt;sup&gt;f&lt;/sup&gt;</td>
<td>Administer one dose (0.2 ml) intranasally to cats ≥4 wk of age</td>
<td>Administer one dose (0.2 ml) intranasally</td>
<td></td>
</tr>
<tr>
<td>Giardia lamblia infection</td>
<td>Adjuvanted inactivated vaccine for parenteral administration</td>
<td>Administer the first dose to cats 8 wk of age and a second dose 3–4 wk later</td>
<td>Administer two doses, 3–4 wk apart</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Cause of feline panleukopenia.
<sup>b</sup>For kittens that are orphaned or at high risk of exposure, vaccination when as young as 4 weeks of age may be indicated.
<sup>c</sup>For kittens that are orphaned or at high risk of exposure, vaccination when as young as 10 to 14 days of age may be indicated.
<sup>d</sup>A specific route of administration may be required; see product information for details.
<sup>e</sup>Most often, the product approved for use annually is given for initial vaccination, followed 1 year later and every 3 years after that by administration of the product approved for use every 3 years; however, vaccination intervals must comply with local and state statutes.
<table>
<thead>
<tr>
<th>Booster Vaccination</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 yr after primary vaccination, then no more frequently than every 3 yr</td>
<td>Highly recommended for all cats; in most cats, protection derived following administration of booster vaccine 1 yr after primary vaccination is sustained for at least 3 yr and probably ≥5–6 yr; MLV vaccines should not be administered to pregnant queens or kittens &lt;4 wk of age</td>
</tr>
<tr>
<td>1 yr after primary vaccination, then every 3 yr</td>
<td>Highly recommended for all cats; MLV vaccine should not be administered to pregnant queens</td>
</tr>
<tr>
<td>1 yr after primary vaccination, then every 3 yr</td>
<td>Highly recommended for all cats; may be used as an alternative to the parenteral product; may be preferable to parenterally administered vaccines in cats reared in or entering environments in which viral upper respiratory tract disease is endemic (e.g., some catteries, boarding facilities, shelters); MLV vaccine should not be administered to pregnant queens</td>
</tr>
<tr>
<td>1 yr after primary vaccination, then every year*</td>
<td>Rabies vaccination is highly recommended for all cats and is required by law in some regions of the country; veterinarians should comply with state and local statutes regarding type of vaccine to be used and vaccination interval</td>
</tr>
<tr>
<td>1 yr after primary vaccination, then every 3 yr*</td>
<td>Rabies vaccination is highly recommended for all cats and is required by law in some regions of the country; veterinarians should comply with state and local statutes regarding type of vaccine to be used and vaccination interval</td>
</tr>
<tr>
<td>1 yr after primary vaccination, then every year</td>
<td>Rabies vaccination is highly recommended for all cats; the recombinant rabies virus vaccine can be used as an alternative to other products approved for annual use; this product does not contain an adjuvant</td>
</tr>
<tr>
<td>Annually</td>
<td>Recommended for cats that are not restricted to a closed, indoor, FeLV-negative environment; most important for cats &lt;16 wk of age; not recommended for cats ≥16 wk of age with minimal to no risk of exposure to FeLV-infected cats</td>
</tr>
<tr>
<td>Annually</td>
<td>Not recommended for routine use; can be considered for use in cats in multiple-cat environments where C. psittaci infections associated with clinical disease have been documented</td>
</tr>
<tr>
<td>Annually</td>
<td>Not recommended; at this time, there is insufficient evidence to support the conclusion that the vaccine induces clinically relevant protection</td>
</tr>
<tr>
<td>Not stipulated</td>
<td>Not recommended for routine use; vaccination may be considered as one component of a comprehensive control program in multiple-cat environments in which M. canis infection is endemic or as adjunctive treatment to hasten resolution of clinical signs in individual cats</td>
</tr>
<tr>
<td>Not stipulated</td>
<td>Not recommended for routine use; vaccination may be considered for cats entering or residing in multiple-cat environments in which B. bronchiseptica infections associated with clinical disease have been documented</td>
</tr>
<tr>
<td>Annually</td>
<td>Not recommended for routine use; vaccination may be considered as one component of a comprehensive control program in multiple-cat environments in which G. lamblia infections associated with clinical disease have been documented</td>
</tr>
</tbody>
</table>

*FeLV testing is recommended before vaccination; infected cats do not derive any benefit from vaccination.

