Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

CHAPTER 57

Updated Vaccination Recommendations for Carnivores

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Protection against viral diseases is an important component of any preventive medicine or health care program for captive carnivores. Carnivores are susceptible to a variety of viral infections, the most significant of which also occur in domestic cats and dogs. For this reason, vaccination programs for wild carnivores are often modeled after recommendations for their domestic counterparts. The goal of this chapter is to assist the zoo veterinarian in developing a vaccination program that meets the needs of the individual animal, collection, and institution. Although carnivore vaccination programs are bound to be similar among institutions, they need not be identical to be effective. Factors to consider when developing these programs include the following: (1) the risk of exposure, including likelihood of exposure based on environmental factors and geographic location; (2) the severity of disease if exposed, which may vary with age, species, gender, and reproductive status; (3) the potential for adverse reactions to one or more vaccines; and (4) the availability of resources (e.g., time, finances, labor). Vaccination alone should not be relied on to prevent disease. Adjunct components to controlling infectious diseases are reducing exposure to these agents in the animal's environment through quarantine practices, cleaning and disinfection protocols, and pest and predator control programs, as well as minimizing factors such as stress, overcrowding, and inadequate nutrition that diminish resistance to disease.

Using the taxonomic classifications presented by Wilson and Reeder,[17] the order Carnivora is divided into two suborders, Feliformia and Caniformia (Table 57-1). Knowing which species are more catlike or more doglike may help predict disease susceptibility when published data are lacking. Commercial vaccines have been developed for use in domestic species, and using them in other carnivores constitutes extralabel use. Although modified live and killed virus vaccines dominate the market, third-generation products are now complementing and in some cases replacing them.[4,8,11] This new technology should have a positive impact on current practices by improving the safety and efficacy of vaccines used in nondomestic carnivores.

Guidelines that have global application for the vaccination of cats and dogs have been compiled by the Vaccination Guidelines Group (VGG) of the World Small Animal Veterinary Association.[18] These guidelines were based on those provided by the American Animal Hospital Association (AAHA) Canine Vaccine Task Force and the Feline Vaccine Advisory Panel of the American Association of Feline Practitioners.[8,9] The guidelines are also consistent with those of the European Advisory Board on Cat Diseases and the South African Veterinary Council.[4,14] The information in this chapter is a condensed version taken directly from these guidelines, with special attention as to how they might be applied to nondomestic carnivores. This information is subject to change in light of developments in research, technology, and experience.

CORE VACCINES: UNIVERSALLY RECOMMENDED

The VGG recommends that all cats and dogs benefit from vaccination. Vaccination protects the individual and provides optimum herd immunity by reducing the number of susceptible animals in the regional population and decreasing disease prevalence. Specific recommendations are based on the concept of core vaccines. Core vaccines are those that every cat or dog, regardless of circumstances, should receive. Core vaccines protect animals from severe life-threatening diseases that have global distribution. Vaccination programs should

