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SPECIAL ARTICLE

2020 AAHA/AAFP Feline Vaccination Guidelines

Abstract: The guidelines are a consensus report on current recommendations for vaccination of cats of any origin, authored by a Task Force of experts. The guidelines are published simultaneously in the *Journal of Feline Medicine and Surgery* (volume 22, issue 9, pages 813–830, DOI: 10.1177/1098612X20941784) and the *Journal of the American Animal Hospital Association* (volume 56, issue 4, pages 249–265, DOI: 10.5326/JAAHA-MS-7123). The guidelines assign approved feline vaccines to core (recommended for all cats) and non-core (recommended based on an individualized risk–benefit assessment) categories. Practitioners can develop individualized vaccination protocols consisting of core vaccines and non-core vaccines based on exposure and susceptibility risk as defined by the patient's life stage, lifestyle, and place of origin and by environmental and epidemiologic factors. An update on feline injection-site sarcomas indicates that occurrence of this sequela remains infrequent and idiosyncratic. Staff education initiatives should enable the veterinary practice team to be proficient in advising clients on proper vaccination practices and compliance. Vaccination is a component of a preventive healthcare plan. The vaccination visit should always include a thorough physical exam and client education dialog that gives the pet owner an understanding of how clinical staff assess disease risk and propose recommendations that help ensure an enduring owner–pet relationship.

Keywords: Vaccination principles; vaccines; lifestyle; risk assessment; veterinarian; injection site; rabies; leukemia; guidelines; maternally derived antibodies

Abbreviations: DNA (deoxyribonucleic acid); FCV (feline calicivirus); FeLV (feline leukemia virus); FHV-1 (feline herpesvirus type 1); FIP (feline infectious peritonitis); FISS (feline injection-site sarcoma); FPV (feline panleukopenia virus); Ig (immunoglobulin); IM (intramuscular); MDA (maternally derived antibodies); SC (subcutaneous); WSAVA (World Small Animal Veterinary Association)

These guidelines were prepared by a Task Force of experts convened by the American Animal Hospital Association (AAHA) and the American Association of Feline Practitioners (AAFP) and were subjected to a formal peer-review process. This document is intended as a guideline only, not an AAHA or AAFP standard of care. These guidelines and recommendations should not be construed as dictating an exclusive protocol, course of treatment, or procedure. Variations in practice may be warranted based on the needs of the individual patient, resources, and limitations unique to each individual practice setting. Evidence-based support for specific recommendations has been cited whenever possible and appropriate.

Other recommendations are based on practical clinical experience and a consensus of expert opinion. Further research is needed to document some of these recommendations. Because each case is different, veterinarians must base their decisions on the best available scientific evidence in conjunction with their own knowledge and experience.

Introduction

As a medically essential and cost-effective method of infectious disease control, vaccination continues to be a mainstay of feline practice and a critical component of an individualized preventive healthcare plan. These guidelines provide the most current information and recommendations for feline vaccination as determined by a Task Force of experts in feline practice. The recommendations are evidence-guided, based on current peer-reviewed literature and data, and complemented by clinical insights collectively derived from decades of experience. The guidelines update the "2013 AAFP Feline Vaccination Advisory Panel Report" and utilize similar recommendations from the 2016 "WSAVA [World Small Animal Veterinary Association] Guidelines for

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the Vaccination of Dogs and Cats".[1,2] Both of these previously published resources should still be considered relevant and actionable complements to the 2020 guidelines.

The guidelines continue the established approach of considering inclusion of core (recommended for all cats) and non-core (recommended based on an individualized risk–benefit assessment) vaccines in an individualized protocol. As explained in the guidelines, a patient-specific vaccination plan should consider environmental risk factors and life stage and lifestyle factors that determine the likelihood of infectious disease exposure and susceptibility. For example, not all feline patients originate from a home environment, and conversely, most cats described as "indoor only" might find themselves periodically exposed to other cats. The guidelines discuss other presentation scenarios that can potentially affect a risk–benefit assessment and include updates on feline injection-site sarcomas (FISSs) and other vaccination-related reactions.

A key component of the guidelines are comprehensive, easy-to-reference tables listing approved core and non-core feline vaccines and the relevant considerations for their use. The guidelines are complemented by an online resource center at aaha.org/felinevaccination and supplemental materials at catvets.com/vaccination. The online resources include frequently asked questions about vaccination that clinicians and pet owners raise as well as a vaccine protocol calculator that uses a cat's life stage and lifestyle information to suggest an appropriate, individualized vaccination protocol.

The guidelines discuss in some detail the importance of staff and client education in implementing vaccination protocols and recommendations for feline patients. This emphasis is noteworthy in view of the fact that many pet owners, especially cat owners, associate professional veterinary care primarily with two events, vaccination and treatment of acute conditions.[3] Thus, a healthcare visit for the purposes of vaccination becomes an opportunity to more broadly discuss an overall preventive healthcare strategy with the pet owner. Implicit in this approach is an explanation of how the clinician considers life stage, lifestyle, patient health status, environmental, and epidemiologic factors in making vaccination recommendations. The vaccination event then occurs in the context of a practitioner–client discussion on how preventive healthcare forms the basis for the pet owner to maintain a long, rewarding relationship with the animal in his or her care.

Kittens may be susceptible to infectious diseases at about 1 month of age, perhaps as much as 2 weeks earlier than puppies.

Vaccination principles

Active immunization, achieved through proper vaccination, plays a critical role in the control of infectious diseases, both for individual cats and for the cat population as a whole. Some vaccines also reduce the potential for spread of zoonotic infections to humans (e.g., rabies). The benefits of routine, widespread vaccination are clear: the incidence of serious disease caused by pathogenic organisms, such as feline panleukopenia virus (FPV), can be reduced dramatically when widespread vaccination is practiced. However, the quality of vaccine-induced immunity is influenced by the patient's environment, the characteristics of the vaccine, the pathogen, and the patient's immune competence. Accurate prediction of the outcome of vaccination or the likelihood of exposure to a pathogen is impossible. Therefore, it is important that veterinarians inform cat owners that vaccination is not a guarantee of protection.

In general, kittens are more susceptible to infection and disease than adults. Thus, they represent a primary target population for immunization. As part of a routine wellness program, the vaccination needs of all cats should be assessed annually, in conjunction with a comprehensive physical examination, modifying vaccination and other control recommendations as necessary based on the current risk (see "Vaccination risk–benefit assessment").

Kittens born to immune queens lack significant transplacentally acquired antibodies[4] and instead absorb specific maternally derived antibodies (MDA) through colostrum, which provides important protection during early life. Most absorption occurs within 24 hours of birth. However, this MDA also interferes with active immunization. Serum MDA inhibits immunoglobulin (Ig)G production within the neonate through negative feedback mechanisms. It also neutralizes vaccine antigens and prevents them from stimulating an immune response. MDA then declines at a variable rate. Maternally derived IgG in kittens in one study was lowest at around 3–4 weeks of age, and serum IgG and IgA increased dramatically at 5–7 weeks of age.[4] These results suggested that kittens may be susceptible to infectious diseases at about 1 month of age, perhaps as much as 2 weeks earlier than puppies.

Nevertheless, it is critical to recognize that there is considerable individual variation in the rate of decline of MDA, and some kittens maintain high concentrations for months.[5] The persistence of MDA is one of the most common reasons for vaccine failure. The amount of MDA in a

kitten at any one time point cannot be predicted because it varies depending on the titer of the dam and the amount of colostrum ingested after birth. *As a result, a series of vaccinations is administered to kittens every 2–4 weeks through 16–18 weeks of age in order to increase the chance that successful immunization will occur soon after the decline of MDA to sufficiently low titers.* The series is started no sooner than 4 weeks of age, because neonates are more likely to develop vaccine organism-associated disease and may not respond well to vaccination. During administration of the series, a window exists when MDA concentrations are high enough to interfere with immunization but are not sufficient to prevent natural infection. This *window of susceptibility* can be minimized by decreasing the interval between vaccinations in the series, although use of intervals less than 2 weeks can interfere with successful immunization, especially with attenuated live vaccines.

Once vaccination has been successfully achieved after the decline of MDA, it is generally recommended that a *booster* vaccine be given 3–4 weeks later (this is especially important for inactivated vaccines, although a boostering effect will also occur following revaccination with attenuated live vaccines). *This means that the series must be extended 3–4 weeks beyond the period in which the decline in MDA occurs, with the final vaccination dose being a booster.* In the past, it was recommended that revaccination be performed 1 year after the initial kitten series, and then for most vaccines every 3 years thereafter. However, owing to studies that suggest up to one-third of kittens may fail to respond to a final core vaccine at 16 weeks and may have blocking MDA at 20 weeks, the WSAVA recommends that the 1 year vaccine (feline viral rhinotracheitis–calicivirus–panleukopenia only) be replaced with revaccination at 6 months of age.[2,6,7]

In this update, this Task Force has adopted the same recommendation of revaccination against FPV, feline herpesvirus type 1 (FHV-1), and feline calicivirus (FCV) at 6 months of age to potentially reduce the window of susceptibility in kittens with MDA toward the end of the kitten series (16–18 weeks). The Task Force recognizes that this means an additional visit will still be necessary for administration of the annual feline leukemia virus (FeLV) and rabies vaccinations in young cats.

The risk of infection and disease varies with factors such as the age and health of the cat, magnitude of exposure to the infectious agent, the pathogenicity of the agent, and the

Vaccines, including those from different manufacturers that are licensed to protect against the same pathogen, should not be assumed as equivalent.