*This product is not the same as the B. bronchiseptica vaccine approved for use in dogs; the product approved for use in dogs should not be used in cats.

Note: Parenteral vaccines should be administered SC or intramuscularly.

AAFP = American Association of Feline Practitioners; AFM = Academy of Feline Medicine; FeLV = feline leukemia virus; MLV = modified-live virus; SC = subcutaneously.
verse events also increases. Additionally, use of polyvalent vaccines may force practitioners to administer vaccine antigens not needed by the patient.

FELINE PANLEUKOPENIA

Feline panleukopenia is caused by feline parvovirus (FPV). The virus remains infectious for months to years in the environment and is primarily spread via the fecal–oral route. Fomites (e.g., cages, food bowls, litterboxes, health care workers) play an important role in transmission of the organism. Clinical signs of infection include lethargy, anorexia, vomiting, diarrhea, fever, and profound panleukopenia; mortality rates are highest in young, susceptible cats. In utero infection with FPV is a common cause of cerebellar hypoplasia.

Vaccination against FPV is highly recommended for all cats. Immunity to FPL is primarily through antibody response to natural infection, vaccination, or passive transfer of maternal antibodies from queen to kittens. Maternal antibody may interfere with immunization when antibody titers are high during the neonatal period. Maternal antibody titers generally wane sufficiently to allow immunization by 12 weeks of age. Immunity conferred by FPL is considered to be excellent, and most vaccinated animals are completely protected from infection and clinical disease. Both serologic and challenge-exposure data indicate that a parenteral FPV vaccine induces immunity that is sustained for at least 7 years. Therefore, following the initial series of vaccinations and revaccination 1 year later, cats should be vaccinated no more frequently than once every 3 years.

Modified-live virus (MLV) vaccines and adjuvanted inactivated virus vaccines for parenteral administration and an MLV vaccine for topical (intranasal [IN]) administration are available and effective. Experimental studies have shown that IN administration of canine parvovirus-2 vaccines to puppies is less effective than is parenteral administration in overcoming maternal antibody interference. The most likely reason is that fewer virus particles reach lymphoid tissue when the product is given IN as compared with parenteral administration, and viral replication in lymphoid tissue is required for immunization with MLV parvovirus vaccines. Although studies have not been performed in cats, the same phenomenon may occur in this species as well. Therefore, caution is appropriate when contemplating the use of IN FPV vaccines for primary immunization of kittens, especially those residing in environments in which exposure to FPV is likely.

Recently, it has been found that some cats with panleukopenia-like disease were infected with canine parvovirus-2b (CPV-2b). Studies show that FPV vaccines provide excellent protection not only from FPV but also from CPV-2b; thus, CPV infection should not be a concern for cats immunized as a result of vaccination with FPV vaccines.

Serious adverse events associated with FPV vaccines are rare. Tumor formation at the site of a topically administered vaccine has not been reported. Vaccination of pregnant queens with modified-live FPV vaccines may result in neurologic disease in developing fetuses; the same concern applies to kittens vaccinated at less than 4 weeks of age. Therefore, the use of MLV vaccines should be avoided in pregnant queens and kittens younger than 1 month of age.

FELINE RHINOTRACHEITIS VIRUS AND FELINE CALICIVIRUS INFECTION

Feline rhinotracheitis virus (FRV), caused by FHV-1, and FCV infection account for up to 90% of all infectious upper respiratory tract disease in cats. Both viruses are shed in ocular, nasal, and pharyngeal secretions of infected cats. Organ-
isms are transmitted from cat to cat directly, through sneezed macrodroplets, or indirectly, via contaminated fomites. The disease is self-limiting; however, infected cats may develop chronic oculonasal disease. Latent infection is lifelong for cats infected with FHV-1; reactivation can occur during periods of stress or following corticosteroid administration. Some cats infected with FCV become persistently infected and shed virus for prolonged periods (i.e., months to years). Although rarely serious in adult cats, disease caused by these viruses may be severe, and sometimes fatal, in kittens. Lameness and chronic oral inflammatory syndromes have been linked to FCV infection and vaccination with modified-live calicivirus vaccines. Risk of exposure to either FHV-1 or FCV is high because both organisms are widespread in the feline population.