TABLE 57-1 Order Carnivora

Suborder	Family	Subfamily	Genus	Common Name
Feliformia	Felidae	Felinae	*Acinonyx*	Cheetah
			Caracal	Caracal
			Catopuma	Bay cat, Asian golden cat
			Felis	Chinese mountain cat, domestic cat, jungle cat, Pallas' cat, sand cat, black-footed cat, wildcat
			Leopardus	Pantanal cat, colocolo, Geoffroy's cat, kodkod, Andean mountain cat, Pampas cat, ocelot, oncilla, margay
			Leptailurus	Serval
			Lynx	Canadian lynx, Eurasian lynx, Iberian lynx, bobcat
			Pardofelis	Marbled cat
			Prionailurus	Leopard cat, Iriomote cat, flat-headed cat, rusty-spotted cat, fishing cat
			Profelis	African golden cat
			Puma	Cougar, jaguarundi
		Pantherinae	*Neofelis*	Clouded leopard
			Panthera	Lion, jaguar, leopard, tiger
			Uncia	Snow leopard
	Viverridae	Paradoxurinae	*Arctictis*	Binturong
			Arctogalidia	Small-toothed palm civet
			Macrogalidia	Sulawesi palm civet
			Paguma	Masked palm civet
			Paradoxurus	Asian palm civet, Jerdon's palm civet, golden palm civet
		Hemigalinae	*Chrotogale*	Owston's palm civet
			Cynogale	Otter civet
			Diplogale	Hose's palm civet
			Hemigalus	Banded palm civet
		Prionodontinae	*Prionodon*	Banded linsang, spotted linsang
		Viverrinae	*Civettictis*	African civet
			Genetta	Abyssinian genet, Angolan genet, Bourlon's genet, crested servaline genet, common genet, Johnston's genet, rusty-spotted genet, Pardine genet, aquatic genet, king genet, servaline genet, Haussa genet, Cape genet, giant forest genet
			Poiana	Leighton's linsang, African linsang
			Viverra	Malabar large-spotted civet, large-spotted civet, Malayan civet, large Indian civet
			Viverricula	Small Indian civet
	Eupleridae	Euplerinae	*Cryptoprocta*	Fossa
			Eupleres	Falanouc
			Fossa	Malagasy civet
		Galidiinae	*Galidia*	Ring-tailed mongoose
			Galidictis	Broad-striped Malagasy mongoose, Grandidier's mongoose
			Mungotictis	Narrow-striped mongoose
			Salanoia	Brown-tailed mongoose
	Nandiniidae		*Nandinia*	African palm civet
	Herpestidae		*Atilax*	Marsh mongoose
			Bdeogale	Bushy-tailed mongoose, Jackson's mongoose, black-footed mongoose
			Crossarchus	Alexander's kusimanse, Angolan kusimanse, common kusimanse, flat-headed kusimanse

Continued

TABLE 57-1 Order Carnivora—cont'd

Suborder	Family	Subfamily	Genus	Common Name
			Cynictis	Yellow mongoose
			Dologale	Pousargues' mongoose
			Galerella	Angolan slender mongoose, Somalian slender mongoose, Cape gray mongoose, slender mongoose
			Helogale	Ethiopian dwarf mongoose, common dwarf mongoose
			Herpestes	Short-tailed mongoose, Indian gray mongoose, Indian brown mongoose, Egyptian mongoose, small Asian mongoose, long-nosed mongoose, collared mongoose, ruddy mongoose, crab-eating mongoose, striped-neck mongoose
			Ichneumia	White-tailed mongoose
			Liberiictis	Liberian mongoose
			Mungos	Gambian mongoose, banded mongoose
			Paracynictis	Selous' mongoose
			Rhynchogale	Meller's mongoose
			Suricata	Meerkat
	Hyaenidae		*Crocuta*	Spotted hyena
			Hyaena	Brown hyena, striped hyena
			Proteles	Aardwolf
Caniformia	Canidae		*Atelocynus*	Short-eared dog
			Canis	Side-striped jackal, golden jackal, coyote, wolf, black-backed jackal, Ethiopian wolf
			Cerdocyon	Crab-eating fox
			Chrysocyon	Maned wolf
			Cuon	Dhole
			Dusicyon	Falkland Islands wolf
			Lycalopex	Culpeo, Darwin's fox, South American gray fox, Pampas fox, Sechuran fox, Hoary fox
			Lycaon	African wild dog
			Nyctereutes	Raccoon dog
			Otocyon	Bat-eared fox
			Speothos	Bush dog
			Urocyon	Gray fox, island fox
			Vulpes	Bengal fox, Blanford's fox, Cape fox, Corsac fox, Tibetan sand fox, arctic fox, kit fox, pale fox, Ruppell's fox, swift fox, red fox, fennec fox
	Ursidae		*Ailuropoda*	Giant panda
			Helarctos	Sun bear
			Melursus	Sloth bear
			Tremarctos	Spectacled bear
			Ursus	American black bear, brown bear, polar bear, Asian black bear
	Otariidae		*Arctocephalus*	South American fur seal, Australasian fur seal, Galapagos fur seal, Antarctic fur seal, Juan Fernandez fur seal, brown fur seal, Guadalupe fur seal, subantarctic fur seal
			Callorhinus	Northern fur seal
			Eumetopias	Stellar sea lion
			Neophoca	Australian sea lion
			Otaria	South American sea lion

