



GUIDELINES FOR THE VACCINATION OF DOGS AND CATS

**COMPILED BY THE VACCINATION GUIDELINES GROUP (VGG)
OF THE WORLD SMALL ANIMAL VETERINARY ASSOCIATION (WSAVA)**

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EXECUTIVE SUMMARY

The WSAVA Vaccination Guidelines Group (VGG) was convened in order to develop guidelines for the vaccination of dogs and cats that have global application. The first version of these guidelines was published in 2007. A survey of WSAVA member nations has indicated the important role these guidelines have played globally. They have been adopted as national policy in some countries where such guidelines did not previously exist, and have been used by other countries as a basis for development of national guidelines. The present document provides an updated and expanded version of these international guidelines for the vaccination of small companion animals. The VGG recognizes that the keeping of pet small animals is subject to significant variation in practice and associated economics throughout the world, and that vaccination recommendations that might apply to a developed country, may not be appropriate for a developing country. Despite this, the VGG strongly recommends that wherever possible ALL dogs and cats receive the benefit of vaccination. This not only protects the individual animal, but provides optimum 'herd immunity' that minimizes the likelihood of an infectious disease outbreak.

With this background in mind, the VGG has defined **core** vaccines which ALL dogs and cats, regardless of circumstances, should receive. Core vaccines protect animals from severe, life-threatening diseases that have global distribution. Core vaccines for dogs are those that protect from canine distemper virus (CDV), canine adenovirus (CAV) and canine parvovirus type 2 (CPV-2). Core vaccines for cats are those that protect from feline parvovirus (FPV), feline calicivirus (FCV) and feline herpesvirus-1 (FHV-1). In areas of the world where rabies virus infection is endemic, vaccination against this agent should be considered core for both species, even if there is no legal requirement for routine vaccination.

The VGG recognizes that maternally derived antibody (MDA) significantly interferes with the efficacy of most current core vaccines administered to pups and kittens in early life. As the level of MDA varies significantly among litters, the VGG recommends the administration of three vaccine doses to pups and kittens, with the final dose of these being delivered at 14–16 weeks of age or above. In cultural or financial situations where a pet animal may only be permitted the benefit of a single vaccination, that vaccination should be with core vaccines at 16 weeks of age or above.

The VGG supports the development and use of simple in-practice tests for determination of seroconversion (antibody) following vaccination.

Vaccines should not be given needlessly. Core vaccines should not be given any more frequently than every three years after the 12 month booster injection following the puppy/kitten series, because the duration of immunity (DOI) is many years and may be up to the lifetime of the pet.

The VGG has defined **non-core** vaccines as those that are required by only those animals whose geographical location, local environment or lifestyle places them at risk of contracting specific infections. The VGG has also classified some vaccines as **not recommended** (where there is insufficient scientific evidence to justify their use) and has not considered a number of minority products which have restricted geographical availability or application.

The VGG strongly supports the concept of the 'annual health check' which removes the emphasis from, and client expectation of, annual revaccination. The annual health check may still encompass administration of selected non-core vaccines which should be administered annually, as the DOI for these products is generally one year or less.

The VGG has considered the use of vaccines in the shelter environment, again recognizing the particular nature of such establishments and the financial constraints under which they operate. The VGG minimum shelter guidelines are simple: that all dogs and cats entering such an establishment should be vaccinated before, or at the time of entry, with core vaccines only. Where finances permit, repeated core vaccination should be administered as per the schedules defined in the guidelines.

The VGG recognizes the importance of adverse reaction reporting schemes but understands that these are variably developed in different countries. Wherever possible, veterinarians should be actively 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.

These fundamental concepts proposed by the VGG may be encapsulated in the following statement:

We should aim to vaccinate every animal with core vaccines, and to vaccinate each individual less frequently by only giving non-core vaccines that are necessary for that animal.

INTRODUCTION

The WSAVA Vaccination Guidelines Group (VGG) was convened in 2006 with the responsibility of producing global vaccination guidelines for dogs and cats that would consider international differences in economic and societal factors that impact on the keeping of these small companion animals. They were launched at the 2007 WSAVA Congress and contemporaneously published in the *Journal of Small Animal Practice* (Day et al., 2007). English and Spanish versions were made publicly available on the WSAVA website.

With recognition that this is a rapidly developing field of companion animal medicine, the VGG was reconvened in 2009 with the targets of (1) updating the 2007 guidelines for veterinarians and (2) preparing a new set of guidelines directed at the owners and breeders of dogs and cats. The VGG has met on three occasions during 2009–2010 and has had active electronic communication between these meetings. The present document represents the conclusion of the first target, and the VGG is well progressed towards the launch of owner-breeder guidelines in 2010.

The first activity of this second phase of the VGG was to assess the impact of the 2007 guidelines on the international veterinary community. To achieve this goal, it developed a simple questionnaire that was circulated to all 70 WSAVA member countries through their WSAVA Assembly representatives. The following questions were asked:

1. Were the 2007 guidelines widely available to veterinarians in your country?
2. Were the 2007 guidelines discussed by your national small animal veterinary association?
3. Does your national small animal veterinary association have its own guidelines for the vaccination of dogs and cats?
4. If not, has your national small animal veterinary association adopted the WSAVA guidelines?
5. Is there any significant conflict between the WSAVA guidelines and national practices in companion animal medical care?

Each country that had its own vaccination guidelines was also asked to send a copy of these to the VGG.

Responses were received from 27 countries, both from developed and developing nations. The 2007 guidelines were generally accessible by the veterinary community (for 18 of 27 respondents); where this was not the case, the reason was most often the unavailability of a translated version. Notably, the lack of computers and internet access in general practice was also flagged by some developing nations. The 2007 guidelines had been discussed by the small animal veterinary associations of 12 of 27 respondent countries. Thirteen of 27 respondent countries already had national guidelines in place or in the case of some smaller European countries - had adopted those used by a larger neighbour. The VGG was privileged to be able to assess six of these national guidelines documents, which ranged from excellent succinct summaries to very detailed and substantial papers that provided solid background discussion of immunology and vaccination.

The VGG was pleased to note that in 12 of 14 countries without vaccination guidelines, the national organizations had either fully adopted or recommended the WSAVA guidelines or were currently using them to develop their own national recommendations. It is also clear that in some countries, publication of the guidelines had precipitated discussion by national organizations that had sometimes been driven by pressure from the general public. Most respondents indicated a range of minor conflicts between the WSAVA guidelines and national practice, but these were not as great as anticipated. For example, many countries maintain legal annual revaccination for rabies, some countries do not have access to the full range of products listed in the guidelines (e.g. individual component products or extended DOI products), and others have specific national products from local manufacturers that are not globally available.

The responses to this questionnaire underline the importance of global vaccination guidelines and of their current revision. The aim of this document is to update and extend the information given in the 2007 version; while much of the text and recommendations will remain the same, specific changes are:

1. A clear indication of the purpose of a guidelines document.
2. A discussion of passive immunization, in particular for canine distemper virus (CDV) infection.
3. Preliminary assessment of vaccines for canine influenza virus (CIV), leishmaniosis and malignant melanoma.
4. Discussion of differences in approach to feline upper respiratory virus (FHV-1 and FCV) and feline leukaemia virus (FeLV) vaccination.
5. Recommendations for sites of vaccination for cats.

6. An update on cross-protection for canine parvovirus (CPV) 2c.
7. A new fact sheet on rabies vaccines.
8. An expanded list of 60 frequently asked questions (FAQs). Feedback suggested that this aspect of the 2007 guidelines document was particularly useful to practitioners.
9. An image bank of major canine and feline vaccine-preventable diseases. The VGG believes that these images will be of great value to the practicing veterinarian during the 'vaccination interview' with clients. The images are freely available via the WSAVA website and provide visual evidence of the significance and severity of infectious diseases that may be prevented by vaccination. The images may be used in the consultation room whilst addressing the 'risk-benefit' of vaccination with pet owners.

The VGG again acknowledges the important work undertaken by the American Animal Hospital Association (AAHA) Canine Vaccine Task Force (Paul et al., 2006) and the American Association of Feline Practitioners (AAFP) Feline Vaccine Advisory Panel (Richards et al., 2006) in addressing companion animal vaccination issues. Since publication of the 2007 WSAVA guidelines, the European Advisory Board on Cat Diseases (ABCD) has also formulated recommendations for feline vaccination from the European perspective, and the work of this group has recently cumulated in publication of a special issue of the *Journal of Feline Medicine and Surgery* (Horzinek and Thiry, 2009).

THE PURPOSE OF GUIDELINES

In speaking to practitioner audiences about the 2007 guidelines it is clear that there is widespread confusion about their purpose. Many practitioners are initially alarmed that the recommendations appear contrary to those given on the product data sheet, and therefore feel that if they adopt guidelines recommendations, they are leaving themselves open to litigation. The distinct difference between a data sheet and guidelines document has been clearly discussed in a recent paper (Thiry and Horzinek, 2007).

A data sheet (or 'summary of product characteristics'; SPC) is a legal document that forms part of the registration process for a vaccine. A data sheet will give details of the quality, safety and efficacy of a product and in the case of vaccines will describe the legal DOI of the product. The legal DOI is based on experimental evidence, represents a minimum value and need not reflect the true DOI of a vaccine. Most companion animal vaccines, until recently, had a 1 year DOI and carried a recommendation for annual revaccination. The sensible response of industry to recent discussions about vaccine safety has been to increasingly license products with an 'extended' (generally 3 year) DOI. However, for most core vaccines (see below) the true DOI is likely to be considerably longer.

There are instances, where the guidelines may recommend a triennial vaccination with a product that still carries a 1 year licensed DOI. The simple reason for this is that the guidelines are based on **current** scientific knowledge and thinking, whereas the data sheet reflects the knowledge available at the time that the vaccine received its original license (which may be more than 20 years earlier). Consequently, guidelines advice will often differ from that given in the data sheet; however, any veterinarian may use a vaccine according to guidelines (and therefore current scientific thinking) by obtaining informed (and documented) owner consent for this deviation from legal recommendations ('off-label use'). Further confusion is often caused by company representatives who will advise, as they are legally obliged to do, that the veterinarian must adhere to the data sheet recommendation.

A further point of confusion arises where veterinarians compare the recommendations given in different sets of guidelines. There are, for example, subtle differences in recommendations made in the USA and Europe that reflect differences in the opinions of local expert groups and in the perception of lifestyles of pet animals that may make them more or less exposed to infections. The VGG faces the difficult challenge of setting a middle-course through various national or regional guidelines. Its recommendations attempt to provide a balanced perspective to account for global differences in the keeping of small companion animals.

In summary, veterinarians should feel comfortable about vaccinating according to the schedules given in these guidelines but should cross-reference these with local recommendations where available. Where the VGG recommendations differ from current legal requirements, the practitioner need only obtain informed client consent to provide that client, and the animal, with a current evidence-based vaccination schedule.

CURRENT ISSUES IN SMALL ANIMAL VACCINOLOGY

If vaccination has been so successful, then why is it necessary to continually re-evaluate vaccination practice? There is little doubt that in most developed countries the major infectious diseases of dogs and cats are considered at best uncommon in the pet population, but there do remain geographical pockets of infection and sporadic outbreaks of disease occur, and the situation regarding feral or shelter populations is distinctly different to that in owned pet animals. However, in many developing countries these key infectious diseases remain as common as they once were in developed nations and a major cause of mortality in small animals. Although it is difficult to obtain accurate figures, even in developed countries it is estimated that only 30–50% of the pet animal population is vaccinated, and this is significantly less in developing nations. In small animal medicine, we have been slow to grasp the concept of ‘herd immunity’—that vaccination of individual pet animals is important, not only to protect the individual, but to reduce the number of susceptible animals in the regional population, and thus the prevalence of disease. Herd immunity with the core vaccines that provide a long (many years) DOI is highly dependent on the percentage of animals in the population vaccinated and not the number of vaccinations that occur annually. Therefore, every effort should be made to vaccinate a higher percentage of cats and dogs with the core vaccines.

A second major concept regarding vaccination of dogs and cats has been the recognition that we should aim to reduce the ‘vaccine load’ on individual animals in order to minimize the potential for adverse reactions to vaccine products. For that reason we have seen the development of vaccination guidelines based on a rational analysis of the vaccine requirements for each pet, and the proposal that vaccines be considered ‘core’ and ‘non-core’ in nature. To an extent this categorization of products has been based on available scientific evidence and personal experience – but concerted effort to introduce effective companion animal disease surveillance on a global scale would provide a more definitive basis on which to recommend vaccine usage. In parallel with the categorization of vaccines has been the push towards marketing products with extended DOI, to reduce the unnecessary administration of vaccines and thereby further improve vaccine safety. Both of these changes have necessitated a frame-shift in the mindset of veterinary practitioners in a culture in which both veterinarian and client have become subservient to the mantra of annual vaccination.