Vaccination against FHV-1 and FCV is highly recommended for all cats. Immunity is through humoral and cell-mediated immune responses to natural infection or vaccination or through passive transfer of maternal antibodies from queen to kitten. Maternal antibody may interfere with induction of a systemic immune response; however, by 12 weeks of age, maternal antibody titers wane sufficiently to allow parenteral immunization. Topically administered (i.e., IN, conjunctival) vaccines are capable of inducing a local immune response in the face of high maternal antibody titers. Vaccines induce an immune response that lessens the severity of disease; vaccines are not immune to infection, nor are they protected from all signs of disease. Currently available FCV vaccines probably do not induce protection from all isolates of the virus. Modified-live virus and inactivated virus vaccines for parenteral administration and MLV vaccines for topical (i.e., IN, conjunctival) administration are available. If a susceptible cat is born into or is entering an environment in which viral upper respiratory tract disease is endemic (e.g., some catteries, boarding facilities, shelters), the use of a topical product may be advantageous. Administration of such products to kittens as young as 10 to 14 days of age could be considered in these situations; however, products that also contain modified-live FPV antigens should not be administered to kittens younger than 4 weeks of age. Adverse events associated with vaccination against FHV-1 and FCV include mild transient fever, sneezing, conjunctivitis, oculonasal discharge, lameness, and, for parenteral products, pain at the injection site. Vaccines induce an immune response; however, products containing FPV antigens should not be administered to kittens younger than 4 weeks of age. Sneezing, conjunctivitis, oculonasal discharge, and ulceration of the nasal philtrum are believed to occur more frequently with vaccines licensed for topical use. Tumor formation at the site of a topically administered vaccine has not been reported.

RABIES

Rabies is transmitted mainly through bite wounds of infected mammals. More cats than dogs develop rabies in the United States, and although relatively resistant to rabies, both species serve as potential sources of infection for humans. Treatment is ineffective in cats that develop clinical signs and should not be attempted because of the high potential for zoonotic infection. All instances of suspected or known rabies virus infection must be reported to local health department officials. Proper precautions and quarantine procedures as outlined by local regulations and described in the Compendium of Animal Rabies Prevention and Control should be followed. Although vaccine-associated sarcomas have been reported to develop in connection with administration of various vaccines, current data suggest the tumors are more frequently associated with administration of feline leukemia virus (FeLV) vaccines and adjuvanted rabies virus vaccines. Inflammatory reactions are commonly observed at sites where adjuvanted rabies virus vaccines have been administered, and concern has arisen regarding the possible connection between these reactions and vaccine-associated sarcomas. With the exception of a recently approved canarypox virus–vectored recombinant feline rabies virus vaccine (PureVax™ Meria, Iselin, NJ), all rabies virus vaccines currently on the market contain adjuvants. In rats, inflammation induced by the recombinant product appears to be minimal, but whether the use of this vaccine will
be associated with a reduced likelihood of vaccine-associated sarcoma formation in cats is not yet known. The recombinant product is currently licensed only for annual administration.

Rabies virus vaccination is highly recommended for all cats and is required by law in some states and municipalities. Manufacturers are required by the USDA to establish, by means of experimental challenge-exposure studies, the minimum duration of immunity for rabies virus vaccines they sell, and products approved for use every year or every 3 years are available. Statutes governing the administration of rabies virus vaccines vary considerably throughout the United States; veterinarians should comply with the legal requirements of their area.

FELINE LEUKEMIA VIRUS INFECTION

Feline leukemia virus infects domestic cats throughout the world. Transmission is through transfer of virus in the saliva or nasal secretions resulting from prolonged intimate contact (e.g., mutual grooming; biting; or sharing of food, water, and utensils). The virus may also be transmitted by transfusion of blood from an infected cat, in utero, or through milk. Exposure to virus persisting in the environment, on fomites, or in aerosolized secretions is not an efficient means of transmission. Clinical signs of FeLV infection are primarily related to neoplasia, anemia, and diseases resulting from immunosuppression.