Table 1 Types of feline vaccines and their attributes

Attributes	Inactivated	Attenuated live	Recombinant
Examples	FPV, FHV-1, FCV, FeLV, rabies, *Chlamydia*	FPV, FHV-1, FCV, FIP, *Chlamydia*, *Bordetella*	Rabies, FeLV
Replication after administration	Does not replicate	May replicate locally and at sites beyond the inoculation site	Limited replication, which is then aborted (for canarypox-vectored vaccines)
Initial vaccination in the absence of MDA	With the exception of rabies, two initial doses required, 3–4 weeks apart Protective immunity is expected within 7–10 days of the second dose. For rabies, only one dose is required, and protection is expected within 28 days	One dose may be sufficient; however, where the likelihood of infection is high, two initial doses are recommended, 3 weeks apart Protective immunity is expected within 7–10 days of the second dose	**Rabies:** One dose is required. Protective immunity is expected to develop by 28 days **FeLV:** Two initial doses are required, 3–4 weeks apart. Protective immunity is expected within 7–10 days of the second dose
Route(s) of administration as stipulated by the manufacturer	Parenteral (SC, IM)	Parenteral (SC, IM): FPV, FHV-1, FCV, *Chlamydia* Mucosal (intranasal): FPV, FHV-1, FCV, FIP, *Bordetella*	Parenteral (SC)
Adjuvanted	Yes, with some exceptions	Not required	Some products contain adjuvant; canarypox-vectored products are non-adjuvanted
Vaccine organism-induced disease	Not possible	Possible, but uncommon, following intranasal administration of respiratory virus vaccines or oral exposure to leaked parenteral vaccine on haircoat	Not possible

Because vaccine-induced protection is variable and not absolute, vaccination should not be used as the only form of protection.

vaccination history of the cat. Some of the factors that impact an individual animal's ability to respond to vaccination include interference from MDA, congenital or acquired immunodeficiency, concurrent disease, inadequate nutrition, chronic stress, and very young or old age. Some vaccines (e.g., those for FPV) induce a stronger protective response than others (e.g., those for FHV-1). Because vaccine-induced protection is variable and not absolute, vaccination should not be used as the only form of protection, and other control measures, such as those that reduce exposure to infectious agents, should also be employed.

Types of feline vaccines

Vaccines, including those from different manufacturers that are licensed to protect against the same pathogen, should not be assumed as equivalent. Differences in processes and technology used to produce vaccines, as well as additives such as adjuvants, and vaccine route of administration influence efficacy, safety, and duration of immunity. Vaccines may be inactivated, attenuated live, or recombinant (Table 1). All veterinary vaccines, before licensing, are assessed for efficacy, safety, potency, and purity. Vaccine efficacy is often expressed as *preventable fraction*, defined as the proportion of vaccinated animals that do not develop a disease after challenge (so-called sterilizing immunity, e.g., FPV, FeLV, and rabies vaccines), compared with unvaccinated animals that do develop the disease. It can also be expressed as *mitigatable fraction* (proportion with reduction in severity of clinical signs, e.g., FHV-1 and FCV vaccines). Other claims include reduction of pathogen shedding, prevention of a specific clinical sign, or prevention of mortality. The level or degree of protection claim can therefore be limited.

✣ **Inactivated vaccines** are vaccines in which the target pathogen is "killed" and therefore unable to replicate in the host. Although these vaccines are unable to revert to virulence, they often contain adjuvants and other excipient proteins to promote an adequate immune response, which have been implicated in acute and delayed adverse reactions in cats. Inactivated vaccines produce weaker immune responses of shorter duration when compared with attenuated live vaccines, and more frequent booster immunizations may be required (generally annually). With the exception of rabies, two initial doses of vaccine 3–4 weeks apart in the absence of MDA are absolutely essential to produce an effective immune response, and if more than 6 weeks elapses between these doses, it is recommended in other guidelines reports that the series be repeated.[2,8] Full protection may not develop until 2–3 weeks after the last dose. Inactivated vaccines are generally considered safer than attenuated live vaccines for use during pregnancy and in immunosuppressed animals, although systemic allergic reactions could still jeopardize pregnancy.

✣ **Attenuated live vaccines** (modified live vaccines) contain microorganisms that are artificially manipulated so as to reduce their virulence or are field strains of low virulence. Repeated passage through cell culture is the most common means of attenuation. Because organisms in attenuated live vaccines replicate in the host, they stimulate an immune response that more closely mimics protection from natural infection. There is generally a more rapid onset of immunity than with inactivated vaccines, and, in the absence of MDA, only one dose of vaccine may be sufficient to provide protection. Partial immunity after vaccination with a single dose of attenuated live FPV vaccines can occur within hours.[9–11] In addition, live vaccine organisms that are shed can immunize other animals in a population. However, the potential for vaccine organism-induced disease exists. This is most likely to occur in immunosuppressed animals, such as neonates that are younger than 4 weeks old. In addition, use of attenuated live vaccines is more likely to result in the generation of false-positive results as indicated by diagnostic tests that are designed to detect the target pathogen (antigen or nucleic acid). With prolonged shedding of live vaccine organisms, this can be a problem for weeks after vaccination. All bacterial and viral vaccines licensed for intranasal administration in cats are attenuated live, as are a number of parenteral vaccines.

✣ **Recombinant vaccines** are created through manipulation of the deoxyribonucleic acid (DNA) of a pathogen in the laboratory, with reduction in pathogen virulence. Types of recombinant vaccines include subunit, deletion mutant, vectored, and DNA vaccines. Currently, the only available recombinant vaccines for cats in North America are vectored vaccines, which use a recombinant canarypox virus as a vector. In these vaccines, DNA of the pathogen that encodes for an immunogenic antigen is incorporated into the canarypox genome, which then undergoes aborted (limited) replication in the host with expression of the immunogen, in turn inciting a protective immune response. Compared with inactivated

Table 2 Core vaccines for pet cats (continued on page 818)

		<16 Weeks of age first dose administered:	>16 Weeks of age first dose administered:	Revaccination	Clinically relevant comments for administration
FPV + FHV-1 + FCV	PARENTERAL **Attenuated live**	No earlier than 6 weeks of age and then q 3–4 weeks until 16–20 weeks of age	One or two doses of a combination vaccine	Consider at 6 months* of age rather than 1 year of age to decrease the potential window of susceptibility if the kitten had MDA at the last kitten booster[2,6,7] (see comments in text) Revaccinate q 3 years thereafter[2] *Note: This means an additional visit for the annual FeLV and rabies revaccination in young cats	✣ Vaccination of pregnant queens and kittens <4 weeks of age should be avoided because of the theoretical concern for cerebellar hypoplasia[15,16] ✣ Because of the theoretical risk of clinical signs due to residual virulence of the attenuated virus in an immunocompromised patient, consider avoiding in cats with retrovirus infections[17,18] ✣ Provides cross-protection to canine parvovirus-2[19,20] ✣ Considered by many clinicians to be their first choice for protection against FPV, especially in high-risk cats owing to more rapid protective response than inactivated vaccines[16,21,22] ✣ For cats going into boarding or other high-exposure, stressful situations, revaccination 7–10 days prior to boarding may be warranted, particularly if the cat has not been vaccinated in the preceding year ✣ Cats residing in a high-risk environment when presented for initial vaccination may benefit from administration of two doses of a combination vaccine 2–4 weeks apart
	PARENTERAL **Inactivated**	No earlier than 6 weeks of age and then q 3–4 weeks until 16–20 weeks of age	Two doses q 3–4 weeks apart	Consider at 6 months* of age rather than 1 year of age to decrease the potential window of susceptibility if the kitten had MDA at the last kitten booster[2,6,7] (see comments in text) Revaccinate q 3 years thereafter[2] *Note: This means an additional visit for the annual FeLV and rabies revaccination in young cats	✣ Likely safer for use in pregnant cats and those with retrovirus infections ✣ Administration should not be avoided in cats with retroviral infection because they can develop more severe clinical signs if exposed to FPV and upper respiratory infections[17] ✣ Provides cross-protection to canine parvovirus-2[19,20] ✣ Dual-strain calicivirus vaccines may provide broader cross-protection[23] ✣ For cats going into boarding or other high-exposure, stressful situations, revaccination 7–10 days prior to boarding may be warranted, particularly if the cat has not been vaccinated in the preceding year
	INTRANASAL **Attenuated live**	No earlier than 6 weeks of age and then q 3–4 weeks until 16–20 weeks of age	One dose and then yearly thereafter	Revaccinate annually Revaccination can be helpful in mitigating upper respiratory infections in stressful/boarding situations	✣ Provides faster protection, which is especially relevant in high-risk populations and with kittens against respiratory disease[24] ✣ Consider vaccination simultaneously with parenteral FPV[25] ✣ Might cause transient clinical signs of respiratory disease ✣ For cats going into boarding or other high-exposure, stressful situations, revaccination 7–10 days prior to boarding may be warranted, particularly if the cat has not been vaccinated in the preceding year
FHV-1 + FCV	INTRANASAL **Attenuated live**	Start at 4–6 weeks of age and then q 3–4 weeks until 16–20 weeks of age	One dose and then yearly thereafter	Revaccinate annually Revaccination can be helpful in mitigating upper respiratory infections in stressful/boarding situations	✣ No protection against FPV ✣ Provides faster protection, which is especially relevant in high-risk populations and with kittens against respiratory disease[24] ✣ Might cause transient clinical signs of respiratory disease ✣ Although mucosal vaccines are not generally considered impacted by MDA interference, the Task Force feels the regimen for <16-week-old kittens is ideal to prevent morbidity from FHV-1 and FCV in very young kittens ✣ For cats going into boarding or other high-exposure, stressful situations, revaccination 7–10 days prior to boarding may be warranted, particularly if the cat has not been vaccinated in the preceding year

Table 2 Core vaccines for pet cats (continued from page 817)