The following VGG guidelines are prepared when considering the optimum model of a committed pet owner, willing and able to bring their animal to the veterinarian, for the full recommended course of vaccination. The VGG is aware that there are less committed pet owners and countries where severe financial or societal constraints will determine the nature of the vaccine course that will be administered. In situations where, for example, a decision must be made that an individual pet may have to receive only a single core vaccination during its lifetime, the VGG would emphasize that this should optimally be given at a time when that animal is most capable of responding immunologically, i.e. at the age of 16 weeks or greater.

The VGG has additionally considered vaccination in the shelter situation. The guidelines that we have proposed are those that we consider provides the optimum level of protection for these highly susceptible animals. The VGG also recognizes that many shelters run with limited financial support which may constrain the extent of vaccination used. The minimum vaccination protocol in this situation would be a single administration of core vaccines at or before the time of admission to the shelter.

This document seeks to address these current issues in canine and feline vaccinology, and to suggest practical measures by which the veterinary profession may move towards more rational use of vaccination in these species. The most important message of the VGG is therefore encapsulated in the following statement:

We should aim to vaccinate every animal with core vaccines, and to vaccinate each individual less frequently by only giving non-core vaccines that are necessary for that animal.

CANINE VACCINATION GUIDELINES

VACCINATION OF INDIVIDUAL DOGS

The Basic Immunization Schedule

Guidelines and recommendations for core (recommended), non-core (optional), and not recommended vaccines for the general veterinary practice are given in Table 1. The VGG considers that a core vaccine is one that all puppies throughout the world must receive in order to provide protection against infectious diseases of global significance. The VGG recognizes that particular countries will identify additional vaccines that they consider core. A particular example of a vaccine that may be considered core in only some countries is that against rabies virus. In a geographical area in which this infection is endemic all dogs should be routinely vaccinated for the protection of both the pet and human populations. In some countries, mandatory rabies vaccination is a legal requirement, and is generally also required for international pet travel. Non-core vaccines are those that are licensed for the dog and whose use is determined on the basis of the animal's geographical and lifestyle exposure and an assessment of risk-benefit ratios. Not recommended vaccines are those for which there is little scientific justification for their use.

Pup Vaccination and the 12 Month Booster

Most pups are protected by MDA in the first weeks of life. In general, passive immunity will have waned by 8–12 weeks of age to a level that allows active immunization. Pups with poor MDA may be vulnerable (and capable of responding to vaccination) at an earlier age, while others may possess MDA at such high titres that they are incapable of responding to vaccination until ≥ 12 weeks of age. No single primary vaccination policy will therefore cover all possible situations. The recommendation of the VGG is for initial vaccination at 8–9 weeks of age followed by a second vaccination 3–4 weeks later, and a third vaccination given between 14–16 weeks of age. By contrast, at present many vaccine data sheets recommend an initial course of two injections. Some products are also licensed with a '10 week finish' designed such that the second of two vaccinations is given at 10 weeks of age. The rationale behind this protocol is to permit 'early socialization' of pups. The VGG recognizes that this is of great benefit to the behavioural development of dogs. Where such protocols are adopted, great caution should still be maintained by the owner – allowing restricted exposure of the pup to controlled areas and only to other pups that are healthy and fully vaccinated. The VGG recommends that whenever possible a third dose of core vaccine be given at 14–16 weeks of age.

In immunological terms, the repeated injections given to pups in their first year of life do not constitute boosters. They are rather attempts to induce a primary immune response by injecting the attenuated virus (of modified live virus [MLV] vaccines) into an animal devoid of neutralizing antibody, where it must multiply to be processed by an antigen presenting cell and stimulate antigen-specific T and B lymphocytes. In the case of killed (inactivated) vaccines, MDA may also interfere with this immunological process by binding to and 'masking' the relevant antigens. Here repeated doses are required.

All dogs should receive a first booster 12 months after completion of the primary vaccination course. The VGG redefines the basic immunization protocol as the ensemble of the pup regime plus this first booster. The 12 month booster will also ensure immunity for dogs that may not have adequately responded to the pup vaccinations.

Revaccination of Adult Dogs

Dogs that have responded to vaccination with MLV core vaccines maintain a solid immunity (immunological memory) for many years in the absence of any repeat vaccination. Following the 12 month booster, subsequent revaccinations are given at intervals of 3 years or longer, unless special conditions apply. It should be emphasized that the considerations given above do not generally apply to killed core vaccines nor to the optional vaccines, and particularly not to vaccines containing bacterial antigens. Thus *Leptospira*, *Bordetella* and *Borrelia* (Lyme disease) products, but also parainfluenza virus components, require more frequent boosters for reliable protection.

Therefore an adult dog may today still be revaccinated annually, but the components of these vaccinations may differ each year. Typically, core vaccines are currently administered triennially, with chosen non-core products being given annually. The VGG is aware that in some countries only multi-component products containing core and non-core combinations are available. The VGG would encourage manufacturers to make a full range of single-component vaccines available wherever possible.

An adult dog that had received a complete course of core vaccinations as a puppy followed by the 12 month booster, but may not have been regularly vaccinated as an adult, requires only a single dose of core vaccine to boost immunity. Many current data sheets

will advise in this circumstance that the dog requires two vaccinations (as for a puppy) but this practice is unjustified and simply contrary to the fundamental principles of immunological memory. By contrast, this approach may be justified for an adult dog of unknown vaccination history, and when serological testing has not been performed.

Serological Testing to Monitor Immunity to Canine Vaccines

Antibody tests are useful for monitoring immunity to CDV, CPV-2, CAV-1 and rabies virus. Antibody assays for CDV and CPV-2 are the tests of greatest benefit in monitoring immunity, especially after the puppy vaccination series. During recent years, many laboratories have standardized their methodologies for such testing. There are legal requirements for rabies antibody testing for pet travel between some countries.

In-practice testing will probably become more popular as soon as rapid, simple, reliable and cost-effective assays are more widely available. A negative test result indicates that the animal has little or no antibody, and that revaccination is recommended. Some of these dogs are in fact immune (false-negative), and their revaccination would be unnecessary. A positive test result on the other hand would lead to the conclusion that revaccination is not required. This is why robust yes/no answers must be provided by any assay. With CDV and/or CPV-2 tests, an animal with a negative result, regardless of the test used, should be considered as having no antibody and susceptible to infection.

On completion of the puppy series at 14–16 weeks of age, an animal should have a positive test result, provided the serum sample is collected 2 or more weeks after vaccination. Seronegative animals should be revaccinated and retested. If it again tests negative, it should be considered a non-responder that is possibly incapable of developing protective immunity.

Flow chart for serological testing of puppies

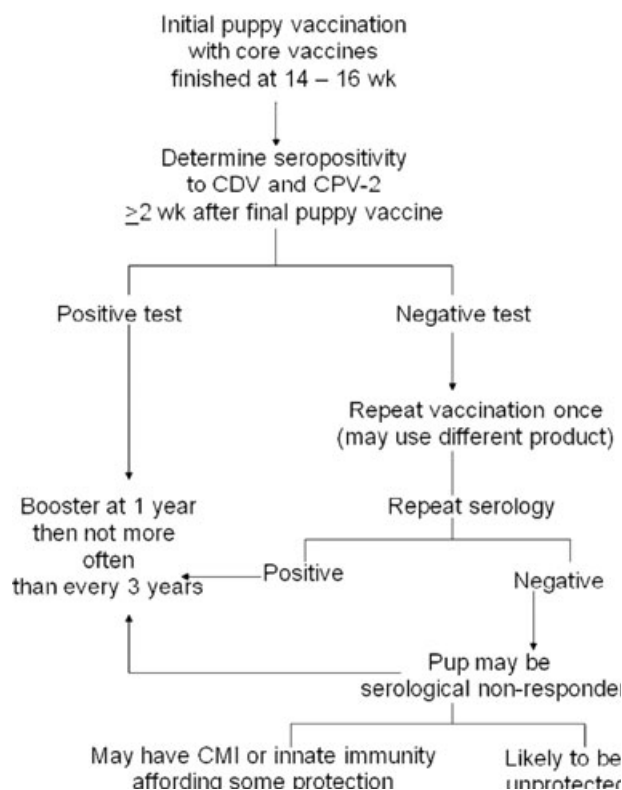


Figure 1. Flow Chart for Serological Testing of Puppies. CMI = cell-mediated immunity.

Testing for antibody is presently the only practical way to ensure that a puppy's immune system has recognized the vaccinal antigen. Vaccines may fail for various reasons:

(1) MDA neutralizes the vaccine virus

This is the most common reason for vaccination failure. However, when the last vaccine dose is given at 14–16 weeks of age, MDA should have decreased to a low level, and active immunization will succeed in most puppies (>98%).

(2) The vaccine is poorly immunogenic

Poor immunogenicity may reflect a range of factors from the stage of vaccine manufacture to administration to the animal. For example, the virus strain, its passage history or production errors in the manufacture of a particular batch of product may be a cause of vaccine failure. Post-manufacture factors such as incorrect storage or transportation (interrupted cold chain) and handling (disinfectant use) of the vaccine in the veterinary practice, may result in inactivation of an MLV product.

(3) The animal is a poor responder (its immune system intrinsically fails to recognize the vaccinal antigens)

If an animal fails to develop an antibody response after repeated revaccination, it should be considered a non-responder. Because immunological non-responsiveness is genetically controlled in other species, certain breeds of dogs have been suspected to be poor-responders. It is believed (but unproven) that the high susceptibility to CPV-2 recognized in certain Rottweilers and Dobermans during the 1980s (regardless of their vaccination history) was due to a high prevalence of non-responders. In the USA today, these two breeds seem to have no greater numbers of non-responders to CPV-2 than other breeds, possibly because carriers of the genetic trait may have died from CPV-2 infection. Some dogs of these breeds may be low or non-responders to other antigens. For example, in the UK and Germany, the non-responder phenotype is prevalent amongst Rottweilers for CPV-2 and rabies virus as recent studies have shown this breed to have a higher proportion of animals failing to achieve the titre of rabies antibody required for pet travel.

Serological Testing to Determine the Duration of Immunity (DOI)

Most vaccinated dogs will have a persistence of serum antibody (against core vaccine antigens) for many years. Immunologically, this antibody reflects the function of a distinct population of long-lived plasma cells (memory effector B cells). Induction of immunological memory is the primary objective of vaccination. For core vaccines there is excellent correlation between the presence of antibody and protective immunity and there is long DOI for these products. This correlation does not exist for many of the non-core vaccines and the DOI related to these products necessitates more frequent revaccination intervals.

Antibody tests can be used to demonstrate the DOI after vaccination with core vaccines. It is known that dogs often maintain protective antibody to CDV, CPV-2, CAV-1, and CAV-2 for three or more years and numerous experimental studies support this observation. Therefore, when antibody is absent (irrespective of the serological test used) the dog should be revaccinated unless there is a medical basis for not so doing. Antibody determinations to other vaccine components are of limited or no value because of the short time period these antibodies persist (e.g. *Leptospira* products) or the lack of correlation between serum antibody and protection (e.g. *Leptospira* or canine parainfluenza). Important considerations in performing antibody tests are the cost and the time to obtain results.

The VGG recognizes that at present such serological testing has limited availability and might be relatively expensive. However, the principles of 'evidence-based veterinary medicine' would dictate that testing for antibody status (for either pups or adult dogs) is a better practice than simply administering a vaccine booster on the basis that this should be 'safe and cost less'. In response to these needs, more rapid, cost-effective tests are being developed.

Passive Immunization

While vaccination (i.e. active immunization) dominates infectious disease prevention, passive immunization also has a venerable history, from the first anti-diphtheria serum to hyperimmune sera available for protecting human infants against anthrax, botulism, and scarlet fever, and adults against varicella-zoster, respiratory syncytial virus, hepatitis A and B, mumps, measles and rabies.

Although virus infections trigger both cellular and humoral immunity, it is mainly the antibody response that contributes to the reduction of viral load and recovery. In many virus infections, antibody levels are therefore taken as correlates of protection. During viraemia, pre-existing or injected antibodies directed against surface structures of virions latch on to the particles, neutralize their infectivity and prepare them for removal. Therapeutically, the serum or immunoglobulin preparations are injected subcutaneously and quickly reach the circulation. Not unexpectedly, intravenous infusions of plasma (not serum) have been found to work as well but this is a more difficult practice that must be used with caution. In local infections, such as those initiated by the bite wound of a rabid carnivore, post-exposure antibody prophylaxis has also proven invaluable. Human rabies immune globulin provides rapid protection

when given on the first day of the post-exposure prophylaxis regimen. As much as possible of the preparation is infiltrated into and around the wound, and may be given intramuscularly at a site distant from the rabies vaccine, which is applied simultaneously.