TABLE 57-1 Order Carnivora—cont'd

Suborder	Family	Subfamily	Genus	Common Name
			Phocarctos	New Zealand sea lion
			Zalophus	California sea lion, Japanese sea lion, Galapagos sea lion
	Odobenidae			Walrus
	Phocidae		*Cystophora*	Hooded seal
			Erignathus	Bearded seal
			Halichoerus	Gray seal
			Histriophoca	Ribbon seal
			Hydrurga	Leopard seal
			Leptonychotes	Weddell seal
			Lobodon	Crabeater seal
			Mirounga	Northern elephant seal, southern elephant seal
			Monachus	Mediterranean monk seal, Hawaiian monk seal, Caribbean monk seal
			Ommatophoca	Ross seal
			Pagophilus	Harp seal
			Phoca	Spotted seal, harbor seal
			Pusa	Caspian seal, ringed seal, Baikal seal
	Mustelidae	Lutrinae	*Aonyx*	African clawless otter, Oriental small-clawed ottter
			Enhydra	Sea otter
			Hydrictis	Spotted-necked otter
			Lontra	North American river otter, marine otter, neotropical otter, southern river otter
			Lutra	European otter, Japanese otter, hairy-nosed otter
			Lutrogale	Smooth-coated otter
			Pteronura	Giant otter
		Mustelinae	*Arctonyx*	Hog badger
			Eira	Tayra
			Galictis	Lesser grison, greater grison
			Gulo	Wolverine
			Ictonyx	Saharan striped polecat, striped polecat
			Lyncodon	Patagonian weasel
			Martes	American marten, yellow-throated marten, Beech marten, Nilgiri marten, European pine marten, Japanese marten, fisher, sable
			Meles	Japanese badger, Asian badger, European badger
			Mellivora	Honey badger
			Melogale	Bornean ferret-badger, Chinese ferret-badger, Javan ferret-badger, Burmese ferret-badger
			Mustela	Amazon weasel, mountain weasel, ermine, Steppe polecat, Colombian weasel, long-tailed weasel, Japanese weasel, yellow-bellied weasel, European mink, Indonesian mountain weasel, black-footed ferret, least weasel, Malayan weasel, European polecat, Siberian weasel, back-striped weasel, Egyptian weasel
			Neovison	Sea mink, American mink
			Poecilogale	African striped weasel
			Taxidea	American badger
			Vormela	Marbled polecat
	Mephitidae		*Conepatus*	Molina's hog-nosed skunk, Humbolt's hog-nosed skunk, American hog-nosed skunk, striped hog-nosed skunk

Continued

TABLE 57-1 Order Carnivora—cont'd

Suborder	Family	Subfamily	Genus	Common Name
			Mephitis	Hooded skunk, striped skunk
			Mydaus	Sunda stink badger, Palawan stink badger
			Spilogale	Southern spotted skunk, western spotted skunk, eastern spotted skunk, pygmy spotted skunk
	Procyonidae		*Bassaricyon*	Allen's olingo, Beddard's olingo, olingo, Harris's olingo, Chiriqui olingo
			Bassariscus	Ringtail, cacomistle
			Nasua	White-nosed coati, South American coati
			Nasuella	Mountain coati
			Potos	Kinkajou
			Procyon	Crab-eating raccoon, raccoon, Cozumel racoon
	Ailuridae		*Ailurus*	Red panda

From Wilson DE, Reeder, DM (eds): Mammal species of the world. A taxonomic and geographic reference, ed 3. Baltimore, 2005, Johns Hopkins University Press.

include only those vaccines that the animal truly needs because all vaccines have the potential to cause adverse reactions.[18]