		<16 Weeks of age first dose administered:	>16 Weeks of age first dose administered:	Revaccination	Clinically relevant comments for administration
FeLV	PARENTERAL Recombinant (live canarypox vector)	Two doses 3–4 weeks apart beginning as early as 8 weeks of age	Two doses 3–4 weeks apart	Revaccinate 12 months after the last dose in the series, then annually for individual cats at high risk of regular exposure through encountering FeLV+ cats and cats of unknown FeLV status either indoors or outdoors[13]	✣ Considered a core vaccine for kittens and young adult cats <1 year of age owing to age-related susceptibility ✣ Considered a non-core vaccine for low-risk adult cats (no potential exposure to other FeLV+ cats or cats of unknown FeLV status) ✣ Test to establish FeLV antigen status prior to vaccination (see text for comments) ✣ There is conflicting evidence in the literature regarding efficacy and safety when comparing recombinant and inactivated vaccines (see text for comments)[12–14,28–30] ✣ The Task Force acknowledges that if an FPV–FHV-1–FCV vaccine is administered at 6 months of age, an additional visit will be required to facilitate vaccinating 12 months after the last FeLV vaccine in the kitten series
	PARENTERAL Inactivated	Two doses 3–4 weeks apart beginning as early as 8 weeks of age	Two doses 3–4 weeks apart	Revaccinate at 12 months after the last dose in the series and then consider revaccination:* ✣ Annually for individual cats with regular exposure through living with FeLV+ cats and cats of unknown FeLV status either indoors or outdoors ✣ Every 2–3 years, where product licensure allows, for individual adult cats less likely to have regular exposure to FeLV+ cats[26,27]* **At-risk (fighting, outdoor lifestyle, etc.) adult cats should continue to be vaccinated against FeLV annually. The consensus of the Task Force is revaccination every 2 years in periodic exposure situations in mature cats. Where vaccines with a 3-year duration of immunity are available, their use can be considered*	✣ Considered a core vaccine for kittens and young adult cats <1 year of age owing to age-related susceptibility ✣ Considered a non-core vaccine for low-risk adult cats (no potential exposure to other FeLV+ cats or cats of unknown FeLV status) ✣ Test to establish FeLV antigen status prior to vaccination (see text for comments) ✣ There is conflicting evidence in the literature regarding efficacy and safety when comparing recombinant and inactivated vaccines (see text for comments)[12–14,28–30] ✣ The Task Force acknowledges that if an FPV–FHV-1–FCV vaccine is administered at 6 months of age, an additional visit will be required to facilitate vaccinating 12 months after the last FeLV vaccine in the kitten series
		Administration instructions		**Clinically relevant comments for administration**	
Rabies	PARENTERAL Recombinant (live canarypox vector)	Follow vaccine label instructions and local laws		✣ There is conflicting evidence in the literature regarding safety when comparing recombinant and inactivated vaccines (see text for comments)[12,30] ✣ Where rabies vaccination is required, the frequency of vaccination may differ based on local statutes or requirements. Veterinarians should be familiar with, and adhere to, local requirements	
	PARENTERAL Inactivated	Follow vaccine label instructions and local laws		✣ There is conflicting evidence in the literature regarding safety when comparing recombinant and inactivated vaccines (see text for comments)[12,30] ✣ Where rabies vaccination is required, the frequency of vaccination may differ based on local statutes or requirements. Veterinarians should be familiar with, and adhere to, local requirements ✣ When local laws/regulations permit, the Task Force recommends a 3-year vaccination interval using a 3-year labeled vaccine	

vaccines, canarypox vectors offer a more rapid onset of immunity and may be more effective in the face of persistent MDA. Canarypox-vectored vaccines also do not require adjuvant and have been associated with a reduced risk of injection-site sarcomas in cats.[12] However, one study suggested that the degree of protection induced by the recombinant canarypox FeLV vaccine may not be as robust as that induced by whole inactivated FeLV vaccines,[13] which might produce sterilizing immunity.[14] However, moderate to severe immunosuppression may have impacted the results, so further studies are required to determine whether a clinically important difference exists.

Core vaccines are for all cats with an unknown vaccination history.

Table 3 Core vaccines for shelter-housed cats

		<20 Weeks of age first dose administered:	>20 Weeks of age first dose administered:	Clinically relevant comments for administration
FPV + FHV-1 + FCV	PARENTERAL Attenuated live	Single dose at intake or where possible at least 1 week before shelter entry; in kittens, the first dose no earlier than 4 weeks, and then q 2 weeks until 16–20 weeks of age	For adults, single dose at intake or where possible at least 1 week before shelter entry Second dose 2 weeks later	✣ Vaccination of pregnant queens and kittens <4 weeks of age should be avoided because of the theoretical concern for cerebellar hypoplasia[15,16] ✣ Because of the theoretical risk of clinical signs due to residual virulence of the attenuated virus in an immunocompromised patient, consider avoiding in cats with retrovirus infections[17,18] ✣ Provides cross-protection to canine parvovirus[19,20] ✣ Considered by many clinicians to be their first choice for protection against FPV, owing to more rapid protective response than inactivated vaccines[16,21,22]
	PARENTERAL Inactivated	Not recommended owing to delayed protective response specifically for FPV (see comments in text)[5,9–11]		
	INTRANASAL Attenuated live	Not recommended in shelters owing to less-than-optimal protection against panleukopenia[31]		✣ Do not vaccinate any earlier than 4 weeks of age because of the concern for cerebellar hypoplasia[15,16] ✣ Shelters should be aware that postvaccinal clinical signs associated with the use of intranasal vaccines could be confused with those caused by natural infections ✣ Provides faster protection, which is especially relevant in high-risk populations and with kittens against respiratory disease[24] ✣ Consider vaccination simultaneously with parenteral FPV ✣ Might cause transient clinical signs of respiratory disease
FHV-1 + FCV	INTRANASAL Attenuated live	Single dose at intake or where possible at least 1 week before shelter entry; in kittens, administer no earlier than 4 weeks	Single dose at intake or where possible at least 1 week before shelter entry	✣ Do not vaccinate any earlier than 4 weeks of age because of the concern for cerebellar hypoplasia[15,16] ✣ Shelters should be aware that postvaccinal clinical signs associated with the use of intranasal vaccines could be confused with those caused by natural infections ✣ Provides faster protection, which is especially relevant in high-risk populations and with kittens against respiratory disease[24] ✣ Might cause transient clinical signs of respiratory disease
FeLV	PARENTERAL Recombinant (live canarypox vector)	Two doses 3–4 weeks apart beginning as early as 8 weeks of age	Two doses 3–4 weeks apart	✣ Optional in individually housed cats but shelters should consider the benefits of vaccinating more cats against FeLV ✣ Strongly recommended in group-housed cats ✣ Recommend testing to establish FeLV antigen status prior to vaccination (see text for comments) ✣ There is conflicting evidence in the literature regarding efficacy and safety when comparing recombinant and inactivated vaccines (see text for comments)[12–14,28–30]
	PARENTERAL Inactivated	Two doses 3–4 weeks apart beginning as early as 8 weeks of age	Two doses 3–4 weeks apart	✣ Optional in individually housed cats but shelters should consider the benefits of vaccinating more cats against FeLV ✣ Strongly recommended in group-housed cats ✣ Recommend testing to establish FeLV antigen status prior to vaccination (see text for comments) ✣ There is conflicting evidence in the literature regarding efficacy and safety when comparing recombinant and inactivated vaccines (see text for comments)[12–14,28–30]
Rabies		**Administration instructions**		**Clinically relevant comments for administration**
	PARENTERAL Recombinant (live canarypox vector)	Follow vaccine label instructions and local laws		✣ Necessary for all cats where legally allowed/mandated or in an endemic region ✣ The authority to administer rabies vaccine to shelter-housed cats is often stipulated by state or local law and may not be at the discretion of shelter personnel ✣ In states/provinces where rabies vaccination may not be mandated, shelters should consider the benefits of vaccinating more cats against rabies ✣ There is conflicting evidence in the literature regarding efficacy and safety when comparing recombinant and inactivated vaccines (see text for comments)[12,30]
	PARENTERAL Inactivated	Follow vaccine label instructions and local laws		✣ Necessary for all cats where legally allowed/mandated or in an endemic region ✣ The authority to administer rabies vaccine to shelter-housed cats is often stipulated by state or local law and may not be at the discretion of shelter personnel ✣ In states/provinces where rabies vaccination may not be mandated, shelters should consider the benefits of vaccinating more cats against rabies ✣ There is conflicting evidence in the literature regarding efficacy and safety when comparing recombinant and inactivated vaccines (see text for comments)[12,30]

Table 4 Non-core vaccines for pet cats

		Administration instructions	Clinically relevant comments for administration
Bordetella	INTRANASAL Attenuated live	For frequency and interval, follow label instructions	✣ Not routinely used in pet cats ✣ Provides incomplete protection ✣ Use as part of a control program in a multi-cat household where infection is confirmed ✣ Never administer parenterally
Chlamydia	PARENTERAL Inactivated	For frequency and interval, follow label instructions	✣ Provides incomplete protection ✣ Use as part of a control program in a multi-cat household where infection is confirmed ✣ Vaccination may be associated with a higher risk of adverse effects (lethargy, limb soreness, anorexia)[32]
Chlamydia	PARENTERAL Attenuated live	For frequency and interval, follow label instructions	✣ Provides incomplete protection ✣ Use as part of a control program in a multi-cat household where infection is confirmed ✣ Vaccination may be associated with a higher risk of adverse effects (lethargy, limb soreness, anorexia)[32]

Non-core vaccines are optional vaccines that should be considered in the light of exposure risk.

To facilitate vaccine selection, vaccines for dogs and cats have been divided into core vaccines, non-core vaccines, and those generally not recommended.

✣ **Core vaccines** are for all cats with an unknown vaccination history. The targeted diseases cause significant morbidity and mortality and are widely distributed. In general, vaccination for core diseases results in good protection. The Task Force recommends vaccines for FHV-1, FCV, FPV, rabies, and FeLV (cats younger than 1 year old) as core vaccines (Table 2, pet cats; Table 3, shelter-housed cats).