In companion animal practice, preventive active immunization is so commonplace that serum prophylaxis/therapy is considered only under exceptional circumstances (e.g. when a dog is presented with distemper or a cat is presented with panleukopenia, or during a disease outbreak in a kennel/cattery). There is still a market for serum and immunoglobulin products, and companies producing them exist in the USA, Germany, the Czech Republic, Slovakia, Russia and Brazil. The preparations are either of homologous or heterologous (horse) origin, are polyvalent (directed against several viruses) and consist of sera or their immunoglobulin fraction.

Despite the availability of such products, the VGG recommends that they be used conservatively, and only after careful consideration. In the case of an outbreak of CDV infection in a kennel it is much safer and more effective to vaccinate all dogs with CDV vaccine rather than giving immune serum. In such a situation it has previously been recommended that MLV vaccines be administered intravenously rather than subcutaneously or intramuscularly, but there is little evidence that this practice provides more effective protection than subcutaneous injection. Administration of CDV vaccines by any of those routes will provide protection from severe disease and death immediately after vaccination. In this instance the vaccine does not prevent infection, but instead it protects from disease (especially from neurological disease) so the animal will survive and will subsequently be immune for life.

In the case of a cattery outbreak of FPV infection, or a kennel outbreak of CPV-2 infection, recent experience has shown that if immune serum is given after clinical signs appear, there is no benefit in reduction of morbidity or mortality. In order to have a beneficial effect, immune serum must be given after infection, but prior to the onset of clinical signs. In this case administration of immune serum must be within 24–48 hours after infection and a large amount of very high titred serum is required. The serum must be given parenterally (e.g. subcutaneously or intraperitoneally) and not orally. There is no benefit from oral administration even when treatment is started prior to infection.

An important consideration in a shelter situation is the relative cost of these commercial products. An alternative practice that is sometimes used in a shelter situation is to collect serum from animals in the shelter that have survived disease or have been recently vaccinated. However, this practice carries risk as the serum will not necessarily have been screened for transmissible pathogens (e.g. haemoparasites or feline retroviruses).

A more effective approach to controlling disease outbreaks in a shelter situation would be through the use of serological testing. Determination of serum antibody titres can identify those animals that are protected (and can therefore safely be left in the shelter in the face of a disease outbreak) and those animals that are susceptible (and are therefore likely to become infected and possibly die) and therefore should be euthanized. If the susceptible population is not euthanized, those animals should be isolated and not be adopted or fostered until it is certain that they are not infected.

New Canine Vaccines

New canine vaccines are becoming available in some countries, and although the scientific literature assessing these products and their application is limited, the VGG has given preliminary consideration to some of them. It should be emphasized that these may not be fully licensed products and have limited regional availability.

A new vaccine against **canine influenza virus** (CIV) infection received conditional license in the USA in June 2009. The influenza A subtype H3N8 has been a particular problem in North America in animals that are housed together, but to date only sporadic cases have been recognized elsewhere (Europe). The CIV vaccine contains inactivated virus and is administered to pups from 6 weeks of age with a booster 2–4 weeks later and then annual revaccination. Immunity develops approximately 7 days after the second dose. The vaccine is considered non-core and is recommended only for at-risk dogs that are likely to encounter group exposure as part of their lifestyle.

The first canine immunotherapeutic vaccine for **malignant melanoma** received conditional license in the USA in March 2007 and was fully licensed in 2010. This product comprises the human tyrosinase gene incorporated into a plasmid (a 'naked DNA' vaccine) that is repeatedly delivered by use of a high-pressure transdermal injection device. The vaccine, which is used in dogs that receive traditional treatments for oral melanomas, induces an immune response to this melanoma target antigen, and studies show that the median survival time of dogs with grade II–IV melanoma increased to 389 days (from an expected survival of 90 days) (Bergman et al., 2006). The vaccine has also recently become available in Europe and, as in the USA, is limited to use by recognized veterinary oncology specialists.

An increasing body of scientific literature has now evaluated the first licensed vaccine for canine **leishmaniosis**. This product is licensed only in Brazil, where leishmaniosis is a disease of major importance to the canine and human population. There is an active programme of culling seropositive infected dogs to reduce the reservoir population. The vaccine is a subunit product containing GP63 of *L. donovani* (also known as the 'fucose mannose ligand') in saponin adjuvant. It is considered to induce antibody that

blocks the transmission of the organism from the dog to the sand fly vector by preventing binding of *Leishmania* to the midgut of the sand fly. The vaccine appears compatible with serological testing to identify infected dogs, as only 1.3% of 5860 vaccinated uninfected animals were positive in the tests used in that screening programme. More importantly, large scale epidemiological studies have shown that vaccination has an additive effect to the culling programme with regions having high uptake of vaccination showing reduced incidence of both canine and human infection (Palatnik de Sousa et al., 2009). These findings add support to the concept that this vaccine might be considered core in a country such as Brazil.

Table 1 WSAVA Canine Vaccination Guidelines

Vaccine	Initial Puppy Vaccination (≤ 16 weeks)	Initial Adult Vaccination (> 16 weeks)	Revaccination Recommendation	Comments and Recommendations See text for definitions of core, non-core and not recommended vaccines
Canine Parvovirus-2 (CPV-2; MLV, parenteral)	Administer at 8–9 weeks of age, then every 3–4 weeks until 14–16 weeks of age.	Two doses, 3–4 weeks apart are generally recommended by manufacturers but one dose is considered protective.	Revaccination (booster) at 1 year, then not more often than every 3 years.	Core
Canine Distemper Virus (CDV; MLV, parenteral)				
Recombinant Canine Distemper Virus (rCDV, parenteral)				
Canine Adenovirus-2 (CAV-2; MLV, parenteral)				Parenteral preferred for enhanced immunity to CAV-1.
CAV-2 (MLV, intranasal)				Not recommended where MLV available
CPV-2 (killed, parenteral)				Not Recommended where CAV-2 MLV available
Canine Adenovirus-1 (CAV-1; MLV and killed parenteral)				
Rabies (killed parenteral)	Administer one dose as early as 3 months of age. *In high risk areas and if permitted by law, give a second dose 2–4 weeks after the first dose	Administer a single dose.	Canine rabies vaccines with either a 1- or 3-year DOI are available. Timing of boosters is determined by this licensed DOI but in some areas may be dictated by statute.	Core where required by statute or in areas where the disease is endemic.
Parainfluenza Virus (CPIV; MLV, parenteral)	Administer at 8–9 weeks of age, then every 3–4 weeks until 14–16 weeks of age.	Two doses, 3–4 weeks apart are generally recommended by manufacturers but one dose is considered protective.	Revaccination (booster) at 1 year, then annually where CPIV is monovalent or combined with other non-core components.	Non-core. Use of CPIV (MLV-intranasal) is preferred to the parenteral product as the primary site of infection is the upper respiratory tract.
CPIV (MLV, intranasal)	Administer as early as 3 weeks of age and revaccinate within 3–4 weeks.	Two doses, 3–4 weeks apart.	Revaccination (booster) at 1 year, then annually	Non-core. This product is generally combined with intranasal <i>Bordetella bronchiseptica</i> and this product should be administered annually following the puppy series.
<i>Bordetella bronchiseptica</i> (live avirulent bacteria, intranasal)	Administer a single dose as early as 3 weeks of age. For best results, a second dose should be given 2–4 weeks after the first.	A single dose.	Annually or more often in very high-risk animals not protected by annual booster.	Non-core. This product is generally combined with intranasal CPIV. Transient (3–10 days) coughing, sneezing, or nasal discharge may occur in a small percentage of vaccinates.
<i>Bordetella bronchiseptica</i> (killed bacterin, parenteral)	Administer one dose at 6–8 weeks and one dose at 10–12 weeks of age.	Two doses, 2–4 weeks apart.	Annually or more often in very high-risk animals not protected by annual booster.	Non-core. The MLV intranasal product is preferred to the killed parenteral to provide local and systemic protection.
<i>Bordetella bronchiseptica</i> (cell wall antigen extract, parenteral)				

Table 1 Continued

Vaccine	Initial Puppy Vaccination (≤ 16 weeks)	Initial Adult Vaccination (> 16 weeks)	Revaccination Recommendation	Comments and Recommendations See text for definitions of core, non-core and not recommended vaccines
<i>Borrelia burgdorferi</i> (Lyme borreliosis; killed whole bacterin, parenteral)	Recommendation is for initial dose at 12 weeks of age or older after completion of the puppy core viral vaccines with a second dose 2–4 weeks later.	Two doses, 2–4 weeks apart.	Annually. Revaccinate just prior to start of tick season as determined regionally.	Non-core. The VGG recommends that this vaccine not be administered before 12 weeks of age and preferably after completion of the core series of puppy vaccines. Generally recommended only for use in dogs with a known high risk of exposure, living in or visiting regions where the risk of vector tick exposure is considered to be high, or where disease is known to be endemic.
<i>Borrelia burgdorferi</i> (rLyme borreliosis) (recombinant-Outer surface protein A [OspA], parenteral)	Initial dose at 12–16 weeks of age or older after completion of the puppy core viral vaccines with a second dose 3–4 weeks later	Two doses 3–4 weeks apart, then annually or more often.		Non-core. Vaccination should be restricted to use in geographical areas where a significant risk of exposure has been established or for dogs whose lifestyle places them at significant risk. These dogs should be vaccinated at 12–16 weeks of age, with a second dose 3–4 weeks later, and then at intervals of 9–12 months until the risk has been reduced. This vaccine is the one least likely to provide adequate and prolonged protection, and therefore must be administered annually or more often for animals at high risk. Protection against infection with different serovars is variable. This product is associated with the greatest number of adverse reactions to any vaccine. In particular, veterinarians are advised of reports of acute anaphylaxis in toy breeds following administration of leptospirosis vaccines. Routine vaccination of toy breeds should only be considered in dogs known to have a very high risk of exposure.
<i>Leptospira interrogans</i> (combined with serovars canicola and icterohaemorrhagiae; killed bacterin, parenteral) (also available in the USA with serovars grippityphosa and pomona)	Two doses 2–4 weeks apart with initial dose at >6 weeks of age	Two doses, 2–4 weeks apart	Annually	Non-core. Conditional license only in USA. Consider for at-risk groups of co-housed dogs such as those in kennels, dog shows or day care.
Canine influenza virus (CIV; killed adjuvanted, parenteral)				Not Recommended. Prevalence of clinical cases of confirmed CCV disease does not justify vaccination.
Canine Coronavirus (CCV; killed and MLV, parenteral)				

The VGG did not consider the following products:

- *Crotalus atrox* toxoid (rattlesnake vaccine)—Conditional USDA License
- *Porphyromonas sp.* (periodontal disease vaccine)—Conditional USDA License
- *Babesia* vaccine (soluble parasite antigen from *B. canis* in saponin)—EU Licensed
- *Babesia* vaccine (soluble parasite antigen from *B. canis canis* and *B. canis rossii* in saponin)—EU Licensed
- Canine herpesvirus vaccine—EU Licensed

The killed parenteral *Giardia lamblia* vaccine for the dog (listed in the 2007 guidelines) is no longer available.

Table 2 WSAVA Guidelines on Canine Vaccination for the Shelter Environment

Recommended Vaccines in Various Combinations (also refer to Table 1)	Initial Vaccine Series for Puppies (<16 weeks of age)	Initial Vaccine Series for Adults (>16 weeks of age)	Comments
CDV + CAV-2 + CPV-2 (MLV) with or without CPIv	Administer one dose prior to or immediately on admission. Repeat at 2 week intervals until 16 weeks of age if animal is still in the facility.	Administer one dose prior to or immediately on admission. Repeat in 2 weeks.	Ideally puppies should be vaccinated beginning at 6 weeks of age. Nursing history is not always available. In the face of an outbreak, vaccination as early as 4 weeks (for distemper or parvovirus) may be indicated.
rCDV + CAV-2 + CPV-2 (rCDV + MLV) with or without CPIv	Note: Where CDV and/or parvovirus infection rates are high, the CDV vaccine may be administered as early as 4 weeks of age but not earlier.		MDA, if present, can interfere with immunization.

Table 2 Continued

Recommended Vaccines in Various Combinations (also refer to Table 1)	Initial Vaccine Series for Puppies (<16 weeks of age)	Initial Vaccine Series for Adults (>16 weeks of age)	Comments
<i>Bordetella bronchiseptica</i> (avirulent live bacterin) + CPiV (MLV) For intranasal use only. Parenteral administration MUST BE avoided.	Administer a single dose as early as 3 weeks of age. For best results, if administered prior to 6 weeks of age, an additional dose should be given after 6 weeks of age.	Two doses 2–4 weeks apart are recommended.	Intranasal (avirulent live) vaccine is preferred to parenteral vaccine in puppies because it can safely be administered to puppies younger than 6 weeks. Additionally a single dose may be protective.
<i>Bordetella bronchiseptica</i> (available as killed bacterin or antigen extract; for parenteral administration only)	Administer one dose at time of admission. Administer a second dose 2–4 weeks later.	Two doses 2–4 weeks apart are recommended.	Topical vaccination in adult dogs or puppies older than 16 weeks has the advantage of providing non-specific immunity immediately after vaccination whereas parenteral does not. Canine respiratory disease complex (kennel cough) is not a vaccine-preventable disease and the vaccine should only be used to help manage the disease.
Canine influenza virus (CIV; available as killed parenteral vaccine)	Administer first dose not earlier than 6 weeks of age, followed in 2–4 weeks by the second dose.	Administer two doses 2–4 weeks apart.	Annual revaccination is recommended for animals in long-stay shelters. For influenza vaccines in general immunity is serotype-specific. This product is only available in the USA.
Rabies	If at all, a single dose, or two doses 2–4 weeks apart in a highly endemic area, should be administered <i>at the time of discharge</i> from the facility.	If at all, a single dose should be administered <i>at the time of discharge</i> from the facility.	The administration of rabies vaccine will be determined by whether the shelter is in a country in which the disease is endemic, and by local statute.