The core vaccines for felids are those that protect from feline parvovirus (panleukopenia) (FPV), feline calicivirus (FCV), and feline herpesvirus (FHV). Rabies virus is included in this core group in areas of the world in which rabies is endemic. With the exception of Australia, Great Britain, Japan, and some islands, rabies is present worldwide.[9] Parenteral killed FPV vaccine is usually preferred because vaccine-associated disease can occur if using a modified live (ML) product, although this has not been documented for ML FPV vaccine. Immunity takes 3 or more weeks to develop after a first dose of killed vaccine and at least 1 week after the second dose. This is in contrast to the ML FPV, which provides long-lasting immunity in approximately 3 days in cats older than 16 weeks. Products containing ML FPV also contain ML FCV and ML FHV. Similarly, products containing killed FPV contain killed FCV and FHV.[13]

Killed vaccines can be used in pregnant animals and should be used in disease-free collections. Using ML products (including the intranasal FPV-FCV-FHV vaccine) can introduce calicivirus and herpesvirus into collections that were previously free of these conditions and is not recommended for nondomestic carnivores. The protection afforded by the FCV and FHV vaccines (either killed or ML) will not provide the same efficacy of immunity as seen with the FPV vaccines. When vaccination does not prevent infection with FCV or FHV, systemic and local cell-mediated and humoral immunity play important roles in preventing or reducing the severity of disease.[9] Although the FCV vaccines have been designed to produce cross-protective immunity against severe clinical disease, there are multiple strains of FCV. It is therefore possible for infection and mild disease to occur in the vaccinated animal.

Virulent systemic calicivirus (VSCV) has recently been described. Vaccination with current vaccines does not protect felids against field infections, but some protection has been shown experimentally.[13,18] There is no FHV vaccine (ML or killed) that can protect against infection with virulent strains of herpesvirus. Virulent strains of herpesvirus will become latent and may be reactivated during periods of severe stress for the life of the felid. The reactivated virus may cause clinical signs in the vaccinated animal or the virus can be shed to susceptible animals and cause disease. This is seen most frequently in captive cheetahs. Vaccination during pregnancy can help protect kittens by prolonging maternally derived antibody (MDA).[9] Cats may become infected with canine parvovirus and certain strains may cause signs of panleukopenia in cats.[7,15] Conventional FPV vaccines have been shown to protect against these canine parvoviruses, but there is a report of a cheetah vaccinated with a killed FPV vaccine that developed canine parvovirus infection (CPV-2b) and gastrointestinal disease.[3,6,16]

The core vaccines for canids are those that protect from canine distemper virus (CDV), canine adenovirus (CAV), and canine parvovirus (CPV). Rabies virus is

included in this core group in areas of the world in which rabies is endemic. In areas or facilities in which CDV is not endemic in domestic or wild susceptible species, ML vaccines should not be used. The risk of introducing a virus into a host population is unacceptable.[11,18] Susceptible wild carnivore species do shed virus following ML CDV vaccine administration and may develop disease. This has been reported in the red panda, black-footed ferret, European mink, gray fox, kinkajou, South American bush dog, and maned wolf.[2] The ML CDV products available contain virulent strains and are for use in domestic dogs only. A poxvirus recombinant canine distemper vaccine (rCDV) is available in many countries and is considered the vaccine of choice for nondomestic carnivores to protect against vaccine-induced disease and natural infection. This recombinant vaccine has the added advantages of being safe in younger animals and more effective for immunizing carnivores with MDA. In the absence of MDA, rCDV vaccine provides immunity immediately after vaccination.[8,12] The rCDV vaccine is currently available as a monovalent product or combined with ML CPV and ML CAV, or with ML CPV, ML CAV, and canine parainfluenza virus (CPI). CPI is considered an optional vaccine (see later).