✣ **Non-core vaccines** are optional vaccines that should be considered in the light of exposure risk; that is, based on geographic distribution and the lifestyle of the cat (Table 4). Optional or non-core vaccines for cats include FeLV (for cats older than 1 year), *Chlamydia felis*, and *Bordetella bronchiseptica* vaccines.

✣ The **not generally recommended** category of vaccines pertains to diseases of low clinical significance or that respond readily to treatment; vaccines for which evidence of efficacy in the field is minimal; or vaccines that may produce a relatively higher incidence of adverse events with limited benefit. The Task Force lists the feline infectious peritonitis (FIP) vaccine as not generally recommended (Table 5). This vaccine is labeled for administration from 16 weeks of age, whereas many kittens become infected with coronaviruses well before this age. It also contains a serotype II strain of FIP virus. Serotype I FIP virus strains predominate in the field and do not have cross-reactive neutralizing epitopes with serotype II strains. Therefore, as noted in the previous iteration of these guidelines,[1,33] there remains insufficient evidence that this vaccine induces clinically relevant protection in the field.

The decision to vaccinate, even with core vaccines, should be based on a risk–benefit assessment for each cat and for each vaccine antigen. Benefits of vaccination should be balanced against the risk of adverse events, likelihood of exposure, and disease severity.

The Task Force lists the FIP vaccine as not generally recommended.

Table 5 Not generally recommended vaccines for pet cats

		Administration instructions	Clinically relevant comments for administration
FIP	INTRANASAL Attenuated live	For frequency and interval, follow label instructions	✣ **Not generally recommended** at this time because its uncertain ability to uniformly prevent disease in North American cat populations does not justify its routine use ✣ Only coronavirus seronegative cats have the potential to be protected, and most cats are seropositive before the age of recommended vaccination ✣ Vaccine virus (serotype II) differs from the serotype (I) that predominantly causes clinical disease ✣ The benefits and risks of vaccination remain unclear (see comments in text)

Every effort should be made to ensure that cats are healthy before vaccination. However, concurrent illness (including retroviral infections) does not necessarily preclude vaccination.[34] The 2020 AAFP Feline Retrovirus Testing and Management Guidelines state that vaccines should not be avoided in cats with retroviral infection because they can develop more severe clinical disease related to FPV and upper respiratory tract infections after natural exposure compared with uninfected cats.[34]

Potential therapeutic benefits of vaccination

Active immunization can enhance non-specific immunity, leading to reduction in disease caused by non-target pathogens. One study showed that vaccination of cats with an intranasal FHV-1–FCV vaccine was associated with reduction in clinical signs following challenge with *B bronchiseptica*.[24] More studies are needed to assess the non-target effects of different vaccine types. There is also interest in whether vaccines might provide therapeutic benefits in cats already infected with target pathogens. Improvement in chronic upper respiratory tract signs that were previously refractory to other treatments was documented in 13 cats vaccinated with an intranasal FHV-1–FCV vaccine.[35] Most vaccines, however, provide no therapeutic benefit, as clearly documented for FeLV vaccines.[36]

Vaccination risk–benefit assessment

The Task Force supports the WSAVA's recommendation that veterinarians should vaccinate every animal with core vaccines and give non-core vaccines no more frequently than is deemed necessary.[2] The decision whether or not to administer a vaccine to a cat, and how frequently, relies on an individual case-by-case assessment by the veterinarian. This involves consideration of the animal, the animal's environment, and the pathogen in question. Additionally, risk–benefit assessments should consider the safety of the vaccine, other adverse effects of vaccination (e.g., the effect of feline immunodeficiency virus vaccination on in-clinic diagnostic test kits), and the efficacy of the vaccine. The result of this assessment should be an individualized, evidence-guided recommendation to vaccinate or not to vaccinate.

Patient's characteristics

Age is an important factor in assessing an individual's risk profile. In contrast to puppies, kittens born to immune queens appear to lack transplacentally acquired antibodies and instead absorb specific MDA through colostrum,[4] which provides important protection during early life. Once MDA have waned, however, kittens become susceptible to infection. Most infectious diseases are more prevalent in kittens than adults, and therefore, kittens (in particular, those younger than 6 months old) represent a principal primary target population for vaccination. Conversely, adult cats generally have a more robust adaptive immune response when challenged (assuming they are healthy and not immunocompromised), whether due to previous natural exposure or vaccination, and age-related resistance to challenge is particularly a feature of FeLV infection.[26] Consequently, vaccination of mature cats is generally considered less critical than vaccination of kittens. The presence of concurrent disease or stress causing immunosuppression should also be a consideration prior to vaccination because this may affect an animal's susceptibility to infection and response to vaccination.

A balancing act

There is always a balance to be struck when considering risks associated with vaccination and benefits of vaccination for the individual patient:

- A decision TO VACCINATE might involve a young cat residing in a multi-cat household with outdoor access, living in an area with a known high prevalence of the pathogen being vaccinated against.
- A decision NOT TO VACCINATE might involve a senior or geriatric cat residing in a single-cat household with no outdoor access, and a vaccine that has poor efficacy against a pathogen with low virulence or limited local prevalence.

Patient's environment

Population density and opportunity for exposure to infectious agents are two critical issues that should form part of the risk–benefit assessment. In general, cats and kittens living in larger multi-cat households and environments (e.g., boarding, breeding, foster, or shelter facilities) have a higher risk of infection than cats living in one- or two-cat households. In addition to the possible presence of infected animals acting as reservoirs for infection in multi-cat households, the immunosuppressive effects of stress associated with high-density feline housing may result in reactivation of some infections as well as increased susceptibility to new infections. The introduction of new cats into multi-cat households also increases the risk of infectious disease not only to the cat entering the household but also to the whole group because of possible direct exposure to new infectious agents.

When assessing the opportunity for exposure to a given pathogen for an individual cat, the lifestyle of the cat and other cats in the same household needs to be considered. It is critical to determine whether the cat is indoor-only or has outdoor access (including supervised outdoor visits on a harness, or boarding) because cats with outdoor access may be at increased risk of pathogen exposure. Indoor-only cats, however, may still be determined to be at risk of exposure to pathogens, either from other cats in the household (i.e., subclinically infected or carrier cats), or by fomite transmission of pathogens brought in from outside on the owner's body, clothing, or shoes. Indoor-only cats may also be exposed to infectious agents when brought to a veteri-

nary clinic for a wellness examination. In theory, strictly indoor cats may be more susceptible to developing some infectious diseases (such as FPV and FCV infection) than cats with outdoor access because they may not receive "natural boosting of immunity" that occurs with natural exposure.[1]

The geographic distribution of infectious agents may also result in different risks of exposure (e.g., rabies), and therefore, questions regarding future travel should be included in determining the risk of exposure to specific infectious agents.

Table 6 Risk assessment variables determining an individualized vaccination plan

Risk factors	Considerations
Age and life stage	Susceptibility, MDA, activity level, reproductive status
Health status	Concurrent disease, nutritional status, level of parasitism
Agent exposure	Geographic prevalence, cat lifestyle, housing
History	Adverse vaccine events, response to vaccination by littermates, previous disease
Immunodeficiency	Congenital or acquired (including chronic stress)

Infectious agents

The likelihood of infection and disease is influenced by pathogen factors such as virulence, strain variation, and challenge dose (i.e., how many infectious units of exposure). The need for vaccination is greatest against pathogens with high virulence, such as FPV, and pathogens that cause widespread morbidity, such as FHV-1.

Creating an individualized, lifestyle-based vaccination plan

The vaccination needs of each cat should be evaluated individually and rationally, based on health status, age, and possible, realistic exposure to disease (Table 6). Owners and veterinarians must work together to determine the likelihood of the animal coming into contact with other animals that may spread disease, acquiring parasites that may harbor a disease-causing agent, or living in an area where a disease is known to be endemic or very widespread.[2]

Questions must be asked about the lifestyle of that specific cat as well as any other cats in the household or potentially introduced into the household. The travel, boarding, housing, and enrichment activities or excursions outside of the home should also be considered.[1] This risk assessment for exposure to disease should be done at least once a year.

The life stage of the cat must also be considered with respect to possibility of exposure to disease and the health status of the animal. Infectious diseases are more prevalent in kittens, and in general, kittens (younger than 6 months old) are more susceptible to infection.[1] Younger cats also tend to behave more unpredictably and require more enrichment activities, which may increase their opportunity for exposure.[37]

The health status of the individual cat, including any previously documented adverse events to vaccines, also determines the vaccination recommendations. The nutritional status, general health (i.e., any concurrent infections or other disease) and the pregnancy status of females may change the type and schedule of vaccination for that individual cat (Table 6). As with lifestyle changes, changes in health status must be evaluated at least yearly.[1]

One vaccination plan or protocol cannot be applied to every cat. Each animal must be evaluated and an individualized plan created that will most protect that particular cat.

The population density, along with the opportunity for exposure to other cats, is a major factor in determining the need for vaccination. Larger multi-cat households are likely to have a greater risk of infection and disease than households of one or two cats. The introduction of new cats and the social dynamics of the group may also cause immunosuppressive stress, leading to increased risk of disease by new infection or recrudescence. Each cat in a multi-cat environment must have a vaccination plan that balances the protection of the individual with that of the household population.[1]

Cats entering boarding, breeding, foster, or shelter situations have increased risk of disease exposure as well as systemic stress. Vaccination may be warranted prior to entering these environments when possible (see Tables 2 and 3). Additionally, vaccination intervals may need to be shortened depending upon these possible scenarios.[1] As with multi-cat households, the vaccination plan for the individual cat must be considered in relation to the entire population.