FELINE VACCINATION GUIDELINES

VACCINATION OF INDIVIDUAL CATS

The Basic Immunization Schedule

Guidelines and recommendations for core (recommended), non-core (optional) and not recommended vaccines for the general veterinary practice are given in Table 3. A particular example of a vaccine that may be considered core in only some countries is that against rabies virus. In a geographical area in which this infection is endemic all cats should be routinely vaccinated for the protection of both the pet and human populations. In some countries, mandatory rabies vaccination is a legal requirement, and is generally also required for international pet travel. In terms of feline core vaccines it is important to realize that the protection afforded by the FCV and FHV-1 vaccines will not provide the same efficacy of immunity as seen with the FPV vaccines. Thus the feline core vaccines should not be expected to give the same robust protection, nor the duration of immunity, as seen with canine core vaccines.

Although the FCV vaccines have been designed to produce cross-protective immunity against severe clinical disease, there are multiple strains of FCV and it is possible for infection and mild disease to occur in the vaccinated animal. With respect to FHV-1, it should be remembered that there is no herpesvirus vaccine that can protect against infection with virulent virus, and that virulent virus will become latent and may be reactivated during periods of **severe** stress. The reactivated virus may cause clinical signs in the vaccinated animal or the virus can be shed to susceptible animals and cause disease in them. The VGG has adopted the recommendation of triennial revaccination for FHV-1 and FCV but appreciates that this is a point of debate amongst experts. For example, the ABDC recommends annual revaccination for cats considered at high risk, but triennial revaccination for low risk (predominantly indoor) animals.

Vaccination against feline leukaemia virus (FeLV) is also often a point of debate amongst experts. The VGG regards FeLV as a non-core vaccine (Table 3) but fully appreciates that use of this product may be determined by the lifestyle and perceived exposure risk of individual cats and the prevalence of infection in the local environment. Many feline experts believe that even though the prevalence of FeLV infection is now markedly reduced due to successful vaccination and control programmes, any cat less than 1 year old with an element of outdoor lifestyle should receive the benefit of protection by routine vaccination with 2 doses of vaccine given 3–4 weeks apart, starting not earlier than 8 weeks of age. This ‘risk-benefit’ analysis for FeLV should form a routine part of the feline vaccination interview.

Kitten Vaccination and the 12 Month Booster

As discussed for pups, most kittens are protected by MDA in the first weeks of life. However, without serological testing, the level of protection and the point at which the kitten will become susceptible to infection and/or can respond immunologically to vaccination is unknown. This is related to the level of maternal antibody and variation in uptake of MDA between litters. In general, MDA will have waned by 8–12 weeks of age to a level that allows an active immunological response, and an initial vaccination at 8–9 weeks of age followed by a second vaccination 3–4 weeks later is commonly recommended. Many vaccines carry data sheet recommendations to this effect. However, kittens with poor MDA may be vulnerable (and capable of responding to vaccination) at an earlier age, while others may possess MDA at such high titres that they are incapable of responding to vaccination until sometime after 12 weeks of age. Therefore the VGG recommends administration of the final kitten dose at 14–16 weeks or older.

All kittens should receive the core vaccines. A minimum of three doses: one at 8–9 weeks of age, a second 3–4 weeks later and a final dose at 14–16 weeks of age or older should be administered. Cats that respond to MLV core vaccines maintain immunity for many years, in the absence of any repeat vaccination.

Revaccination of Adult Cats

All cats should receive a first booster within 12 months after completion of the kitten vaccination course (this will ensure adequate vaccine-induced immunity for cats that may not have adequately responded to the primary course). Following this first booster, subsequent revaccinations are given at intervals of 3 years or longer, unless special conditions apply. Adult cats of unknown vaccination status should receive a single initial MLV core vaccine injection followed by a booster vaccination 1 year later.

Cats that have responded to vaccination with MLV core vaccines maintain a solid immunity (immunological memory) for many years in the absence of any repeat vaccination. It should be emphasized that the considerations given above do not generally apply to killed core vaccines nor to the optional vaccines, and particularly not to vaccines containing bacterial antigens. Thus *Chlamydomphila* and *Bordetella* products require annual boosters for the limited protection afforded by these products.

Therefore an adult cat may today still receive an annual vaccination; however, the components of that vaccination may differ each year. Typically, core vaccines are currently administered triennially with chosen non-core products being given annually. The VGG is aware that in some countries only multi-component products containing core and non-core combinations are available. The VGG would encourage manufacturers to make a full range of vaccines available wherever possible or at the very least, make a core only combination for those not wanting to give any of the non-core vaccines.

An adult cat that received a complete course of vaccination for FPV, FHV-1 and FCV as a kitten (including the 12 month booster), but may not have been regularly vaccinated as an adult requires only a single dose of vaccine to boost immunity. It should be noted that many current data sheets will advise in this circumstance that the cat requires two vaccinations (as for a kitten) but this practice is unjustified and simply contrary to the fundamental principles of immunological memory. By contrast, this approach may be justified when an adult cat's vaccination history is unknown and where serological testing of such an animal is not performed.

Sites of Vaccination for Cats

Over the past 20 years it has become evident that one trigger for the feline injection site sarcoma (FISS) may be the administration of adjuvanted FeLV and rabies vaccines. Most subcutaneous injections (including of vaccines) have traditionally been given into the interscapular region of the cat and this is a common site for formation of a FISS. The infiltrative nature of these tumours has meant that often radical surgical resection was necessary to attempt removal of these lesions.

In North America the response to this issue was the recommendation of a protocol whereby the two perceived high-risk adjuvanted vaccines would be administered into distinct anatomical sites that would be more amenable to surgical removal of any FISS that might develop. Accordingly the recommendation 'left leg leukaemia, right leg rabies' suggested that FeLV vaccine should be given as far distal as possible into the left hind limb, whilst rabies vaccine should be given as far distal as possible into the right hind limb. A recent study has evaluated the effect of this practice by comparing the anatomical distribution of FISS in cats before the recommendation was made (1990–1996) and after the practice was adopted (1997–2006). These data show a significant decrease in the prevalence of interscapular FISS and an increase in prevalence of tumours in the right (but not left) hind limb. More notably, there was also an increase in the number of tumours reported arising in the right and left lateral abdomen, and this was attributed to the difficulty of injecting into the distal hindlimb and these abdominal sites being accidentally injected (Shaw et al., 2009).

This practice has not been adopted outside of North America. Given these recent data, the VGG recommends the following approach to reducing the risk of FISS:

- Non-adjuvanted vaccines should be administered to cats wherever possible.
- Vaccines (particularly adjuvanted products) should not be administered into the interscapular region.

- Vaccines (particularly adjuvanted products) should be administered into other subcutaneous (and not intramuscular) sites. The most accessible sites, with acceptable safety for the vaccinators (i.e. to avoid accidental self-injection during difficult restraint of the animal), would appear to be the skin of the lateral thorax or abdomen. The skin of the lateral abdomen represents the best choice as FISS that might arise at this site may be more readily excised than those occurring in the interscapular or intercostal regions where more extensive surgical resection is required.
- Vaccines should be administered into a different site on each occasion. This site should be recorded in the patient's record or on the vaccination card by use of a diagram indicating which products were administered on any one occasion. The sites should be 'rotated' on each occasion. Alternatively, a practice might develop a group policy that all feline vaccinations are administered to a specific site during one calendar year and this site is then rotated during the following year.
- The VGG encourages all cases of suspected FISS to be notified via the appropriate national reporting route for suspected adverse reactions.

Serological Testing

At this point in time there is limited availability of serological testing for vaccinal antibody responses in the cat, and tests for the detection of FPV antibody in this context are still under development. The titre check test routinely used in the USA for CPV antibody can be used to detect FPV antibody in the cat. It is not anticipated that a titre test for serum antibody to FCV nor FHV-1 will ever be of value in measuring vaccine immunity in the cat. Therefore, the VGG endorses the use of the serological tests for FPV antibody only. These test results can be used in the same way as described above for the dog. It should be emphasized that antibody testing for FIV is used to diagnose disease and is of no value in determining immunity to FIV.

Table 3 WSAVA Feline Vaccination Guidelines

Vaccine	Initial kitten vaccination (≤ 16 weeks)	Initial adult vaccination (> 16 weeks)	Revaccination recommendation	Comments
Panleukopenia Virus (FPV; MLV, parenteral)	Begin at 8–9 weeks of age, with second dose 3–4 weeks later, and final dose at 16 weeks of age or later	2 doses, 3–4 weeks apart	A single dose is given 1 year following the last dose of the initial series, then no more frequently than every 3 years	Core. Use of MLV vaccines is not recommended in pregnant cats and FeLV and/or FIV infected cats. Intranasal vaccination may not be as effective as injectable vaccination in high-risk environments where exposure may occur soon after vaccination such as animal shelters. Parenteral MLV is recommended in shelters.
FPV (killed, adjuvanted or killed, non-adjuvanted, parenteral)				
FPV (MLV, non-adjuvanted, intranasal)				
Feline Herpesvirus-1 (FHV-1; MLV, non-adjuvanted, parenteral and intranasal products are available)	Begin at 8–9 weeks of age, with second dose 3–4 weeks later, and final dose at 16 weeks of age or later.	2 doses, 3–4 weeks apart	A single dose is given 1 year following the last dose of the initial series, then every 3 years.	Core. MLV FHV-1/FCV vaccines are invariably combined with each other, either as bivalent products or in combination with additional vaccine antigens (e.g. FPV). Mild upper respiratory disease signs are occasionally seen following intranasal vaccination.
FHV-1 (killed, adjuvanted, parenteral)				
Feline calicivirus (FCV; MLV, non-adjuvanted, parenteral and intranasal products are available)	Begin at 8–9 weeks of age, with second dose 3–4 weeks later, and final dose at 16 weeks of age or later.	2 doses, 3–4 weeks apart	A single dose is given 1 year following the last dose of the initial series, then every 3 years.	Core. MLV FHV-1/FCV vaccines are invariably combined with each other, either as bivalent products or in combination with additional vaccine antigens. Mild upper respiratory disease signs are occasionally seen following intranasal vaccination.
FCV (killed, adjuvanted, parenteral)				
Rabies (canary pox virus-vectored recombinant, non-adjuvanted, parenteral)	Administer a single dose as early as 8 weeks of age, with revaccination 1 year later.	Administer 2 doses, 12 months apart.	Annual booster is required.	Non-core except where required by statute (e.g. for pet travel) or in areas where the disease is endemic
Rabies (1, 3 and 4 year killed, adjuvanted products are available, parenteral)	Administer a single dose as early as 12 weeks of age, with revaccination 1 year later.	Administer 2 doses, 12 months apart.	Booster as per licensed DOI or as required by local regulations.	Non-core except where required by statute (e.g. for pet travel) or in areas where the disease is endemic