Kittens are the most susceptible to infection; resistance increases with maturity. Experimental data demonstrate that kittens younger than 16 weeks of age are most susceptible to infection, with cats older than this being relatively resistant. Cats at greatest risk are outdoor cats (i.e., free-roaming, stray, and feral cats). Also at risk are animals residing in open, multiple-cat environments, cats living with FeLV-infected cats, and cats residing in households with unknown FeLV status.

The decision to vaccinate an individual cat against FeLV infection should be based on the cat's age and its risk of exposure. Vaccination against FeLV is recommended for cats at risk of exposure (i.e., cats not restricted to a closed, FeLV-negative, indoor environment), especially those younger than 4 months of age. Vaccination is not recommended for cats with minimal to no risk of exposure, especially those older than 4 months of age. The ability of a particular vaccine brand to induce an immune response sufficient to resist persistent viremia varies from study to study. Because protection is not induced in all vaccinates, preventing exposure to infected cats remains the most effective way to prevent FeLV infection. Vaccination against FeLV does not diminish the importance of testing cats to identify those that are viremic. It is of critical importance that viremic cats not be in contact with other cats, especially those younger than 4 months of age. Therefore, the FeLV infection status of all cats should be determined.

Adverse events associated with vaccination against FeLV include local swelling or pain, transient lethargy or fever, and postvaccination granuloma formation. Although vaccine-associated sarcomas have been reported to develop in association with administration of other vaccines, current data suggest they are more frequently associated with administration of FeLV vaccines and adjuvanted rabies virus vaccines. If vaccination is deemed appropriate, annual revaccination is recommended. Cats should be tested for FeLV infection before initial vaccination and when there is a possibility that they have been exposed to FeLV since they were vaccinated. The ELISA is the preferred screening test; the immunofluorescent assay is the preferred confirmatory test. Cats confirmed to be infected with FeLV need not receive FeLV vaccines, but they should be segregated from uninfected cats.

CHLAMYDIOsis

Chlamydia psittaci is a bacterial pathogen of the conjunctiva and respiratory tract of cats. Transmission is through direct cat-to-cat contact; fomite transmission is less likely because the organism is unstable in the environment. Serous conjunctivitis, which may initially affect only one eye, is the most common clinical sign. Mild sneezing or nasal discharge may develop. Clinical signs are usually evident 5 to 10 days after infection and resolve with appropriate antimicrobial treatment. Isolation rates reportedly range from approximately 1% for cats without signs of respiratory tract disease to approximately 14% for cats with concurrent upper respiratory tract disease. The highest infection rates are reported for cats between 5 weeks and 9 months of age. Immunity conferred by C. psittaci vaccines is similar to that conferred by FHV-1 and FCV vaccines, in that
vaccinates are protected from severe clinical disease but not from infection. The frequency of adverse systemic events associated with *C. psittaci* vaccines is higher than that associated with other commonly used vaccines; reactions include lethargy, depression, anorexia, lameness, and fever that occurs 7 to 21 days after vaccination. Because signs of disease associated with *C. psittaci* infection are comparatively mild and respond favorably to treatment and because adverse events associated with use of *C. psittaci* vaccines are of greater concern than are adverse events associated with use of many other products, routine vaccination against *C. psittaci* infection is not recommended. Vaccination may be considered for cats in multiple-cat environments in which infections associated with clinical disease have been confirmed. If vaccination is deemed appropriate, annual revaccination is recommended.

**FELINE INFECTIOUS PERITONITIS**

Feline coronaviruses (FCoVs) vary considerably in pathogenic potential and have historically been grouped into two biotypes: feline enteric coronaviruses (FECVs), which typically cause subclinical to mild enteric infections, and feline infectious peritonitis (FIP) viruses, which cause FIP. Currently, FIP viruses are believed to be generated as mutant variants in FECV-infected cats. FCoVs are widespread in feline populations worldwide, with seropositivity rates highest in crowded multiple-cat environments. Transmission of the virus is mainly via the fecal–oral route. In environments in which FCoV infection is endemic (i.e., most multiple-cat environments), 35% to 70% of cats will be shedding FCoV in the stool at any given time. Most infected cats remain healthy, although a few—usually 1% to 5%—ultimately develop FIP. Affected cats rarely survive regardless of treatment. Kittens are most often affected with FIP, but the disease reportedly can develop in cats of all ages. A genetic predisposition has been suggested, with a higher disease incidence in certain lines.