One vaccination plan or protocol cannot be applied to every cat. Each animal must be evaluated and an individualized plan created that will most protect that particular cat. That plan must be reassessed when changes in health and lifestyle occur, requiring client education and compliance with at least yearly veterinary visits.[38]

Feline patient populations

For the purpose of creating specific, individualized vaccination recommendations based on risk of exposure, the Task Force has identified and defined the following feline populations based on their environment and lifestyle. The guidelines begin by discussing pet cats and then discuss a number of feline populations that are considered to be at relatively high

risk of infectious disease exposure; namely, shelter cats, trap–neuter–return/trap–neuter–release cats, cattery cats, and foster cats.

Pet cats

Pet cats include any cat kept by human beings as a source of companionship and pleasure. Pet cats are further categorized by housing status (indoor, outdoor, or indoor–outdoor cats) and number of cats in the household (single-cat or larger multi-cat). Although these distinctions are important, the most significant issue to consider regarding vaccination of pet cats is the individual cat's exposure risk and exposure frequency to other cats and feline infectious diseases. Even indoor cats from single-cat households will inevitably be exposed to other feline infectious pathogens in situations such as a veterinary clinic visit, contact with other cats entering the premises, or exposure to contaminated fomites introduced by human contact. Client education for owners of these patients should focus on risk of exposure to other cats rather than on where the cat eats, sleeps, or spends most of its time.

For high-risk, multi-cat households, the probability of infectious disease exposure and transmission is proportionate to the number or density of cats on the premises.[39] It is important to educate clients about the increased disease risks to this population of cats and to discuss increased owner responsibility to ensure appropriate preventive healthcare initiatives associated with housing many cats in a confined space.

Shelter cats

These are cats living for indeterminate periods in centers for relinquished or lost animals.

Clinicians should understand when and why to perform antibody testing and use this knowledge to make evidence-based decisions prior to vaccination.

Trap–neuter–return/trap–neuter–release cats

These are community or feral cats of either sex that live entirely separate from people and cannot safely be handled. Trap–neuter–release/trap–neuter–return cats may survive completely independently of humans, but some semi-feral colonies receive support from individuals.

Cattery cats

These cats are maintained in commercial facilities; for example, breeding or boarding facilities, and pet stores with a showcase model.

Foster cats

Foster cats are kittens or adult cats temporarily housed for rescue, rehabilitation, and rehoming purposes. The most important consideration in a foster cat household is ensuring that the permanent population of the household is appropriately vaccinated to provide protection from disease exposure originating with foster cats.

Serology and diagnostics

The interpretation of an antibody test result can be complex because antibody testing is used for many reasons. Depending on the antibodies tested for, antibody testing can be used for (1) diagnosis of infection, (2) identification of previous exposure to pathogens (particularly in unvaccinated animals), and (3) assessment of immunity prior to or following vaccination (Table 7). Clinicians should understand when and why to perform antibody testing and use this knowledge to make evidence-based decisions prior to vaccination.

Hemagglutination inhibition (for FPV) and serum neutralization (for FHV-1, FCV, and

Table 7 Possible uses of in-clinic serology testing

Pathogen	Usefulness of antibody testing
FPV	Useful for assessment of immunity because presence of antibodies correlates strongly with protection.[6,40] Result can be used to decide whether to vaccinate (i.e., only vaccinate antibody-negative cats)
FHV-1	Not reliable for assessment of immunity.[1,40] Effective immunity against FHV-1 requires both an antibody and cell-mediated immune response. Result should not be used to decide whether to vaccinate
FCV	Not reliable for assessment of immunity.[1,40] Effective immunity against FCV requires both an antibody and cell-mediated immune response. Result should not be used to decide whether to vaccinate
FeLV	Useful for assessment of exposure and/or diagnosis of infection (in combination with other testing methodologies).[41] Recently a rapid in-clinic test kit to detect antibodies to FeLV transmembrane protein (p15E) was released in Europe. A positive p15E antibody result cannot differentiate between exposure and infection. FeLV-vaccinated cats usually have low levels of antibodies to p15E.[41] Results from FeLV antigen testing (and not antibody testing) should be used to decide whether to vaccinate. Rapid in-clinic FeLV test kits detect soluble p27 antigen in whole blood, serum, or plasma and are not affected by FeLV vaccination. The AAFP recommends testing all cats for FeLV p27 antigen prior to initial vaccination. There is no proven benefit to vaccinating infected cats[14,34,42]
FIV	Useful for diagnosis of infection.[34] Between 2002 and 2015, an inactivated whole-virus vaccine was available in North America that interferes with antibody results using some test kits.[43,44] Additionally, cats may travel from locations where the vaccine is still in use to the USA, Canada, and other countries where the vaccine is not available. FIV-vaccinated cats may test antibody positive for more than 7 years after the last vaccination.[45] Rapid in-clinic test kits able to differentiate between FIV-infected and FIV-vaccinated cats are available[46]
Rabies	Vaccination against rabies is essential in regions where it is required by statute/law or where the virus is endemic and should follow label recommendations. Serum neutralization results cannot be used to decide whether to vaccinate against rabies

rabies) are the reference standards to determine the presence of effective antibody-mediated immunity. These test methodologies can only be performed in a laboratory setting using live cell cultures (i.e., they cannot be performed in a practice using rapid patient-side test kits). These diagnostic tests are predominantly research tools used in vaccine efficacy and prevalence studies.

It is important when attempting to demonstrate protective immunity in a patient using an in-clinic antibody test kit that the performance of the kit be compared against the appropriate reference standard in order to demonstrate correlation with protective immunity.

The presence of anti-FPV antibodies correlates strongly with protection (Table 7). Currently, experts recommend antibody testing for FPV to assess immunity and inform decisions about whether to vaccinate.[6,40] Rapid in-clinic test kits to detect antibodies to FPV, FHV-1, and FCV are available to veterinarians in North America and have been validated in two different studies using the appropriate reference tests.[47,48] Of concern, however, was the occurrence of some anti-FPV antibody false-positive results in one study, which in practice would lead to some unprotected cats not being vaccinated.[48]

Adverse postvaccination reactions

Although the administration of biological products is never entirely free of risk, currently available feline vaccines have an excellent safety record. That said, the true prevalence of adverse reactions is likely to be underestimated owing to underreporting by both veterinarians and owners.[49] Therefore, it is important to report any known or suspected negative events associated with vaccination. In the United States, veterinarians are requested to contact the manufacturer (Veterinary Technical Services) of the vaccine(s) considered to be involved. Veterinarians may also report known or suspected adverse events directly to the U.S. Department of Agriculture; the Center for Veterinary Biologics of the U.S. Department of Agriculture's Animal and Plant Health Inspection Service can be contacted by the following means:

- **Website:** https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/veterinary-biologics/adverse-event-reporting/CT_Vb_adverse_event.
- **Mail:** Send the report form to the Center for Veterinary Biologics, 1920 Dayton Avenue, PO Box 844, Ames, Iowa 50010, USA.
- **Telephone:** +1 (800) 752-6255.

At the time of vaccine administration, included in the patient's permanent medical record should be the name, serial number, expiration date and manufacturer of the vaccine(s) given, date of administration, name of the person administering the vaccine(s), and the site and route of the vaccine administration. Adverse events should be recorded in a manner that will clearly alert all staff members during future visits.

Currently available feline vaccines have an excellent safety record.

Prevalence and types of adverse reactions

Postvaccination adverse events in cats are considered rare.[49] In the most substantial survey to date, any adverse reactions were recorded for cats presented to Banfield Pet Hospitals in the United States between 2002 and 2005.[42] During this period, more than 1.25 million doses of various vaccines were administered to nearly 500,000 cats. Adverse reactions within 30 days of vaccination were reported at a rate of 0.52% of cats vaccinated. The most commonly reported vaccine reactions are lethargy, anorexia, and fever for a few days after vaccination, or local inflammation at the site of injection.[42,50,51] In the Banfield Pet Hospital population, the risk of an adverse reaction was greatest in cats around 1 year of age and/or increased as the total volume of vaccine and number of vaccines administered concurrently increased.[42]

Hypersensitivity reactions

Although anaphylaxis (type I hypersensitivity reaction) is rare (approximately 1–5 per 10,000 vaccinations),[42,52] it may manifest as vomiting, diarrhea, respiratory distress, facial or generalized pruritus, facial swelling, and collapse.[51,53,54] Where revaccination is considered necessary in a cat that has experienced an allergic reaction, using a different vaccine formulation and premedicating with an antihistamine and glucocorticoid 20–30 minutes prior to vaccine administration is recommended, followed by close observation of the patient for several hours.[42,53] Other forms of hypersensitivity reactions (types II, III, and IV) almost certainly also occur in cats after vaccination, but these are rarely documented.

Postvaccination monitoring

The Task Force recommends that veterinarians and owners monitor the vaccination site for swelling or lumps using the "3-2-1" rule. Biopsy of any mass present is warranted if it (1) remains present 3 months after vaccination, (2) is larger than 2 cm in diameter, or (3) is increasing in size 1 month after vaccination.[1,55] It is recommended to obtain an incisional biopsy on any masses meeting any of these criteria. Fine-needle aspirates may not provide diagnostic cellular tissue, whereas excisional biopsies rarely meet appropriate margins (5 cm in two fascial planes) as required in the case of injection-site sarcomas, thus increasing the morbidity and mortality risks associated with sarcoma invasion.

Update on feline injection-site sarcomas

FISSs, largely caused by vaccines (although other materials have been implicated), have been recognized since 1991.[56] Three decades later, much about them remains unknown. Within the United States, FISS incidence estimates, although low, have varied by at least an order of magnitude, and worldwide FISS incidence estimates vary by country depending on the relative use of vaccine types (e.g., FeLV, rabies) and population susceptibility.