Table 3 Continued

Vaccine	Initial kitten vaccination (≤ 16 weeks)	Initial adult vaccination (> 16 weeks)	Revaccination recommendation	Comments
Feline Leukemia Virus (FeLV; canary pox virus-vectored recombinant, non-adjuvanted, transdermal USA and injectable elsewhere)	Administer an initial dose as early as 8 weeks of age; a second dose should be administered 3–4 weeks later. Two initial doses required.	2 doses, 3–4 weeks apart	When indicated a single dose is given 1 year following the last dose of the initial series, then not more often than every 3 years in cats determined to have sustained risk of exposure.	Non-Core. In the United States, the 0.25 ml rFeLV vaccine dose may only be administered via the manufacturer's transdermal administration system. Only FeLV negative cats should be vaccinated. FeLV testing prior to vaccine administration should be mandatory.
FeLV (killed, adjuvanted, parenteral)	Administer an initial dose as early as 8 weeks of age; a second dose should be administered 3–4 weeks later. Two initial doses required.	2 doses, 3–4 weeks apart	When indicated, a single dose is given 1 year following the last dose of the initial series, then not more often than every 3 years in cats determined to have sustained risk of exposure.	Non-Core. Only FeLV negative cats should be vaccinated. FeLV testing prior to vaccine administration should be mandatory.
FeLV (recombinant protein subunit, adjuvanted, parenteral)	Administer an initial dose as early as 8 weeks of age; a second dose should be administered 3–4 weeks later. Two initial doses required.	2 doses, 3–4 weeks apart	When indicated, a single dose is given 1 year following the last dose of the initial series, then not more often than every 3 years in cats determined to have sustained risk of exposure.	Non-Core. Only FeLV negative cats should be vaccinated. FeLV testing prior to vaccine administration should be mandatory.
Feline Immunodeficiency Virus (FIV; killed, adjuvanted, parenteral)	3 doses are required: The initial dose is administered as early as 8 weeks of age; 2 subsequent doses should be administered at an interval of 2–3 weeks.	3 doses are required: Each dose is administered 2–3 weeks apart.	When indicated, a single dose is given 1 year following the last dose of the initial series, then annually in cats determined to have sustained risk of exposure.	Not recommended. Vaccination induces production of antibodies indistinguishable from those developed in response to FIV infection, and interferes with antibody-based FIV diagnostic tests for at least a year following vaccination. Some discriminatory serological tests have been reported and quantitative PCR diagnostics are becoming more widely available.
Feline Infectious Peritonitis (FIP; MLV, non-adjuvanted, intranasal)	Administer a single dose as early as 16 weeks of age, and a second dose 3–4 weeks later.	2 doses, 3–4 weeks apart.	Annual booster is recommended by the manufacturer.	Not Recommended. According to the limited studies available, only cats known to be feline coronavirus antibody negative at the time of vaccination are likely to develop some level of protection. It is rare that a cat will be coronavirus antibody negative.
<i>Chlamydomphila felis</i> (avirulent live, non-adjuvanted, parenteral)	Administer the initial dose as early as 9 weeks of age; a second dose is administered 3–4 weeks later.	Administer 2 doses, 3–4 weeks apart.	Annual booster is indicated for cats with sustained exposure risk.	Non-Core. Vaccination is most appropriately used as part of a control regime for cats in multiple-cats environments where infections associated with clinical disease have been confirmed. Inadvertent conjunctival inoculation of vaccine has been reported to cause clinical signs of infection. These vaccines may be associated with adverse reactions (hypersensitivity).
<i>Chlamydomphila felis</i> (killed, adjuvanted, parenteral)	Administer the initial dose as early as 9 weeks of age; a second dose is administered 3–4 weeks later.	Administer 2 doses, 3–4 weeks apart.	Annual booster is indicated for cats with sustained exposure risk.	Non-Core. Vaccination is most appropriately used as part of a control regime for cats in multiple-cats environments where infections associated with clinical disease have been confirmed. Inadvertent conjunctival inoculation of vaccine has been reported to cause clinical signs of infection. These vaccines may be associated with adverse reactions (hypersensitivity).
<i>Bordetella bronchiseptica</i> (avirulent live, non-adjuvanted, intranasal)	Administer a single dose intranasally as early as 8 weeks of age.	Administer a single dose intranasally	Annual booster is indicated for cats with sustained risk.	Non-Core. Vaccination may be considered in cases where cats are likely to be at specific risk of infection. Studies have not shown this product to reduce severity of the feline respiratory disease complex.

The killed parenteral *Giardia lamblia* vaccine for the cat (listed in the 2007 guidelines) is now no longer available.

Table 4 WSAVA Guidelines on Feline Vaccination for the Shelter Environment

Vaccine	Kittens (≤ 16 weeks)	Adult and Adolescent (> 16 weeks)	Comments
FPV	Administer a single dose prior to or at the time of admission as early as 4–6 weeks of age; then, every 2–4 weeks until 16 weeks of age if still in the facility.	Administer a single dose at the time of admission; repeat in 2–4 weeks if the animal remains in the shelter.	MLV preparations are preferable. Use of intranasal FPV vaccines is generally not recommended in the shelter environment. Use of intranasal FCV/FHV-1 MLV vaccines may be preferable when rapid onset (48 hrs) of immunity is important. Post-vaccinal sneezing, more commonly seen following administration of intranasal FCV/FHV-1 vaccine, may be impossible to distinguish from active infection.
FHV-1	Administer a single dose prior to or at the time of admission as early as 4–6 weeks of age; then, every 2–4 weeks until 16 weeks of age if still in the facility.	Administer a single dose at the time of admission; repeat in 2–4 weeks if the animal remains in the shelter.	MLV preparations are preferable. Use of intranasal FPV vaccines is generally not recommended in the shelter environment. Use of intranasal FCV/FHV-1 MLV vaccines may be preferable when rapid onset (48 hrs) of immunity is important. Post-vaccinal sneezing, more commonly seen following administration of intranasal FCV/FHV-1 vaccine, may be impossible to distinguish from active infection.
FCV	The earlier recommended age (4 weeks) and short end of the interval (2 weeks) should be used in very high risk environments or during outbreaks.	Administer a single dose at the time of admission; repeat in 2–4 weeks if the animal remains in the shelter.	MLV preparations are preferable. Use of intranasal FPV vaccines is generally not recommended in the shelter environment. Use of intranasal FCV/FHV-1 MLV vaccines may be preferable when rapid onset (48 hrs) of immunity is important. Post-vaccinal sneezing, more commonly seen following administration of intranasal FCV/FHV-1 vaccine, may be impossible to distinguish from active infection.
Rabies	If at all, a single dose should be administered at the time of discharge from the facility.	If at all, a single dose should be administered at the time of discharge from the facility.	The administration of rabies vaccine will be determined by whether the shelter is in a country in which the disease is endemic, and by local statute.

The VGG does not recommend the use of other feline vaccines in the shelter situation.

VACCINATION IN THE SHELTER ENVIRONMENT

An animal shelter is a holding facility for animals usually awaiting adoption, rescue, or reclaim by owners. In general, animal shelters are characterized by a random source population with a mostly unknown vaccination history, high population turnover, and high infectious disease risk. The term 'shelter' encompasses situations ranging from sanctuaries that possess a stable population, to facilities that admit hundreds of animals per day, to rescue and foster homes that care for multiple individuals or litters at any given time. Just as the vaccination strategy varies with each individual pet, there is no one-size-fits-all strategy for vaccinating shelter animals. The likelihood of exposure and the potentially devastating consequences of infection necessitate a clearly defined shelter vaccination program.

Shelter medicine differs from individual care in that it has to practice in an environment where eradication of infectious disease cannot be attained. It is possible, however, to minimize the spread of infections within a high-density, high-risk population and maintain the health of not yet infected individuals. When the overall purpose is to place healthy pets into welcoming homes, the time and effort dedicated to controlling infectious disease is only one of many variables in the complex shelter medicine and husbandry equation. The recommendations provided here attempt to address some shelter-unique issues as they pertain to vaccination and disease control.

Guidelines and recommendations for vaccines to be used in shelters are given in Tables 2 and 4. If unambiguous documentation of vaccination is provided for an animal at the time of admission to a shelter, there is no reason to revaccinate with canine core vaccines, but feline core vaccines, specifically the FCV and FHV, may be of value in boosting immunity.

The VGG discriminates between a shelter and a boarding kennel/cattery. The latter are facilities where fully vaccinated animals may be temporarily boarded for relatively short periods of time (e.g. when owners are on vacation). It should be a requirement of entry to any such facility that the individual dog or cat is fully vaccinated with core products given according to the guidelines presented herein. The use of non-core vaccines against respiratory infections is also appropriate under these circumstances. The VGG is aware that in some countries vaccination protocols for animals entering a boarding kennel/cattery are formulated by local authorities and may be contrary to current guidelines (e.g. insistence on annual revaccination). The VGG encourages such authorities to reconsider these recommendations in light of current scientific thinking.

GENERAL CONSIDERATIONS

Comprehensive Individual Care beyond Vaccination

In the past, veterinary practice has benefited from the annual administration of vaccines. By encouraging owners to bring their pets yearly for vaccination, veterinarians were able to recognize and treat disease earlier than might otherwise have been the case. In addition, the annual visit provided an opportunity to inform clients of important aspects of canine and feline health care.

Unfortunately, many clients have come to believe that vaccination is the most important reason for annual veterinary visits. Veterinarians are now concerned that a reduction in vaccination frequency will cause clients to forgo the annual visits and that the quality of care will diminish. It is therefore essential that veterinarians stress the importance of all aspects of a comprehensive individualized health care program. Emphasis should be placed on a detailed vaccination interview, a comprehensive physical examination by the veterinarian, and individualized patient care. The importance of dental care, proper nutrition, appropriate diagnostic testing and the control of parasites and of zoonotic diseases should also be addressed during evaluation of each pet. Behaviour concerns should be discussed, as well as the necessity for more frequent examination of young and geriatric animals.

The yearly health care/vaccination interview should assess the need for non-core vaccines for the pet. The practitioner should explain to the client the types of vaccines available, their potential benefits and risks, and their applicability to the particular animal, given its lifestyle and risk of exposure. Whilst an animal might not receive core vaccination every year, most non-core vaccines do require annual administration – so owners will continue to see their animal vaccinated annually. The regional incidence and risk factors for various infectious diseases should also be discussed. Ways to reduce the impact of acquired disease (e.g., avoiding overcrowding, improving nutrition, and restricting access to infected animals) should also be reviewed.

Vaccinations should be considered as only one component of a comprehensive preventive health care plan individualized based on the age, breed, health status, environment (potential exposure to harmful agents), lifestyle (contact with other animals), and travel habits of the pet.

Age has a significant effect on the preventive health care needs of any given individual. Puppy/kitten programs have traditionally focused on vaccinations, parasite control, and neutering. Today, opportunity exists to incorporate behaviour counselling and zoonotic disease management. For the aging pet, senior care programs are becoming increasingly popular. Nutritional, dental disease, and parasite control assessment and counselling should take place on an individualized basis throughout the life of the pet. There is no evidence that older dogs and cats, which have been fully vaccinated as pups or kittens, require a specialized programme of core vaccination. Experimental evidence shows that aged dogs and cats have persisting immunological memory to core vaccines that is readily boosted by administration of a single vaccine dose. By contrast, aged animals may not be as efficient at mounting primary immune responses to novel antigens that they have not previously encountered. Studies of UK dogs and cats vaccinated for the first time against rabies for pet travel have clearly shown that more aged animals fail to achieve the legally required antibody titre.

Certain breeds are predisposed to various diseases. Early detection (particularly of neoplasia) and management of breed-associated disease can significantly improve the quality of the animal's entire life. Pets with chronic medical conditions warrant periodic scheduled medical progress examinations and testing. Animals receiving certain medications also warrant therapeutic monitoring of blood levels and/or organ systems. The development of recheck protocols for chronic diseases and medications, which can be included in reminder systems, can greatly improve client compliance and, accordingly, pet care.

The environment in which a pet resides can profoundly affect its health status and should be assessed during annual health care visits in order to define risk factors and develop appropriate preventive measures.

By determining the extent to which dogs and cats come into contact with other animals in unobserved circumstances, veterinarians can assess the need for non-core vaccinations. Dogs that visit kennels, grooming salons, common areas, and wooded, tick-infested areas are potentially at greater risk from certain infectious diseases than dogs that do not frequent these areas.

Just as the human population has become more mobile, so has the pet population, resulting in potential exposure to infectious agents, parasites, and environmental hazards not found in the home environment. Determining past and anticipated future travel during each visit allows for greater individualization of preventive care and diagnostic testing plans.

Medical Record Documentation

At the time of vaccine administration, the following information should be recorded in the patient's permanent medical record:

- date of vaccine administration,
- identity (name, initials, or code) of the person administering the vaccine,
- vaccine name, lot or serial number, expiry date, and manufacturer
- site and route of vaccine administration.

The use of peel-off vaccine labels and stamps that imprint the medical record with the outline of a pet facilitates this type of record keeping which is mandatory in some countries. Adverse events should be recorded in a manner that will alert all staff members during future visits. Informed consent should be documented in the medical record in order to demonstrate that relevant information was provided to the client and that the client authorized the procedure (e.g. 'off-label' use of products as discussed above). At the very least, this notation should indicate that a discussion of risks and benefits took place prior to vaccination.

Adverse Events

Adverse events are defined as any side effects or unintended consequences (including lack of protection) associated with the administration of a vaccine product. They include any injury, toxicity, or hypersensitivity reaction associated with vaccination, *whether or not the event can be directly attributed to the vaccine*. Adverse events should be reported, whether their association with vaccination is recognized or only suspected. A vaccine adverse event report should identify the product(s) and animal(s) involved in the event(s) and the individual submitting the report.