Considerable controversy surrounds the ability of the currently available FIP vaccine (Primucell-FIP, Pfizer Animal Health, Exton, PA) to prevent disease. Some studies demonstrate protection from disease; others show little benefit from vaccination. Antibody-dependent enhancement of disease in vaccinates has been demonstrated in experimental challenge-exposure studies, but it is uncertain whether antibody-dependent enhancement occurs in a natural setting. Discrepancies between study results are probably attributable to differences in test methodology (e.g., strain and dose of challenge virus, genetic predisposition of the test animals). Protection from disease has not been demonstrated in animals vaccinated at younger than 16 weeks of age. However, most kittens born and reared in environments in which FCoV infection is endemic are infected before reaching this age. In these instances, vaccination of infected cats has not proven beneficial. At this time, there is no evidence to suggest that the vaccine induces clinically relevant protection; therefore, its use is not recommended.

**DERMATOPHYTOSIS**

Dermatophytosis in cats is primarily caused by infection with *Microsporum canis*. A variety of clinical manifestations, including transitory clinical disease and chronic infection (with or without clinical signs), have been reported. Although successful treatment of cats is usually straightforward, elimination of endemic infection from multiple-cat environments is expensive, labor intensive, and time-consuming.

An *M. canis* vaccine (Fel-O-Vax® MC-K, Fort Dodge Animal Health, Overland Park, KS) is approved for use as an aid in the prevention and treatment of clinical signs associated with *M. canis* infection. Vaccination has not been demonstrated to prevent infection or eliminate *M. canis* organisms from infected cats. Therefore, routine vaccination against *M. canis* infection is not recommended. At the time of this writing, the product had not been independently evaluated for efficacy. Based on studies conducted by the manufacturer, it is reasonable to consider vaccination as adjunctive treatment for individual infected cats 4 months of age or older to hasten resolution of clinical signs. If the vaccine induces an immune response that accelerates lesion resolution, then the number of infectious fungal spores produced by vaccinates may be reduced as well; therefore, it is reasonable to consider vaccination as one component of a comprehensive treatment program in multiple-cat environments in which *M. canis* infection is endemic. Nonetheless, the ability of this product to hasten elimination of endemic infections from such environments has not been evaluated. The revaccination interval is not stipulated on
the label. Major adverse events reportedly associated with the use of this product are pain, temporary hair loss, and formation of sterile abscesses or granulomas at the vaccine site.

**BORDETELLA BRONCHISEPTICA INFECTION**

*Bordetella bronchiseptica* is a small, aerobic, gram-negative coccobacillus that has long been recognized as a respiratory tract pathogen of several animal species. The natural route of transmission in cats is believed to be via the aerosol or IN route. Experimental challenge-exposure studies have shown that *B. bronchiseptica* can act as a primary pathogen in cats; inoculation of specific-pathogen-free (SPF) kittens results in self-limiting disease characterized by variable degrees of fever, nasal or ocular discharge, sneezing, induced or spontaneous coughing, pulmonary rales, and submandibular lymphadenopathy. Bronchopneumonia associated with naturally occurring *B. bronchiseptica* infection has been reported in both kittens and adult cats. Other factors (e.g., nutritional status, overcrowding, coinfection with other agents such as FCV or FHV-1, and suboptimal hygiene) may influence the outcome of exposure.

Seroprevalence surveys suggest that exposure to the organism is common, with infection rates varying from population to population. The highest rates of seropositivity (often over 80%) are found among cats in rescue shelters and multiple-cat households, especially when there is a history of respiratory tract disease. The lowest rates are found among cats in households with few cats and no history of respiratory tract disease. Similarly, isolation rates vary. *B. bronchiseptica* was isolated from the oropharynx of 19 of 614 (3.1%) and from the distal trachea in 6 of 614 (1%) asymptomatic cats from shelters in Louisiana. In a recent survey of 740 cats in the United Kingdom, none of the household cats were found to be infected, but 9% of cats from breeding colonies and 19% of cats from rescue shelters were found to be carrying the organism. In the same survey, 9% of healthy cats and 14% of cats with respiratory tract disease tested positive for the organism. An additional finding was a strong positive association between oropharyngeal isolation of *B. bronchiseptica* and residence in households containing dogs with a recent history of respiratory tract disease.