The Task Force makes the following observations regarding vaccination:

- Neither vaccinating in the interscapular space nor decreasing vaccine volume is recommended.
- Distal limb injection is recommended to facilitate amputation with 5 cm margins in two fascial planes in the case of injection-site sarcoma (Figure 1).
- More recently, ventral abdominal subcutaneous injections have been used because of the perceived relative ease of tumor removal without the need for amputation.[2] However, the need to remove two fascial planes and 5 cm margins would still necessitate aggressive tissue removal from the abdomen and abdominal cavity.

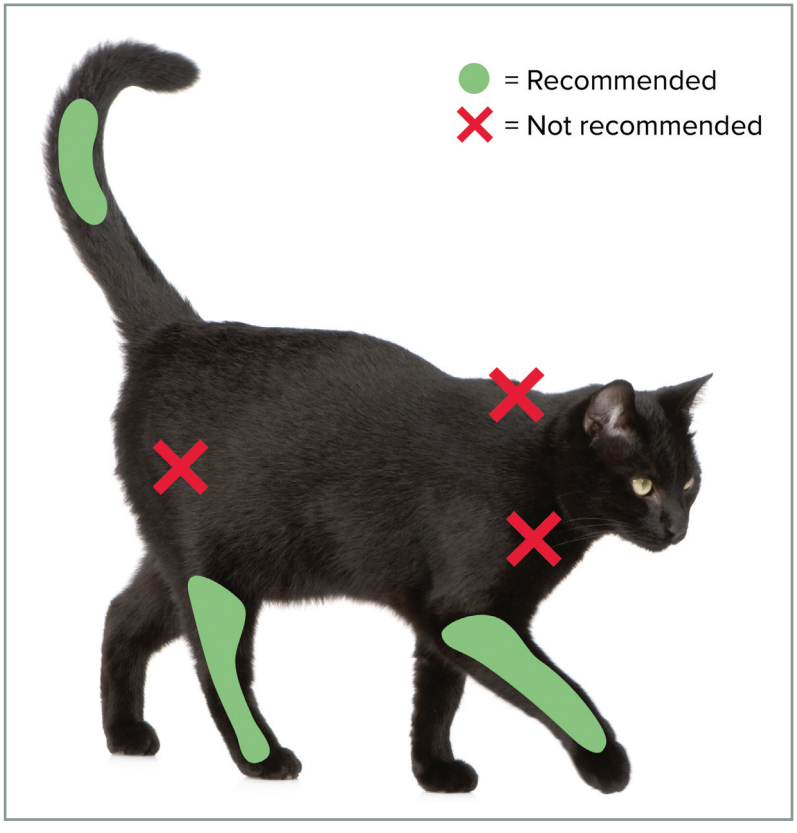

Figure 1 **Vaccination sites: recommended injection sites in the distal limbs and tail.**
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- Tail vaccination has also been reported as well tolerated and elicited acceptable serological responses to vaccination in the distal limbs.[57] To facilitate 5 cm margins in the case of injection-site sarcoma, vaccinations must be administered in the distal tail, something that may not be practical for most clinicians.
- Follow the 3-2-1 rule for postvaccination swelling.[1,55] Obtain incisional biopsies for appropriate diagnosis.

The 2013 AAFP Feline Vaccination Advisory Panel Report included recommendations for specific vaccine antigens to be administered at specific anatomical locations in the distal limbs.[1] This technique has helped facilitate the identification of the vaccine antigen used if a sarcoma developed subsequently at the injection site. Since this technique has been widely adopted, these injection-site recommendations have also led to a shift in the site of tumor formation to the distal limbs, thus facilitating potentially life-saving surgery for patients suffering from these invasive tumors.[58] The 2020 AAHA/AAFP Feline Vaccination Guidelines Task Force recognizes and supports the value of the 2013 recommendations and recognizes that practitioners may, at times, need to use medically appropriate discretion regarding the anatomical location of vaccine administration. Practitioners are strongly advised to keep complete, accurate records for antigen administration site and route of vaccine administration.

The Task Force offers the following analysis of current research about vaccine safety:

- **Experimental studies of vaccine-induced inflammation:** These studies provide weak evidence for detecting differential vaccination effects on sarcoma incidence yet represent progenitors of the "more vaccine-induced inflammation leads to increased sarcoma risk" conjecture. One immediate problem is that it is unclear how to define inflammation in the context of tumor induction. Macy and Hendrick (1996) cite an unpublished study that defined inflammation as "the size of the local reaction."[59] Grosenbaugh et al. (2004) interpreted it as the presence of "injection-site reaction," which could have included "scab, crust, swelling, erosion, ulceration, or pain at the injection site or development of lameness."[28] Day et al. (2007) used histopathological scoring that included quantifying neutrophils, lymphocytes, and macrophages (inflammatory phase of tissue reaction); quantifying fibroblasts, collagen, and granulation tissue (repair phase); and assigning a "global severity score" based on biopsy site reactivity and extension of involvement of the tissue section.[60] Because the many manifestations of inflammation in cats do not invariably lead to neoplasia, more sensitive biomarkers such as DNA damage may

Worldwide FISS incidence estimates vary by country depending on the relative use of vaccine types (e.g., FeLV, rabies) and population susceptibility.

one day be used to distinguish the potential for adjuvanted versus non-adjuvanted vaccines to induce tumors.[61] But because none of the cats in the above studies developed sarcomas, such experimental research does not have logical standing to infer relative vaccine safety.

✣ **Associational studies of diagnoses:** In the past 10 years, two studies based on data from pathology registries have provided contradictory findings. Wilcock et al. (2012) found no decrease in the proportion of "post-vaccinal sarcomas" in feline skin and subcutaneous mass submissions from 1992 to 2010 in a Canadian registry despite the introduction of a non-adjuvanted rabies vaccine in 2000.[62] In contrast, Graf et al. (2018) studied the proportion of feline biopsies that were fibrosarcomas submitted to Swiss pathology laboratories between 2009 and 2014 and noted "a marked drop in the relative frequency of fibrosarcoma diagnoses after the introduction of a non-adjuvanted FeLV vaccine into the Swiss market" in 2007 (rabies vaccines are rarely used now in Switzerland).[29] Such studies of diagnostic proportions are difficult to interpret. Moreover, they are influenced not only by disease incidence but also by factors related to differential cost and motivation for histopathologic diagnoses, which are subject to change over time. Therefore, there are always competing explanations for findings.

✣ **Longitudinal studies of comparative incidence:** A study by Srivastav et al. (2012) is the only one to perform a comparative (case-control) analysis of vaccine types in common use in the past 10 years.[12] Unlike previous epidemiologic studies, it provides tenuous evidence that non-adjuvanted vaccines may be less likely to induce sarcomas than adjuvanted vaccines. However, the work suffers from sample size limitations and bias concerns.[30] Although it arguably serves as an epidemiologic-methods blueprint for future investigations, it is insufficient to justify a wholesale recommendation for a single vaccine formulation with as yet unforeseen consequences on population immunity. The Task Force believes that there is currently insufficient research to justify recommending a single vaccine type. Since injection-site sarcomas are a risk, the Task Force recommends vaccination in the lower distal limbs to facilitate clean margins if surgical amputation is required.

Staff and client education

The veterinarian's role and responsibilities

✣ A veterinarian should assess every patient regardless of appointment type (wellness, acute care or follow-up visit) for current vaccination status based on age and lifestyle. Informed by this assessment, an individualized patient vaccination plan should be developed or modified and then discussed and agreed upon in collaboration with the cat owner.

✣ In addition to overseeing the development of feline vaccination protocols, the veterinarian should provide staff education on the following:

– Zoonotic disease prevention.
– Separate administration sites for each vaccination (based on consistent vaccination site guidelines for that practice).
– Potential life-threatening adverse events (i.e., anaphylaxis) and minor adverse events (i.e., localized swelling) following vaccination.
– Vaccine reconstitution and handling (the AAFP recommends using vaccines within 30 minutes of reconstitution).[53]
– Standard sharps safety procedures to prevent accidental needle sticks.[63]

The Centers for Disease Control and Prevention (CDC) online training module, "You Call the Shots: Vaccine Storage and Handling," is a useful resource for staff training on vaccination.[64] The practice should designate a person to be the primary vaccine coordinator for the facility. This person will be responsible for ensuring all vaccines are stored and handled correctly. A second staff member to serve as an alternate in the absence of the primary coordinator should be appointed (this is particularly important in case of after-hours emergencies). Both coordinators should be fully trained in routine and emergency policies and procedures.[65]

The healthcare team, led by the veterinarian, should emphasize and educate clients that they are part of a team approach to vaccine management, requiring the entire staff's understanding of zoonotic disease, core and non-core vaccines determined by the pet's lifestyle, hospital policy, state law, client compliance, and adverse vaccination events.

Credentialed veterinary technician or veterinary assistant roles and responsibilities

A veterinary technician or assistant often assumes the role of designated vaccine coordinator, assisting in vaccination storage and inventory management. AAHA guidelines on vaccine storage and handling, and the CDC Vaccine Storage and Handling Toolkit are useful resources for this purpose.[64,65] The vaccine

coordinator is often responsible for reconstitution of vaccines and administration of vaccinations as directed by the attending veterinarian in compliance with state law.[66] This individual is also often given responsibility for implementing feline-friendly handling techniques in the hospital setting to minimize stress during examinations and vaccine administration[67] and for maintaining effective client education and follow-up, including verbal and written instructions on potential adverse events after vaccine administration and disease prevention.

Roles and responsibilities of reception and other client-service personnel

The reception staff is typically charged with maintaining patient files with vaccination information, including date administered, along with the production lot serial number and expiration date of the vaccine. Reception personnel are also responsible for contacting clients and scheduling follow-up appointments for booster series and yearly vaccinations in advance as directed by the prescribing veterinarian. Non-clinical staff should understand the potential life-threatening and minor adverse events that can occur following vaccination that require veterinary assistance.