Reporting field observations of unexpected vaccine performance is the most important means by which the manufacturer and the regulatory agency are alerted to potential vaccine safety or efficacy problems that may warrant further investigation. The purpose of pre-licensure safety studies is to detect relatively common adverse events. Rare adverse events will be detected only by post-marketing surveillance through analysis of reported adverse events. Adverse events should be reported to the manufacturer and/or the local regulatory authority. In many countries governmental surveillance schemes are not available and reactions should therefore be notified to the manufacturer. The VGG recognizes that there is gross under-reporting of vaccine-associated adverse events which impedes knowledge of the ongoing safety of these products. The VGG would actively encourage all veterinarians to participate in such surveillance schemes.

If a particular adverse event is well documented, reporting serves to provide a baseline against which future reports can be compared. In addition, reported adverse events can lead to detection of previously unrecognized reactions, detection of increases in known reactions, recognition of risk factors associated with reactions, identification of vaccine lots with unusual events or higher numbers of adverse events, and can further stimulate clinical, epidemiological, or laboratory studies. Therefore, veterinarians are encouraged to report any clinically significant adverse event occurring during or after administration of any licensed vaccine. Reporting a vaccine adverse event is not an indictment against a particular vaccine; it facilitates review of temporally associated conditions and adds to the safety database of the product.

REFERENCES

- Bergman PJ, Camps-Palau MA, McKnight JA, Leibman NF, Craft DM, Leung C, Liao J, Riviere I, Sadelain M, Hohenhaus AE, Gregor P, Houghton AN, Perales MA and Wolchok JD. (2006). Development of a xenogeneic DNA vaccine program for canine malignant melanoma at the Animal Medical Centre. *Vaccine* **24**, 4582-4585.
- Day MJ, Horzinek M and Schultz RD. (2007). Guidelines for the vaccination of dogs and cats. *Journal of Small Animal Practice* **48**, 528-541.
- Horzinek MC and Thiry E. (2009). Vaccines and vaccinations: the principles and the polemics. *Journal of Feline Medicine and Surgery* **11**, 530-537.
- Palatnik-de-Sousa CB, Silva-Antunes I, de Aguiar Morgado A, Menz I, Palatnik M and Lavor C. (2009). Decrease of the incidence of human and canine visceral leishmaniasis after dog vaccination with Leishmune® in Brazilian endemic areas. *Vaccine* **27**, 3505-3512.
- Paul, M.A., Carmichael, L.E., Childers, H., Cotter, S., Davidson, A., Ford, R., Hurley, K.F., Roth, J.A., Schultz, R.D., Thacker, E. and Welborn, L. (2006). 2006 AAHA canine vaccine guidelines. *Journal of the American Animal Hospital Association*, **42**, 80-89.
- Richards, J.R., Elston, T.H., Ford, R.B., Gaskell, R.M., Hartmann, K., Hurley, K., Lappin, M.R., Levy, J.R., Rodan, I., Scherk, M., Schultz, R.D. and Sparkes, A.H. (2006). The 2006 American Association of Feline Practitioners Feline Vaccine Advisory Panel Report. *Journal of the American Veterinary Medical Association*, **229**, 1405-1441.
- Shaw SC, Kent MS, Gordon IK, Collins CJ, Greasby TA, Beckett LA, Hammond GM and Skorupski KA (2009) Temporal changes in characteristics of injection-site sarcomas in cats: 392 cases (1990-2006). *Journal of the American Veterinary Medical Association*, **234**, 376-380
- Thiry E and Horzinek MC. (2007). Vaccination guidelines: a bridge between official requirements and the daily use of vaccines. *Revue Scientifique et Technique de l'Office International des Épizooties* **26**, 511-517.

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APPENDICES

FACT SHEET: CANINE PARVOVIRUS TYPE 2 (CPV-2) VACCINES

TYPES OF VACCINES AVAILABLE

Modified Live Virus (MLV) Vaccines: These vaccines contain canine parvovirus of various isolates, different genotypes and at various titres. Currently, three variants of the original CPV-2 are recognized worldwide, which are referred to as CPV-2a, CPV-2b and CPV-2c. The most recent of these to emerge is CPV-2c and this genotype is recognized in North and South America, Europe and Asia. All genotypes are antigenically comparable; vaccination with any current CPV vaccine will provide protective immunity against all the other variants. Current vaccines contain either CPV-2 or CPV-2b in the USA and these protect against all currently circulating variants including CPV-2c.

Inactivated (Killed) Vaccines: Only a few killed CPV-2 vaccines are available; they are less effective and take much longer to induce an immune response when compared with the MLV vaccines. They are not recommended for routine use. Killed vaccines may provide some benefit in wild and exotic species or pregnant bitches, where MLV vaccines are not recommended. However, killed CPV-2 vaccines have not been tested for safety or efficacy in these situations.

MECHANISMS AND DURATION OF IMMUNITY (DOI)

- DOI after natural infection/disease is life-long.
- DOI after vaccination with MLV vaccines is 9 years or longer, based on challenge and serological studies.
- DOI after vaccination with killed vaccines is unknown; a killed feline parvovirus (panleukopenia) vaccine was demonstrated in challenge studies to provide a DOI of 7.5 years in the cat.
- Systemic immunity from vaccination with MLV products is mediated by IgG and IgM neutralizing antibodies. An antibody titre correlated with protective immunity is stimulated only after multiple doses of the parenterally administered, killed, non-adjuvanted vaccines. Secretory IgA and CMI have not been shown to be important for protective immunity.
- MDA interferes with active immunization for varying periods of time in the puppy, depending on the titre of colostral antibody and the amount of antibody absorbed after birth, as well as the specific vaccine.
- The 'window of susceptibility' is defined as the period of time during which a pup can be infected by field virus, but vaccines cannot immunize. For highly effective MLV vaccines the 'window of susceptibility' is as short as two weeks or less, whereas for less effective vaccines, the window of susceptibility is as long as 10–12 weeks.
- After completing the puppy series at around 16 weeks and vaccinating again at 1 year of age, revaccination need not be done more often than every 3 years.
- In the absence of MDA, MLV vaccines provide immunity as early as 3 days after vaccination.
- The presence of serum antibody, regardless of titre, in an actively immunized dog over the age of 16 weeks is correlated with protection.

PRECAUTIONS

- In geographical areas or isolation facilities where CPV-2 is not endemic in domestic or wild susceptible species, MLV vaccines should not be used as the virus will be shed and could potentially revert to virulence as well as infect other individuals or other species.
- The attenuated vaccinal CPV-2 is always shed, but it will not cause disease in in-contact pups over 4 weeks of age, and it may immunize them. However, it may cause problems, e.g. myocarditis, in very young (less than 2 weeks of age), antibody negative pups, or infections/disease signs in exotic or wild species. MLV is shed at low levels in faeces for several days after vaccination.
- Reversions to virulence of MLV vaccines and confirmed cases of disease caused by vaccine virus have not been reported.
- Puppies younger than 5 weeks should not be vaccinated with MLV products.
- If a dog is found positive in a CPV-2 antigen test, especially if it has signs of parvovirus, regardless of recent (<2 weeks) vaccination, the animal should be considered infected with virulent CPV-2. Vaccinated dogs usually do not shed enough virus to cause antigen capture ELISA tests to become positive. In contrast, the PCR test performed on faeces will be positive for up to 7 days in recently vaccinated antibody negative dogs.

DISEASE FACTS

After infection, it takes 5 days or longer for signs of disease to appear. CPV-2 faecal shedding rarely persists for >2 weeks. Dogs persistently infected for >4 weeks have not been reported and one can expect the animal to die or clear the virus in that period of time. In the environment, however, the virus can remain infectious for one year or more. Therefore, all facilities where infected animals have been present must be considered infected.

FACT SHEET: CANINE ADENOVIRUS (CAV-2) VACCINES

TYPES OF VACCINES AVAILABLE

Modified Live Virus (MLV) Vaccines: CAV-2 containing vaccines are the most commonly available products. They are the only vaccines recommended for the prevention of infectious canine hepatitis (ICH) caused by CAV-1 and for reducing the signs of respiratory disease associated with CAV-2 infection. They are exceptionally effective and will not cause the adverse reaction commonly seen with CAV-1 vaccines known as allergic uveitis or 'blue eye'. In addition to parenteral MLV CAV-2 vaccine preparations there are combination or monovalent products to protect against the canine respiratory disease complex (CRDC), which includes multiple bacteria (notably *Bordetella bronchiseptica*) and multiple viruses (notably canine parainfluenza virus and canine influenza virus). The intranasal product that contains CAV-2, CPiV and *Bordetella* can be used to decrease the severity of CRDC, but should not be used as the only vaccine to prevent ICH; for this purpose, the parenteral MLV-CAV-2 should also be given.

Inactivated (Killed) Vaccines: Inactivated (killed) CAV-1 and CAV-2 vaccines are available in some countries but they are not recommended as they are poorly effective and can cause adverse reactions.

MECHANISMS AND DURATION OF IMMUNITY (DOI)

- DOI after natural CAV-1 infection and ICH disease is life-long.
- DOI after vaccination with MLV vaccines is 9 years or longer, based on challenge and serological studies.
- DOI for protection from ICH with killed CAV-1 or CAV-2 is unknown. The DOI for protection from CRDC caused by CAV-2 in combination with other agents is approximately 3 years, but as a multifactorial disease CRDC is not vaccine-preventable. The current vaccines only help in reducing disease severity. Other factors, like stress, poor ventilation, dust, ammonia gas in unsanitary facilities, infections with *Streptococcus spp.*, *Pasteurella multocida*, *Bordetella bronchiseptica*, *Mycoplasma spp.*, CPiV, CIV and canine respiratory coronavirus contribute to CRDC.
- Systemic immunity from vaccination is mediated by IgG virus neutralizing antibody. Immunity against the CAV-2 associated with CRDC is mediated by both IgG and secretory IgA when an intranasal vaccine has been given. IgG antibody developing after a parenteral vaccination protects the lungs against infection/disease, but not against upper respiratory tract infection, which requires secretory IgA and local cell-mediated immunity. CAV-2 vaccine may not provide adequate protection against ICH if the animal had only received an intranasal vaccine.
- MDA will block immunization after vaccination with the parenteral product, but not protection offered by the intranasal product. Since protection against ICH is afforded primarily by parenteral products, the last dose should be given along with the other viral vaccines (e.g. CDV, CPV-2) when the puppy is about 16 weeks of age or older.
- After completing the puppy series at around 16 weeks and vaccinating again at 1 year of age, revaccination need not be done more often than every 3 years.
- In the absence of MDA, MLV vaccines protect against ICH as early as 5 days after vaccination.
- The presence of serum antibody, regardless of titre, in an actively immunized dog over the age of 16 weeks is correlated with protection.

PRECAUTIONS

- When given intranasally, CAV-2 is readily shed from the respiratory tract, whereas it is not shed when given parenterally.
- The vaccine virus has not been shown to revert to virulence in back passage studies.

- Similar to other adenoviruses, MLV-CAV-1 and MLV-CAV-2 can cause neoplastic transformation of various cell types (such as hamster kidney cells) *in vitro*. The significance of this observation for dogs is not known.
- CAV-2 virus is commonly present in the upper respiratory tract of dogs; thus natural immunization, especially among shelter, show, and kennel dogs is widespread.

DISEASE FACTS

After experimental infection with CAV-1, it takes 5 days or longer for signs of ICH to appear. CAV-2 combined with other agents associated with CRDC can cause respiratory disease in 3–4 days.

CAV-2 is transmitted primarily through the air, whereas CAV-1 is transmitted primarily through contaminated secretions/excretions such as saliva and urine. CAV-1 and CAV-2 are moderately stable, surviving for several days to weeks in the environment.

FACT SHEET: CANINE DISTEMPER VIRUS (CDV) VACCINES

TYPES OF VACCINES AVAILABLE

Modified Live Virus (MLV) Vaccines: These are the most common products. They generally contain the CDV strains Rockborn, Snyder Hill, Onderstepoort, Lederle or others at various titres. There are many biotypes of CDV which can cause varying clinical signs in a wide variety of species. However, serological differences among the many isolates are insignificant, and vaccination with any one of the current vaccines should provide protective immunity against any biotype.

Vectored Recombinant (rCDV) Vaccines: A poxvirus recombinant product is available in the USA and a few other countries. It is safe and effective and is often used in wild and exotic species that are susceptible to CDV infection and disease.

Inactivated (Killed) Vaccines: Killed vaccines, not readily available, are not effective and therefore should not be used for immunization against distemper.