There are four genotypes of canine parvovirus that are recognized worldwide—CPV-2, CPV2a, CPV-2b, and CPV-c—and all genotypes are antigenically comparable. This means that vaccination with any one genotype provides protective immunity against all other genotypes.[9,18] CPV is hypothesized to be a natural genetic mutation of FPV that first emerged in dogs in 1978.[6,7] CPV strains can replicate in both canine and feline cells, but FPV has been shown to only replicate efficiently in feline cells. There are only a few killed CPV vaccines available and are less effective than the ML vaccines. In addition, they are often combined with a ML CDV vaccine. Although killed vaccines are preferable for use in wild or nondomestic species, this killed product may not be the best choice if it is part of a polyvalent vaccine that contains ML CDV for the reasons noted earlier. Canids are most susceptible to severe disease caused by CPV infection during the first year of life. Each institution should decide whether they could effectively isolate pups to prevent introduction of disease or whether the benefits of using a ML CPV product outweigh the risks. ML CPV vaccination will result in shedding of virus, and this virus could potentially revert to virulence, as well as infect other individuals or other species. Once in the environment, the virus can remain infectious for 1 year or longer.[8] Similar to ML FPV vaccines, ML CPV vaccines provide immunity 3 days after vaccination. When CPV first appeared, FPV vaccines were used to provide some protection until a more specific vaccine was manufactured.[15] It is not known whether a killed FPV monovalent vaccine will protect against CPV in nondomestic carnivores but recent studies have suggested that it may offer some protection.[3] Alternatively, one could consider not revaccinating canids with a positive antibody titer to CPV postvaccination using a ML product, because life-long immunity should result.[12] Experimental canine DNA vaccines have been developed for CPV-2 and hold promise for the future. In contrast to ML CPV vaccines, ML CAV vaccine virus has not been shown to revert to virulence in back passage studies. ML CAV-2 containing vaccines are the most commonly available products. They will prevent infectious canine hepatitis (ICH) caused by CAV-1 and reduce the signs of respiratory disease caused by CAV-2. They also do not cause the adverse reaction commonly seen with CAV-1 vaccines, known as allergic uveitis, or blue eye.

MDA significantly interferes with the efficacy of most core vaccines currently available, with the exception of rCDV vaccine. Because the level of MDA varies among litters, young carnivores should receive three doses of vaccine. These repeated injections in the first year of life do not constitute boosters but rather are an attempt to induce a primary immune response. In general, passive immunity will have waned by 8 to 12 weeks to a level that allows for active immunization. The age at which to begin the vaccination series can vary, but vaccinations are typically begun between 6 and 9 weeks of age and then are readministered at 2- to 4-week intervals until the animal is 14 to 16 weeks of age; 16 weeks is usually preferable to ensure that the waning of maternal antibody is complete.[8,9,12,13,18] Starting the immunizations as early as 6 weeks may be appropriate in situations of high risk (e.g., FHV in cheetahs) and questionable MDA status. In situations in which only one vaccine can be administered, this should be done when the animal is immunologically capable of responding—that is, at the age of 16 weeks or older. After an initial series of three vaccines, the animal should receive a booster in 12 months. The initial series and this booster are referred to as the primary vaccination course. The booster at 12 months also ensures immunity for carnivores that did not adequately respond to the first series of vaccines. Core vaccines are given no more frequently than every 3 years thereafter. There are reports in the literature that suggest that the duration of immunity is at least 3 years when killed products are used.[4,8,10] A notable exception is that an annual booster is required for the

recombinant virus, nonadjuvanted, canarypox-vectored rabies vaccine labeled for use in domestic cats. For this reason, the killed rabies vaccine is often chosen, despite concerns with the use of adjuvants. Primary rabies vaccination should occur at 12 to 16 weeks of age, with revaccination 1 year later. Annual or triennial vaccination should follow, depending on the type of vaccine used and applicable legal requirements. There is a push towards marketing vaccines with an extended duration of immunity (DOI). This will reduce the unnecessary administration of vaccines, thereby further improving vaccine safety.