Client education

Pet owner clients are an essential member of a cat's healthcare team. Although clients can be instrumental in helping improve healthcare for their cats, the Task Force recommends that vaccination be performed by a veterinarian. Vaccination is a medical procedure. Vaccines are available through sources other than a veterinarian, but they may not protect a cat against disease unless properly stored, handled, and administered. The principles of feline vaccination outlined in the box below represent a basic client education overview for cat owners.

ADDITIONAL CLIENT EDUCATION RESOURCES

To help educate clients about vaccine and general health issues, both AAHA and the AAFP have handouts available to members and non-members. Additionally, more extensive information is available at aaha.org/felinevaccination and catvets.com/vaccination

Vaccination talking points for clients

Vaccines help protect against specific infectious diseases. They stimulate the body's immune system to recognize and fight an infection. Without vaccination, many cats would become seriously ill or die from preventable diseases. Some infections are more difficult to prevent using vaccination than others. For example, vaccination is very effective against feline panleukopenia infection but does not entirely protect against respiratory virus infections. However, cats vaccinated against respiratory tract infections generally have milder illness and are far less likely to die from their disease.

A veterinarian is the best person to evaluate a cat's individual vaccination needs. Many factors need to be taken into consideration when deciding how often and for what diseases a feline patient needs to be vaccinated. These considerations include health status, age, and lifestyle of the cat; a vaccine's duration of immunity; what diseases are prevalent in the area; and the severity of endemic diseases. Even cats living exclusively indoors require regular vaccination because they still may be exposed to diseases in many circumstances, such as when traveling or boarding, visiting a veterinary practice, interacting with other cats, or through viruses carried on the pet owner's hands or clothing.

A veterinarian is the best person to evaluate a cat's individual vaccination needs.

Veterinarian-administered vaccination is particularly important with respect to rabies. Rabies is a fatal but preventable disease that can be spread to humans by contact with saliva from an infected individual. If an unvaccinated cat is scratched or bitten by a wild animal, or if it bites a person, it should be quarantined or euthanized. In many US states, it is against the law for anyone other than a licensed veterinarian to administer a rabies vaccine. Rabies vaccination of cats is required by law in many but not all states. Ontario is the only Canadian province that requires rabies vaccination of cats. Even in areas where it is not required, feline rabies vaccination is still recommended (i.e., it is a core vaccine).

Severe vaccine reactions are rare. Veterinarians should convey the appropriate risk–benefit analysis of any vaccination. Cats may experience mild, short-lived reactions (malaise) such as poor appetite, lethargy, and fever that will resolve without treatment. Clients should seek immediate veterinary attention if their cat begins vomiting or scratching, develops bumps (hives) or facial swelling, or has difficulty breathing within a few hours of being vaccinated. The client and veterinary practice team have the same goal: to provide the best possible care for the pet.

SUMMARY POINTS

- Vaccination protocols for cats should consist of recommended core vaccines and discretionary non-core vaccines as defined and listed in the guidelines. Vaccines in the latter category are given based on a risk–benefit assessment. Risk is determined by the patient's life stage, lifestyle, clinical history, and health status and by environmental and epidemiologic risk factors.
- Although feline vaccination is universally practiced by primary care companion animal practices, there is no single protocol suitable for all feline patients. Rather, vaccination of cats should be patient-specific and guided by an individual risk–benefit assessment using the criteria listed in the guidelines.
- In the case of some vaccines, practitioners have a choice of different types of antigens, including those that are inactivated, attenuated, and in recombinant form. The patient's clinical and vaccination status, such as the possible presence of maternally derived immunity or a history of adverse postvaccination reactions, are factors that may influence the choice of vaccine type.
- Although most feline patients are household pets, practitioners should anticipate situations in which higher-risk cats are presented for vaccination, including those from shelter, cattery, feral, or foster care origins.
- Adverse postvaccination reactions unavoidably occur in a small percentage of cats. Because of their neoplastic etiology, FISSs continue to be the most serious, if infrequent, vaccine-associated adverse event. Detection of patterns in FISS incidence remains elusive, and their occurrence continues to be idiosyncratic. Advising clients in advance of the possibility of hypersensitivity or other reactions will help minimize their concerns.
- All members of the practice team, including clinical and non-clinical personnel, should have a well-informed understanding of the importance of vaccination of feline patients and be able to advise clients of the practice's approach to an individualized vaccination plan.
- The vaccination visit is an ideal time for a client education dialog in which the clinical staff has an opportunity to discuss the role of vaccination as an essential component of preventive healthcare tailored to the individual patient.

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Conflict of interest

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Ethical approval

This work did not involve the use of animals and, therefore, ethical approval was not necessarily required.

Informed consent

This work did not involve the use of animals and, therefore, informed consent was not required. For any animals individually identifiable within this publication, informed consent (either verbal or written) for their use in the publication was obtained from the people involved.

References

1 Scherk MA, Ford RB, Gaskell RM, et al. **2013 AAFP Feline Vaccination Advisory Panel Report.** *J Feline Med Surg* 2013; 15: 785–808.
2 Day MJ, Horzinek MC, Schultz RD, et al. **WSAVA guidelines for the vaccination of dogs and cats.** *J Small Anim Pract* 2016; 57: E1–45.
3 Volk JO, Felsted KE, Thomas JG, et al. **Executive summary of the Bayer veterinary care usage study.** *J Am Vet Med Assoc* 211; 238: 1275–1282.
4 Casal ML, Jezyk PF and Giger U. **Transfer of colostral antibodies from queens to their kittens.** *Am J Vet Res* 1996; 57: 1653–1658.
5 DiGangi BA, Levy JK, Griffin B, et al. **Effects of maternally-derived antibodies on serologic responses to vaccination in kittens.** *J Feline Med Surg* 2012; 14: 118–123.
6 DiGangi BA, Levy JK, Griffin B, et al. **Prevalence of serum antibody titers against feline panleukopenia virus, feline herpesvirus 1, and feline calicivirus in cats entering a Florida animal shelter.** *J Am Vet Med Assoc* 2012; 241: 1320–1325.
7 Jakel V, Cussler K, Hanschmann KM, et al. **Vaccination**