MECHANISMS AND DURATION OF IMMUNITY (DOI)

- DOI after natural infection/disease is life-long.
- DOI after vaccination with MLV vaccines is 9 years or longer, based on challenge and serological studies.
- DOI after vaccination with rCDV vaccine is ≥ 5 years, based on challenge and ≥ 6 years based on serology.
- DOI after vaccination with killed vaccines is unknown and they are not recommended.
- Systemic immunity is predominantly mediated by neutralizing antibody that prevents infection, or antibody and CMI in the vaccinated animal. Humoral immunity is provided by IgG; secretory antibody plays little or no role in preventing infection in a vaccinated animal.
- MDA interferes with active immunization for varying periods of time in the puppy, depending on the titre of colostral antibody and the amount of antibody absorbed after birth.
- The 'window of susceptibility' is defined as the period of time during which a pup can be infected by field virus, but vaccines cannot immunize. Unlike CPV-2 vaccines, there generally is not a long 'window of susceptibility' for CDV vaccines (less than 2 weeks).
- Puppy vaccination using MLV products should not start earlier than 6 weeks of age; after completing the series at around 16 weeks and vaccinating again at 1 year of age, revaccination need not be done more often than every 3 years.
- In the absence of MDA, MLV and recombinant vaccines provide immunity immediately after vaccination.
- CDV vaccines are among the most effective vaccines when compared to vaccines for any other species. Actively immunized dogs will not develop disease regardless of the amount of virus they are exposed to by contact infection.
- The presence of serum antibody, regardless of titre, in an actively immunized dog over the age of 16 weeks is correlated with protection.

PRECAUTIONS

- In geographical areas or isolation facilities where CDV is not endemic in domestic or wild susceptible species, MLV vaccines should not be used. The risk of introducing a virus into a host population is unacceptable. In this situation recombinant preparations are preferred because of their safety and effectiveness.
- Certain MLV CDV vaccines (e.g. based on the Rockborn or Snyder Hill strains) can regain virulence after about 7 experimental back passages in dogs. Since vaccinated dogs minimally shed virus, if at all, natural back passage rarely occurs. Susceptible wild carnivore species can shed the virus.
- The MLV preparations are attenuated (modified) for use in the domestic dog, not for use in wild and exotic species. These vaccines are highly virulent (e.g. in the ferret, black-footed ferret and grey fox), causing disease and death. Vaccination of these species with MLV vaccines should never be considered.
- Puppies younger than 4 weeks should not be vaccinated with MLV vaccines. For such young pups and for wild or exotic susceptible species, rCDV vectored vaccines are recommended. When locally unavailable, one should make every attempt to obtain rCDV vaccines rather than use an MLV product. Preparations containing the Ondesterpoort strain are considered the safest, but even this MLV strain has created problems in certain wild/exotic species.

DISEASE FACTS

Signs of disease appear between 2–6 weeks after infection. During the incubation period, CDV causes immunosuppression, making the animal more susceptible to microbial infections. These may lead to respiratory disease, pneumonia and death, before the more typical signs of distemper virus infection appear. In the environment, the virus quickly loses infectivity.

FACT SHEET: FELINE PANLEUKOPENIA VIRUS (FPV) VACCINES

TYPES OF VACCINES AVAILABLE

Modified Live Virus (MLV) Vaccines: These preparations contain attenuated (avirulent) feline parvovirus (feline panleukopenia virus) at various titres, without adjuvant. There are injectable preparations and others for intranasal application, in combination with other vaccinal antigens (e.g. FCV and FHV-1). MLV vaccines are advantageous for their faster onset of action, greater efficacy at overcoming maternal antibody, and greater likelihood of conferring sufficient immunity. Intranasal FPV combination vaccines should not be used in the shelter environment or if used for FCV/FHV-1 immunity, they should be given simultaneously with an MLV-FPV parenteral product.

Inactivated (Killed) Vaccines: Killed adjuvanted FPV vaccines are available; a single injected dose of some products may induce good antibody responses in naïve cats within a relatively short time span. However, all killed FPV products require two doses 3–4 weeks apart and immunity is present only after the second dose. Killed vaccines may be beneficial in wild and exotic species or pregnant queens, where MLV vaccines are not recommended.

MECHANISMS AND DURATION OF IMMUNITY (DOI)

- DOI after natural infection/disease is life-long
- DOI after vaccination with MLV vaccines is 7 years or longer, based on challenge and serological studies
- DOI after vaccination with a killed panleukopenia vaccine was demonstrated to last for a minimum of 7.5 years
- While most cases of feline panleukopenia are caused by infection with FPV, variants of canine parvovirus (CPV-2a, CPV-2b, and CPV-2c) have emerged that infect cats and may cause disease. Current FPV vaccines afford protection against these CPV variants.
- Systemic immunity from vaccination is mediated by neutralizing antibodies. Antibody titre correlates with protection. Secretory IgA and CMI are not important for protective immunity. Immunity can occur as early as 3 days after vaccination.
- Maternally derived antibody (MDA) interferes with active immunization for varying periods of time in the kitten, depending on the titre of colostral antibody and the amount of antibody absorbed during the first 8 hours after birth.

- The ‘window of susceptibility’ is defined as the period of time during which a kitten can be infected by field virus, but vaccines cannot immunize. By analogy with canine parvovirus, an immunity gap is assumed to exist at around 6–8 weeks of age, when antibody levels are too low to protect against natural infection, but still high enough to interfere with vaccination.
- After completing the kitten series at around 16 weeks and vaccinating again at 1 year of age, revaccination need not be done more often than every 3 years.
- The presence of serum antibody, regardless of titre, in an actively immunized cat over the age of 16 weeks is correlated with protection.

PRECAUTIONS

- Concerns have been raised regarding the reversion to virulence of MLV strains, but this has never been documented. Nevertheless, in regions or facilities where FPV is not endemic in domestic or wild susceptible species, MLV vaccines should not be used.
- MLV FPV vaccines should never be used in pregnant queens because of the risk of transfer of virus to the fetus and fetal damage. In some countries, inactivated FPV vaccines are licensed for use in pregnant queens, but in general, unnecessary administration of products to pregnant queens should be avoided.
- MLV FPV vaccines should never be administered to kittens less than 4 weeks of age, to avoid damage to the cerebellum which is still developing in neonates.
- MLV FPV vaccines should be used with caution in severely immunosuppressed individuals – although the risk appears small, with severe immunosuppression (for example with clinical FIV or FeLV infection or with the use of highly immunosuppressive drugs) failure to control viral replication could potentially lead to clinical signs after vaccination.
- When vaccination is being used to control disease in the face of an outbreak, the more rapid induction of immunity induced by MLV vaccines is of clinical advantage.

DISEASE FACTS

After infection, it takes 2–7 days for signs of disease to appear. Vomiting usually develops 1–2 days after the onset of fever. Diarrhoea may begin later but is not always present. Dehydration develops rapidly, and an affected cat may sit at a water bowl, obviously thirsty, but without drinking. Terminal cases are hypothermic and may develop septic shock and disseminated intravascular coagulation. In the environment, the virus can remain infectious for one year or more. Therefore, all facilities where infected animals have been present must be considered infected.

FACT SHEET: FELINE HERPESVIRUS (FHV-1) VACCINES

TYPES OF VACCINES AVAILABLE

Modified Live Virus (MLV) Vaccines: These preparations contain marginally attenuated feline herpesvirus (feline rhinotracheitis virus, occurring as a single serotype) at various titres, without adjuvant. There are injectable preparations and others for intranasal application, alone or in combination with other vaccinal antigens (always with feline calicivirus).

Inactivated (Killed) Vaccines: Adjuvanted killed and subunit vaccines have been developed.

MECHANISMS AND DURATION OF IMMUNITY (DOI)

- Assessment of the DOI is difficult. Complete clinical protection is seen only shortly after vaccination, and its efficacy decreases with time.
- Immunity is far from solid after natural infection/disease, and of variable duration.
- Protection afforded by FHV-1 (as well as the feline calicivirus) vaccines is not as complete as that seen with the feline panleukopenia vaccines. The other two feline core vaccines (FHV-1 and FCV) should not be expected to provide the same robust degree and duration of immunity as seen with the canine core vaccines or FPV.

- Persistence of antibody titre after vaccination with a killed FHV-1 vaccine was demonstrated for 3 years, but antibody titre for FHV-1 does not correlate with protection.
- Protection from challenge with virulent FHV-1 7.5 years after vaccination with two doses of killed vaccines is not complete but was similar to protection after 1 year with the killed product.
- After completing the kitten series at around 16 weeks and vaccinating again at 1 year of age, revaccination need not be done more often than every 3 years. If booster vaccinations have lapsed, a single injection is considered adequate to boost immunological memory.
- No herpesvirus vaccine can protect against infection with virulent virus; FHV-1 will become latent and may be reactivated during periods of severe stress. The reactivated virus may cause clinical signs in vaccinated animals; the virus may be shed, transmitted to susceptible animals and cause disease in susceptible kittens and cats.
- Cell-mediated immunity plays an important role in protection, since the absence of detectable serum antibody levels in vaccinated cats does not necessarily indicate that cats are susceptible to disease. On the other hand, seroconversion does correlate with protection against virulent FHV-1 challenge.
- MDA interferes with active immunization for varying periods of time in the kitten, depending on the titre of colostrum antibody and the amount of antibody absorbed after birth. The primary course of vaccination is usually started at around 9 weeks of age, although some vaccines are licensed for use at an earlier age. MDA interferes less with MLV intranasal (IN) vaccines than parenterally administered MLV products. It would be expected that the IN vaccines will immunize 2–4 weeks earlier than the parenteral vaccines in kittens with MDA.

PRECAUTIONS

- Modified live parenteral vaccines retain some pathogenic potential and may induce disease if administered incorrectly (i.e. when accidentally aerosolized or ingested from vaccine deposited on the skin/hair).
- Upper respiratory disease signs are sometimes seen following intranasal vaccination.
- In breeding catteries, infections mostly appear in kittens prior to weaning, typically between 4–8 weeks of age, as MDA wanes. In most cases, the source of infection is the queen, whose latent virus is reactivated due to the stress of parturition and lactation.

DISEASE FACTS

Viral excretion starts as soon as 24 hours after infection and lasts for 1–3 weeks. Acute disease appears after 2–6 days and resolves within 10–14 days. The virus spreads along the sensory nerves and reaches neurons, particularly in the trigeminal ganglia, which are the main sites of latency. Most cats become lifelong latent carriers, shedding the virus periodically, upon stressful events. Viral genomic DNA persists in the nucleus of infected neurons without replication. In the environment, the virus is labile and inactivated by common disinfectants.

FACT SHEET: FELINE CALICIVIRUS (FCV) VACCINES

TYPES OF VACCINES AVAILABLE

Modified Live Virus (MLV) Vaccines: These preparations contain feline caliciviruses of several types without an adjuvant. There are injectable preparations and others for intranasal application, alone or in combination with other vaccinal antigens (always with feline herpesvirus).

Inactivated (Killed) Vaccines: Killed adjuvanted vaccines are also available.

MECHANISMS AND DURATION OF IMMUNITY (DOI)

- There is considerable antigenic variability amongst FCV strains, but the virus is considered as a single serotype. Prior infection with one strain can significantly reduce the acute clinical signs upon exposure to a heterologous strain, and also oral virus shedding. In general, the level of heterologous protection depends on the pair of virus strains examined.

- Virus neutralizing antibodies first appear approximately 7 days after infection, their titre correlates well with protection against homologous challenge. Cats may also be protected in the absence of serum antibody, since local secretory IgA antibody and cellular responses have been demonstrated to provide protection in vaccinated cats.
- After vaccination with a killed FCV vaccine, antibody has been shown to persist for 3 years. Accordingly, a DOI of >3 years has been established for FCV vaccines.
- Protection from challenge with virulent FCV 7.5 years after vaccination with two doses of killed vaccine was not complete, but was similar to protection after 1 year with the killed product.
- Protection afforded by FCV (as well as by feline herpesvirus) vaccines is not as complete as that seen with the feline panleukopenia vaccines. The two core respiratory vaccines should not be expected to provide the same robust degree and duration of immunity as seen with feline parvovirus or the canine core vaccines.
- After completing the kitten series at around 16 weeks and vaccinating again at 1 year of age, revaccination need not be done more often than every 3 years.
- MDA is important for protection during the first weeks of life and may interfere with vaccination. The average half-life of MDA was determined to be 15 days with persistence for 10–14 weeks. In a field study, about 20% of kittens at six weeks of age had no detectable antibodies against a widely used vaccine strain. MDA interferes less with MLV intranasal than parenterally administered MLV products. It would be expected that the IN vaccines will immunize 2–4 weeks earlier than the parenteral vaccines in kittens with MDA.

PRECAUTIONS

- Upper respiratory disease signs are more commonly seen following intranasal vaccination.
- Because of the multitude of antigenically differing viruses circulating in the field, vaccine strain combinations have been chosen to cross-protect against severe clinical disease - but mild disease may still occur in vaccinated cats.
- In contrast to feline herpesvirus, which is shed upon a stressful event, shedding of FCV is continuous. The impact of vaccination on shedding is controversial, with observations ranging from moderate reduction to extension of the period of virus shedding post infection. Live parenteral FCV vaccine strains can be shed, although infrequently.

DISEASE FACTS

FCV infection can cause acute oral and upper respiratory signs but has also been associated with chronic gingivostomatitis, which may be immune-mediated. Acute oral and upper respiratory disease signs are mainly seen in kittens. The incubation period is 2–10 days. Oral ulceration, sneezing and serous nasal discharge are the main signs.