NONCORE (OPTIONAL) AND NOT GENERALLY RECOMMENDED VACCINES

Noncore vaccines are those that are required only by those animals whose geographic location, local environment, or lifestyle places them at risk of contracting specific infections. There should be an assessment of the risks and benefits prior to choosing to use a noncore vaccine. This assessment includes an evaluation of the risk of infection, severity of disease, and efficacy of the products available.[8,9,18] Although feline leukemia virus (FELV) vaccine is recommended as a noncore vaccine in domestic cats that test negative for the virus, this vaccine is not recommended in nondomestic felids. Nondomestic felids should be tested for FELV and feline immunodeficiency virus (FIV), and negative and positive animals should be managed separately in lieu of vaccination. Antibodies produced following FIV vaccination interfere with all antibody-based FIV diagnostic tests and can be passed from queens to kittens in the colostrum. Additional noncore vaccines include *Chlamydophila felis* vaccine and *Bordetella bronchiseptica* vaccine. Although *Chlamydophila* and *Bordetella* can contribute to a feline respiratory disease complex, the value or need for these vaccines in the control of this complex disease is of questionable importance. Therefore, their use is of questionable importance in most cats. It should also be recognized that these two vaccines are associated with a variety of adverse reactions in a small percentage of animals.[13] rCDV vaccine would be a noncore vaccine that could be very valuable for use in nondomestic felids (e.g., genus *Panthera* or *Lynx*) or other susceptible catlike carnivores.[1,5] For species-specific recommendations, the reader is encouraged to refer to the guidelines provided by the Association of Zoo and Aquariums (AZA) Taxon Advisory Group (TAG) or Species Survival Plan (SSP) veterinary advisors. Similarly, the European Association of Zoos and Aquaria (EAZA) European Endangered Species Programmes (EEP) would also be a valuable resource.

The combination products with CPV-2, CDV, and CAV-2 currently often include CPI virus. New core-only products have been and are being developed that do not include CPI. However, the most effective route to vaccinate for CPI is intranasal, because local immunity is more important than systemic immunity.[8,12] Canine influenza virus (CIV) is antigenically unrelated to any other virus of dogs, but is related to equine influenza virus, which first infected greyhounds in Florida in 2004. The virus caused significant respiratory disease in that initial outbreak. At present, it is not known whether this virus will be an important cause of canine respiratory disease, nor if it will be an emerging disease of dogs. It is often acute, with mild to moderate clinical signs in most dogs. Mortality is very low. It does not readily spread to other dogs in the area; thus, it will remain relatively confined to the affected group. Many questions about the role of influenza virus, viruses other than CPI and CAV-2, bacteria other than *B. bronchiseptica*, various mycoplasmas, and other factors causing canine respiratory disease complex remain unanswered. *B. bronchiseptica* is an optional vaccine in nondomestic carnivores and is most likely not indicated for zoological collections. This organism can, however, be transmitted between canids and felids.[9] If used, it is important to realize that this vaccine needs to be given every 6 to 12 months.

Considering the low efficacy, adverse event rate, and minimal risk for leptospirosis in many regions of the United States, some practitioners are not using the current products. However, if an animal is in a high-risk environment for leptospirosis, the product to use should contain the four serovars (there is no significant cross protection), and the animal should be vaccinated starting no earlier than 12 weeks of age, revaccinated in 2 to 4 weeks, revaccinated at 6 months of age, revaccinated at 1 year of age, and may need to be revaccinated as often as every 6 to 9 months for optimal protection. Using this program, the animal should not develop clinical disease with *Leptospira*, but it may get infected and shed organisms in its urine.[12]

There are some vaccines that are classified as not recommended because of insufficient scientific evidence to justify their use. Currently, these include feline infectious peritonitis vaccine and feline *Giardia* vaccine.[9] The new FCV vaccine, a killed adjuvanted vaccine that is designed to aid in the prevention of VSCV, has not been in the field long enough to know whether it will be of

any value in preventing or reducing the development of this extremely rare disease. VSCV was first recognized in cats approximately 10 years ago. It results when any one of the respiratory strains of calicivirus mutates to a variant that can cause an exceptionally virulent acute systemic disease. This acute disease can cause 50% to 75% or higher mortality. The use of this vaccine is not recommended at this time.[13]