against feline panleukopenia: implications from a field study in kittens. *BMC Vet Res* 2012; 8: 62.
8 American Animal Hospital Association Canine Vaccination Task Force; Welborn LV, DeVries JG, et al. **2011 AAHA canine vaccination guidelines.** *J Am Anim Hosp Assoc* 2011; 47: 1–42.
9 Brun A, Chappuis G, Precausta P, et al. **Immunisation against panleukopenia: early development of immunity.** *Comp Immunol Microbiol Infect Dis* 1979; 1: 335–339.
10 Larson LJ, Newbury S and Schultz RD. **Canine and feline vaccinations and immunology.** In: Miller L and Hurley K (eds). Infectious disease management in animal shelters. Ames, IA: Wiley-Blackwell, 2009, pp 61–82.
11 Larson LJ and Schultz RD. **Effect of vaccination with recombinant canine distemper virus vaccine immediately before exposure under shelter-like conditions.** *Vet Ther* 2006; 7: 113–118.
12 Srivastav A, Kass PH, McGill LD, et al. **Comparative vaccine-specific and other injectable-specific risks of injection-site sarcomas in cats.** *J Am Vet Med Assoc* 2012; 241: 595–602.
13 Patel M, Carritt K, Lane J, et al. **Comparative efficacy of feline leukemia virus (FeLV) inactivated whole-virus vaccine and canarypox virus-vectored vaccine during virulent FeLV challenge and immunosuppression.** *Clin Vaccine Immunol* 2015; 22: 798–805.
14 Torres AN, O'Halloran KP, Larson LJ, et al. **Feline leukemia virus immunity induced by whole inactivated virus vaccination.** *Vet Immunol Immunopathol* 2010; 134: 122–131.
15 Sharp NJ, Davis BJ, Guy JS, et al. **Hydranencephaly and cerebellar hypoplasia in two kittens attributed to intrauterine parvovirus infection.** *J Comp Pathol* 1999; 121: 39–53.
16 Disease Information Fact Sheet: Feline Panleukopenia. *J Feline Med Surg* 2013; 15: Supplementary File. This Disease Information Fact Sheet accompanies the 2013 AAFP Feline Vaccination Advisory Panel Report published in *J Feline Med Surg* 2013; 15: 785–808.
17 Buonavoglia C, Marsiolio F, Tempesta M, et al. **Use of a feline panleukopenia modified live virus vaccine in cats in the primary-stage of feline immunodeficiency virus infection.** *Zentralbl Veterinarmed B* 1993; 40: 343–346.
18 Reubel GH, Dean GA, George JW, et al. **Effects of incidental infections and immune activation on disease progression in experimentally feline immunodeficiency virus-infected cats.** *J Acquir Immune Defic Syndr* 1994; 7: 1003–1015.
19 Chalmers WS, Truyen U, Greenwood NM, et al. **Efficacy of feline panleucopenia vaccine to prevent infection with an isolate of CPV2b obtained from a cat.** *Vet Microbiol* 1999; 69: 41–45.
20 Nakamura K, Ikeda Y, Miyazawa T, et al. **Characterisation of cross-reactivity of virus neutralising antibodies induced by feline panleukopenia virus and canine parvoviruses.** *Res Vet Sci* 2001; 71: 219–222.
21 Lappin MR. **Feline panleukopenia virus, feline herpesvirus-1 and feline calicivirus antibody responses in seronegative specific pathogen-free kittens after parenteral administration of an inactivated FVRCP vaccine or a modified live FVRCP vaccine.** *J Feline Med Surg* 2012; 14: 161–164.
22 Truyen U, Addie D, Belák S, et al. **Feline panleukopenia. ABCD guidelines on prevention and management.** *J Feline Med Surg* 2009; 11: 538–546.
23 Huang C, Hess J, Gill M, et al. **A dual-strain feline calicivirus vaccine stimulates broader cross-neutralization antibodies than a single-strain vaccine and lessens clinical signs in vaccinated cats when challenged with a homologous feline calicivirus strain associated with virulent systemic disease.** *J Feline Med Surg* 2010; 12: 129–137.
24 Bradley A, Kinyon J, Frana T, et al. **Efficacy of intranasal administration of a modified live feline herpesvirus 1 and feline calicivirus vaccine against disease caused by *Bordetella bronchiseptica* after experimental challenge.** *J Vet Intern Med* 2012; 26: 1121–1125.
25 Schultz RD. **A commentary on parvovirus vaccination.** *J Feline Med Surg* 2009; 11: 163–164.
26 Wilson S, Greenslade J, Saunders G, et al. **Difficulties in demonstrating long term immunity in FeLV vaccinated cats due to increasing age-related resistance to infection.** *BMC Vet Res* 2012; 8: 125. DOI: 10.1186/1746-6148-8-125.
27 Jirjis FF, Davis T, Lane J, et al. **Protection against feline leukemia virus challenge for at least two years after vaccination with an inactivated feline leukemia virus vaccine.** *Vet Ther* 2010: 11: E1–6.
28 Grosenbaugh DA, Leard T, Pardo MC, et al. **Comparison of the safety and efficacy of a recombinant feline leukemia virus (FeLV) vaccine delivered transdermally and an inactivated FeLV vaccine delivered subcutaneously.** *Vet Ther* 2004; 5: 258–262.
29 Graf R, Guscetti F, Welle M, et al. **Feline injection site sarcomas: data from Switzerland 2009–2014.** *J Comp Pathol* 2018; 163: 1–5.
30 Kass PH. **Prevention of feline injection-site sarcomas: is there a scientific foundation for vaccine recommendations at this time?** *Vet Clin North Am Small Anim Pract* 2018; 48: 301–306.
31 Klingborg DJ, Hustead DR, Curry-Galvin EA, et al. **AVMA Council on Biologic and Therapeutic Agents' report on cat and dog vaccines.** *J Am Vet Med Assoc* 2002; 221: 1401–1407.
32 Starr RM. **Reaction rate in cats vaccinated with a new controlled-titer feline panleukopenia rhinotracheitis-calicivirus-*Chlamydia psittaci* vaccine.** *Cornell Vet* 1993; 83: 311–323.
33 Disease Information Fact Sheet: Feline Infectious Peritonitis. *J Feline Med Surg* 2013; 15: Supplementary File. This Disease Information Fact Sheet accompanies the 2013 AAFP Feline Vaccination Advisory Panel Report published in *J Feline Med Surg* 2013; 15: 785–808.
34 Little S, Levy J, Hartmann K, et al. **2020 AAFP feline retrovirus testing and management guidelines.** *J Feline Med Surg* 2020; 22: 5–30.
35 Fenimore A, Carter K, Fankhauser J, et al. **Evaluation of intranasal vaccine administration and high-dose interferon-alpha2b therapy for treatment of chronic upper respiratory tract infections in shelter cats.** *J Feline Med Surg* 2016; 18: 603–611.
36 Helfer-Hungerbuehler AK, Spiri AM, Riond B, et al. **No benefit of therapeutic vaccination in clinically healthy cats persistently infected with feline leukemia virus.** *Vaccine* 2015; 33: 1578–1585.
37 Vogt AH, Rodan I, Brown M, et al. **AAFP–AAHA feline life stage guidelines.** *J Am Anim Hosp Assoc* 2010; 46: 70–85.
38 Adams CL and Kurtz S. Skills for communicating in veterinary medicine. Parsippany, NJ: Dewpoint Publishing, 2017, p 112.
39 Kass PH and Dent TH. **The epidemiology of feline infectious peritonitis in catteries.** *Feline Pract* 1995; 23: 27–32.
40 Lappin MR, Andrews J, Simpson D, et al. **Use of serologic tests to predict resistance to feline herpesvirus 1, feline cali-**

civirus, and feline parvovirus infection in cats. *J Am Vet Med Assoc* 2002; 220: 38–42.
41 Boenzli E, Hadorn M, Hartnack S, et al. **Detection of antibodies to the feline leukemia virus (FeLV) transmembrane protein p15e: an alternative approach for serological FeLV detection based on antibodies to p15e.** *J Clin Microbiol* 2014; 52: 2046–2052.
42 Moore GE, DeSantis-Kerr AC, Guptill LF, et al. **Adverse events after vaccine administration in cats: 2560 cases (2002–2005).** *Vet Clin North Am Small Anim Pract* 2010; 40: 393–407.
43 Uhl EW, Heaton-Jones TG, Pu R, et al. **FIV vaccine development and its importance to veterinary and human medicine: FIV vaccine 2002 update and review.** *Vet Immunol Immunopathol* 2002; 90: 113–132.
44 Yamamoto JK, Sanou MP, Abbott JR, et al. **Feline immunodeficiency virus model for designing HIV/AIDS vaccines.** *Curr HIV Res* 2010; 8: 14–25.
45 Westman ME, Malik R, Hall E, et al. **Determining the feline immunodeficiency virus (FIV) status of FIV-vaccinated cats using point-of-care antibody kits.** *Comp Immunol Microbiol Infect Dis* 2015; 42: 43–52.
46 Levy JK, Crawford P and Tucker SJ. **Performance of 4 point-of-care screening tests for feline leukemia virus and feline immunodeficiency virus.** *J Vet Intern Med* 2017; 31: 521–526.
47 DiGangi BA, Gray LK, Levy JK, et al. **Detection of protective antibody titers against feline panleukopenia virus, feline herpesvirus-1, and feline calicivirus in shelter cats using a point-of-care ELISA.** *J Feline Med Surg* 2011; 13: 912–918.
48 Mende K, Stuetzer B, Truyen U, et al. **Evaluation of an in-house dot enzyme-linked immunosorbent assay to detect antibodies against feline panleukopenia virus.** *J Feline Med Surg* 2014; 16: 805–811.
49 Gaskell R, Gettinby G, Graham S, et al. **Veterinary Products Committee working group report on feline and canine vaccination.** *Vet Rec* 2002; 150: 126–134.
50 Day MJ. **Vaccine side effects: fact and fiction.** *Vet Microbiol* 2006; 117: 51–58.
51 Moore GE and HogenEsch H. **Adverse vaccinal events in dogs and cats.** *Vet Clin North Am Small Anim Pract* 2010; 40: 393–407.
52 Clark N, Kushner NN, Barrett CB, et al. **Efficacy and safety field trials of a recombinant DNA vaccine against feline leukemia virus infection.** *J Am Vet Med Assoc* 1991; 199: 1433–1443.
53 Richards JR, Elston TH, Ford RB, et al. **The 2006 American Association of Feline Practitioners Feline Vaccine Advisory Panel Report.** *J Am Vet Med Assoc* 2006; 229: 1405–1441.
54 Davis-Wurzler GM. **Current vaccination strategies in puppies and kittens.** *Vet Clin North Am Small Anim Pract* 2006; 36: 607–640, vii.
55 Vaccine-Associated Feline Sarcoma Task Force. **The current understanding and management of vaccine-associated sarcomas in cats.** *J Am Vet Med Assoc* 2005; 226: 1821–1842.
56 Hendrick MJ and Goldschmidt MH. **Do injection site reactions induce fibrosarcomas in cats?** *J Am Vet Med Assoc* 1991; 199: 968.
57 Hendricks CG, Levy JK, Tucker SJ, et al. **Tail vaccination in cats: a pilot study.** *J Feline Med Surg* 2014; 16: 275–280.
58 Shaw SC, Kent MS, Gordon IK, et al. **Temporal changes in characteristics of injection-site sarcomas in cats: 392 cases (1990–2006).** *J Am Vet Med Assoc* 2009; 234: 376–380.
59 Macy DW and Hendrick MJ. **The potential role of inflammation in the development of postvaccinal sarcomas in cats.** *Vet Clin North Am Small Anim Pract* 1996; 26: 103–107.
60 Day MD, Schoon HA, Magnol JP, et al. **A kinetic study of histopathological changes in the subcutis of cats injected with nonadjuvanted and adjuvanted multi-component vaccines.** *Vaccine* 2007; 25: 4073–4084.
61 Kang S, Southard T and Hume KR. **DNA damage is a feature of feline injection-site sarcoma.** *Vet Comp Oncol* 2016; 15: 518–524.
62 Wilcock B, Wilcock A and Bottoms K. **Feline postvaccinal sarcoma: 20 years later.** *Can Vet J* 2012; 53: 430–434.
63 Weese JS and Jack DC. **Needlestick injuries in veterinary medicine.** *Can Vet J* 2008; 49: 780–784.
64 Centers for Disease Control and Prevention. CDC Vaccine Storage and Handling Toolkit. Available at: https://www.cdc.gov/vaccines/hcp/admin/storage/toolkit/storage-handling-toolkit.pdf (accessed September 24, 2019).
65 Ford RB, Larson LJ, McClure KD, et al. **2017 AAHA canine vaccination guidelines.** *J Am Anim Hosp Assoc* 2017; 53: 243–251.
66 American Veterinary Medical Association. Rabies Vaccination State Law Summary. Available at: https://www.avma.org/Advocacy/StateAndLocal/Documents/Rabies-state-law-chart.pdf (accessed September 24, 2019).
67 Rodan I, Sundahl E, Carney H, et al. **AAHA and ISFM feline-friendly handling guidelines.** *J Feline Med Surg* 2011; 13: 364–375.

Available online at jfms.com and catvets.com/vaccination