Definitive diagnosis of disease associated with *B. bronchiseptica* infection may be difficult, in part because signs of infection often mimic those associated with FHV-1 or FCV infection. Isolation of *B. bronchiseptica* from a cat with respiratory tract disease is supportive of the diagnosis, but carriage of the organism in asymptomatic cats precludes establishing a direct cause-and-effect relationship. Resolution of disease with appropriately chosen antimicrobial medication might suggest a causative role for *B. bronchiseptica*, but the self-limiting nature of many cases of viral upper respiratory tract disease prevents attributing disease resolution solely to antimicrobial treatment.

A vaccine to prevent disease caused by infection with *B. bronchiseptica* (Protex®, Intervet, Millsboro, DE) has recently been licensed. The product contains a live, reduced-virulence culture of *B. bronchiseptica* and is licensed for administration via the IN route to cats 4 weeks of age and older. Efficacy of the vaccine has not been independently evaluated, but in studies conducted by the manufacturer to gain vaccine licensure, vaccinated 4-week-old SPF cats experienced less severe signs of disease than did unvaccinated controls when challenge-exposed 3 weeks after vaccination. Similar results were obtained when 8-week-old kittens were challenge-exposed 72 hours after vaccination. As of this writing, no studies to evaluate the duration of protection induced by the vaccine have been completed, and the revaccination interval is not yet stipulated on the label. Routine use of this vaccine is not recommended. It is reasonable to consider vaccinating cats entering or residing in multiple-cat environments (e.g., shelters, catteries, boarding facilities) in which disease associated with *B. bronchiseptica* infection has been confirmed. However, the ability of the product to reduce the prevalence of infection or the severity of disease in these environments has not been evaluated.

**GIARDIASIS**

Infection of cats with the protozoan *Giardia lamblia* is associated with acute or chronic gastrointestinal disease, ranging in severity from subclinical to severe. Because infected cats shed cysts intermittently, diagnosis of *G. lamblia* infection is often cumbersome and usually requires multiple fecal examinations.

Several methods of diagnosis are available, including examination of a fecal smear, the zinc sulfate centrifugation method, and use of an ELISA to test feces. There are cur-
Giardiasis is a recognized disease transmitted via the fecal–oral route. Cysts may be ingested from contaminated water; from direct cat-to-cat transmission, especially in crowded environments (e.g., through mutual grooming); from exposure to contaminated litterboxes; and from consuming prey.\(^6\) Giardiasis is a recognized zoonotic disease, but the role of cats in transmission of the organism is not well established.\(^5,6\) A vaccine has recently been licensed by the USDA) as an aid in the prevention of disease associated with *G. lamblia* infection and reduction in the severity of shedding of cysts (Fel-O-Vax® Giardia, Fort Dodge Animal Health). This vaccine is composed of quantified, homogenated, and chemically inactivated *G. lamblia* trophozoites and contains an adjuvant commonly found in other feline products from the manufacturer but different from the adjuvant in the manufacturer’s canine product. The vaccine is approved for use in cats at least 8 weeks of age. At the time of this writing, the vaccine had not been independently evaluated for efficacy, but in studies conducted by the manufacturer to gain vaccine licensure, vaccines had a statistically significant reduction in severity of clinical signs (e.g., diarrhea), duration of cyst shedding, and prevalence of infection (percentage of cats with trophozoites at the end of the trial) compared with control animals. Protection was demonstrated to persist for at least 1 year after vaccination.

Routine use of this vaccine is not recommended; but because vaccines had less severe clinical disease and shed cysts for a shorter time, it is reasonable to consider vaccination as part of a comprehensive control program in environments in which exposure to *G. lamblia* is clinically significant. When parasite exposure is ongoing, revaccination at annual intervals is recommended. Some vaccines may shed cysts subsequent to *G. lamblia* exposure; therefore, proper hygiene and sanitation practices should be implemented even in vaccinated cats. The ability of this product to aid in hastening elimination of endemic infection from multiple-cat environments has not been evaluated.

**REFERENCES**

23. Krebs JW, Smith JS, Rupprecht CE,