The geographic distribution of Lyme disease suggests that vaccination would only be of benefit in certain U.S. regions. Thus, widespread use of this product is neither necessary nor desired. Tick control for prevention and antibiotics for treatment must be used in high-risk areas.[8,12] In the vaccination guidelines from the AAHA, neither *Giardia* nor *Coronavirus* vaccines are recommended unless they can be proven to be beneficial for a specific animal. There are also new vaccines for snake bite (*Crotalus* spp.) and for periodontal disease (*Porphyromonas* spp.) but no scientific research has been presented to support their use.

SEROLOGIC TESTING TO MONITOR IMMUNITY TO VACCINES AND DURATION OF IMMUNITY

Antibody tests are useful for monitoring immunity to the core vaccines FPV, CDV, CAV (CAV-1), and CPV (CPV-2). A negative test result indicates that the animal has little or no antibody and revaccination is recommended. Once a juvenile carnivore has completed the vaccine series at 14 to 16 weeks of age, the animal should test positive for antibodies. The serum sample should be collected 2 or more weeks after the last vaccination. Seronegative animals should be revaccinated and retested. There may have been interference from MDA (unlikely after 12 weeks of age) or the vaccine used was poorly immunogenic. If the animal again tests negative, it should be considered a nonresponder that is possibly incapable of developing protective immunity, or the immune system failed to recognize the antigenic determinants of the specific vaccine.[8]

Most vaccinated carnivores will have persistence of serum antibody (against core vaccine antigens) for many years. For core vaccines, there is excellent correlation between presence of antibody and protective immunity, and there is long DOI for these products. When antibody is absent, the animal should be revaccinated unless there is a medical or logistical basis for not doing so. Antibody determination to vaccine components other than those listed earlier are of limited value because of the short time period for which these antibodies persist or the lack of correlation between serum antibody and protection (e.g., canine parainfluenza).[8] For FHV, the absence of detectable serum antibody levels in vaccinated felids does not necessarily indicate that cats are susceptible to disease because cell-mediated immunity plays an important role in protection. However, FHV seroconversion does correlate with protection against virulent FHV. Important considerations in performing antibody tests are cost and the time to obtain results.[9]

RECORD KEEPING AND ADVERSE EFFECTS

The VGG recommends that the following information be recorded in the animal's medical record[18]:

- Date of vaccine administration
- Identity (name, initials, or code) of the person administering the vaccine
- Vaccine name, lot or serial number, expiration date, and manufacturer
- Site and route of vaccine administration

Veterinarians are encouraged to report all possible adverse events to the manufacturer and/or regulatory authority to expand the knowledge base that drives development of improved vaccine safety. Adverse events are defined as any side effects or unintended consequences (including lack of protection) associated with vaccination, whether or not the event can be directly attributed to the vaccine.[18] Local (injection site) reactions following vaccinations include pain, pruritis, swelling, alopecia, abscess formation, granuloma formation, and neoplasia. Systemic reactions are events that involve the entire body or a defined location and/or region other than the injection site, such as angioedema, anaphylaxis, vomiting, diarrhea, respiratory distress, fever, lethargy, neurologic or behavioral changes, or immune-mediated disease.[8] Injectable adjuvanted vaccines have been associated with local inflammatory reactions at injection sites, with the degree of inflammation varying among products. The potential role of local inflammatory reactions in the genesis of vaccine-associated sarcomas remains controversial. All vaccines have the potential to cause adverse reactions and that reaction is dependent not only on the product but also on the individual animal. Often, there is a genetic predisposition that leads to adverse immune reactions and cancer. Current vaccine recommendations stress that veterinarians should administer only those vaccines

that an animal truly needs. In addition, these vaccines should be given only as required, because all vaccines have the potential to cause adverse reactions.[13]

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