Recently, a new syndrome, the 'virulent systemic feline calicivirus (VS-FCV) disease' has been described. The incubation period for this infection in cats exposed in shelters and hospitals is 1–5 days; in the home environment it may be up to 12 days. This disease appears to be more severe in adults than kittens. Vaccination with current vaccines does not protect cats against field infections, but some protection has been shown experimentally. This might be due either to the inherent characteristics of the hypervirulent strains or to the fact that 'vaccine susceptible' strains are unlikely to cause outbreaks, since vaccination is so widely practiced. There is a killed VS-FCV strain in a vaccine available in the USA that is reported to provide protection against VS-FCV strains. It is not known if this strain of VS-FCV will provide protection against the homologous or heterologous VS-FCV strains.

FACT SHEET: RABIES VACCINES

TYPES OF VACCINES AVAILABLE

Modified Live Virus (MLV) Vaccines: These have been used world-wide for oral immunization of wildlife (e.g. foxes in Canada and Europe, raccoon dogs in Finland) and are all safe derivatives of the SAD (Street Alabama Dufferin) virus strain.

Vectored Recombinant Rabies Vaccines: Recombinant vaccine viruses are particularly safe because they contain only a single rabies virus gene for glycoprotein G that is relevant for protection. Poxviruses (vaccinia and canary pox) vectors expressing the rabies virus glycoprotein are used routinely in the USA for the control of rabies in wildlife (vaccinia vector) by the oral route and cats (canary pox vector) by the parenteral route. These vaccines have been available and used for more than 5 years in the USA. These vaccines are avirulent in all avian and mammalian species tested.

Inactivated (Killed) Vaccines: The use of killed vaccines is the rule for individual dog and cat protection and mass canine vaccinations. The killed vaccines are easier to manage than live preparations because of their stability at ambient temperatures, and accidents of self-inoculation do not represent a risk, as would be the case for MLV vaccines.

MECHANISMS AND DURATION OF IMMUNITY (DOI)

- Canine and feline rabies is controlled mostly by the use of inactivated vaccines. However, in the USA recombinant canary pox vectored rabies vaccine is licensed and widely used in cats because it is not associated with the pronounced inflammation at the injection site caused by adjuvanted rabies vaccines. The recombinant canary pox vaccine is not licensed for use in dogs and in its current formulation does not provide immunity in the dog. Cats in general respond better than dogs to rabies vaccines. In the USA all initial rabies vaccinations must be followed one year later by revaccination. Only after that second vaccination can the interval for revaccination be legally extended to 3 years with a product that has a 3 year DOI label.
- DOI after natural infection cannot be assessed, because disease following street virus infection is fatal in the dog and cat.
- DOI after vaccination with commercially available inactivated and recombinant products is 3 years or longer, based on challenge and serological studies.
- First vaccination is at not earlier than 12 weeks of age and revaccination one year later; antibody titres generally achieve protective levels 4 weeks after injection. Where serological testing is required for legal purposes the interval between vaccination and testing is crucial and may be product-dependent. The product data sheet and legal requirements should be consulted.
- Some vaccines protect against virulent rabies virus challenge for 3 years or longer, but national or local legislation may call for annual boosters. The VGG encourages all legislators to consider scientific advances in formulating policy.
- The presence of a serum antibody titre of ≥ 0.5 IU/ml in an actively immunized dog over the age of 16 weeks is correlated with protection. Achieving this titre (≥ 0.5 IU/ml) is also considered a legal requirement for pet travel for some countries which include serological testing post-vaccination in their protocol for movement of pets.

DISEASE FACTS

Signs of disease appear between 2 weeks and several months after infection, depending upon the site of infection (transmission is generally by bite or scratch). Any unexplained aggressive behaviour or sudden behavioural change must be considered suspicious. The disease manifests itself as a 'furious' or a 'dumb' form. Signs of the classical 'furious' form of rabies include reduced palpebral, corneal and pupillary reflexes, strabismus, dropped jaw, salivation, seizures, twitching, tremors, disorientation, aimless pacing, exaggerated emotional responses (irritability, rage, fear, photophobia), as well as ataxia and paralysis, ultimately followed by coma and death from respiratory arrest. The 'dumb' form of rabies is more common in dogs than cats and presents as lower motor neuron paralysis that progresses from the site of the bite injury to involve the entire central nervous system. The paralysis rapidly leads to coma and death from respiratory failure.

In the environment, the virus quickly loses infectivity, and is readily inactivated using detergent-based disinfectants.

FREQUENTLY ASKED QUESTIONS (FAQ)

QUESTIONS RELATED TO VACCINE PRODUCTS

1. May I give a MLV product to a wild, exotic species or to a domestic species other than to the ones which the vaccine was licensed to protect?

No, never give MLV vaccines unless they have been shown to be safe in that species. Many MLV vaccines have caused disease in animal species other than those for which they had been licensed. Even worse: the vaccine could be shed from the wild animals, regain virulence through multiple passages and cause disease even in the target species for which it had been developed. The consequences could be catastrophic!

A highly effective and very safe vaccine for species that are susceptible to CDV is a canary poxvirus-vectored recombinant CDV vaccine that is available as a monovalent product for ferrets or a combination product for dogs. The monovalent vaccine is being used in many wild and exotic species susceptible to CDV, but is only available in certain countries.

2. May I vaccinate a puppy that is at high risk of getting CDV with a human measles vaccine?

No. Due to an insufficient amount of virus, the human MV vaccine is not immunogenic in the puppy. Measles virus vaccines made specifically for the dog (sometimes combined with CDV and additional viral components) will give temporary protection at an earlier age than a CDV vaccine. At 16 weeks or older, the puppy must be vaccinated with a CDV vaccine, to achieve permanent immunity.

3. Can certain vaccines immunize pups having maternally derived antibody (MDA) against CDV at an earlier age than the conventional MLV CDV vaccines?

Yes. The heterotypic measles vaccine for dogs will immunize pups about 4 weeks earlier than the MLV-CDV vaccines. Similarly, the canary pox vectored recombinant CDV vaccine will immunize approximately 4 weeks earlier than the MLV vaccines.

4. I know that maternally derived antibodies (MDA) can prevent active immunization with MLV vaccines - but can they also block immunity to killed vaccines?

Yes. MDA can indeed block certain killed vaccines. If the killed product requires two doses, as is often the case, and the first dose is blocked by MDA, then the second dose will not immunize. In this circumstance, the second dose will prime (if not blocked), and a third dose is required to immunize and boost.

This is not true for MLV, where - in the absence of MDA - it only takes a single dose to prime, immunize, and boost. Nevertheless two doses are often recommended, particularly in young animals, to be sure one is given when MDA cannot block. That is why in the puppy or kitten series, the last dose should be given at around 16 weeks of age or later.

5. I have been told that certain canine MLV combination core products need only be given twice, with the last dose at an age as young as 10 weeks. Is that accurate?

The VGG is aware that certain canine vaccines are licensed for such an 'early finish' in order to allow pups the benefit of early socialization. The VGG accepts the behavioural benefits of this practice but has reservations about its immunological validity. No combination core product currently available will immunize an **acceptable percentage** of puppies when the last dose is given at 10 weeks of age. The VGG advises that wherever possible the last dose should be given at around 16 weeks of age, regardless of the number of doses given earlier. Where the 'early finish' protocol is adopted, the VGG recommends that owners carefully control the exposure of their pup to restricted environments and only permit contact with healthy and fully vaccinated puppies.

6. May I give the same type of vaccine parenterally and intranasally, for example the canine and feline vaccines used to prevent respiratory diseases ('kennel cough' and feline upper respiratory disease)?

Yes. However, you should be sure to give the product approved for that route. If you use the parenteral MLV vaccines containing FCV and FHV-1 locally, you could cause disease in the cat. If you use the killed FCV and FHV-1 vaccines locally, you would not get any immunity and might cause significant adverse reactions. If you gave the intranasal live 'kennel cough' vaccine parenterally, you could cause a severe necrotizing local reaction and even kill the dog, whereas giving the parenteral killed *Bordetella* vaccine intranasally will not immunize and may cause a hypersensitivity reaction.

However, both types of products can be given at the same time or at various times in the life of the animal. Vaccinating both parenterally and intranasally may actually provide better immunity than vaccinating at only one site. Thus parenteral vaccination provides protection in the lung but little or no immunity in the upper respiratory tract (especially local secretory IgA and CMI), whereas intranasal vaccination will engender good secretory IgA and local CMI and non-specific immunity (e.g. type I interferons), but will not always provide immunity in the lung.

7. How long after vaccination does it take for the dog to develop immunity that will prevent severe disease when the core vaccines are used?

This is dependent on the animal, the vaccine and the disease.

- The fastest immunity is provided by CDV vaccines – MLV and recombinant canary pox virus vectored. The immune response starts within minutes to hours and provides protection within a day to animals without interfering levels of MDA and dogs that are not severely immunosuppressed.
- Immunity to CPV-2 and FPV develops after as few as 3 days and is usually present by 5 days when an effective MLV vaccine is used. In contrast, the killed CPV-2 and FPV vaccines often take 2 to 3 weeks or longer to provide protective immunity.
- CAV-2 MLV given parenterally would provide immunity against CAV-1 in 5–7 days. However, when given intranasally the same level of immunity to CAV-1 is not present until after 2 or more weeks and in some dogs it doesn't develop. Thus parenteral CAV-2 is recommended for immunity to CAV-1.
- Time from vaccination to immunity is difficult to determine for FCV and FHV-1 because some animals will not develop protective immunity. However, when it does develop, it takes 7–14 days.

8. What can I expect from the core vaccines in terms of efficacy in the properly vaccinated puppy/dog and kitten/cat?

- Dogs properly vaccinated with MLV or recombinant CDV, CPV-2 and CAV-2 would have $\geq 98\%$ protection from disease. Similarly we would expect a very high protection from infection.
- For the properly vaccinated cat that had received MLV vaccines, we would estimate that $\geq 98\%$ would be protected from disease and infection with FPV.
- In contrast, we can expect FCV and FHV-1 vaccines, at best, to protect from disease, not infection, especially in a highly contaminated environment (e.g. shelter) and protection would be seen in 60 to 70% in a high risk environment. Protection would appear to be much higher in the household pet cat isolated from other cats or with cats that have been vaccinated and in the household for a long time because the risk for infection with the viruses is so much lower, as is the stress level.

9. Are there mutants (biotypes or variants) of CDV or CPV-2 in the field that the current vaccines cannot provide protective immunity against?

No. All of the current CDV and CPV-2 vaccines provide protection from all the known isolates of CDV or CPV-2, respectively, when tested experimentally as well as in the field.

10. Do the current CPV-2 vaccines provide protection from disease caused by the new variant CPV-2c? How long does the protection last?

Yes. The CPV-2 vaccines, regardless of what variant they contain, stimulate an active immune response (e.g. antibody response), that provides long term (4 or more years) protection from all current CPV-2 variants (2a, 2b, and 2c) when the dogs are challenged.

11. Can parvovirus vaccines (e.g. canine parvovirus-2 and feline parvovirus [panleukopenia]) be administered orally?

No. CPV-2 and FPV vaccines, when given orally, will not immunize. They will immunize when given intranasally, however the most effective route is parenteral (subcutaneous or intramuscular) vaccination.

12. Can certain CPV-2 vaccines immunize pups with MDA at an earlier age than other CPV-2 vaccines?

Yes. Certain CPV-2 vaccines with higher viral titres and/or with more immunogenic isolates (regardless of variant) will immunize a few weeks (e.g. 2 weeks) earlier than other CPV-2 vaccines.

13. Are serum antibody titres useful in determining vaccine immunity?

Yes. This is particularly the case for CDV, CPV-2 and CAV-1 in the dog, FPV in the cat and rabies virus in the cat and dog. Serum antibody titres are of limited or no value for the other vaccines. Assays for CMI are of little or no value for any of the vaccines for various technical and biological reasons. Such factors are less of an issue for serological tests where it is much easier to control many of the variables. However, discrepant results are still obtained, depending on the quality assurance program of the given laboratory.

14. When a *Leptospira* vaccine (bacterin) is used, should it be a product with two serovars or one with more than two serovars (e.g. four component product available in the USA)?

When a *Leptospira* vaccine is used in high risk dogs, the commercial vaccine that contains all the serovars that cause disease in the dog in that region, if available, should be used. Always use a product that provides protection against all the important serovars. In the USA, the four serovars responsible for most, if not all, cases of leptospirosis are canicola, icterohaemorrhagiae, pomona and grippityphosa. Therefore, the four component product is recommended. In many other countries there is insufficient knowledge of which serovars are circulating in the canine population. The VGG would encourage collection of such data.

15. Do *Leptospira* vaccines give long term (e.g. years) immunity and are they highly effective, like the core viral vaccines?

No. *Leptospira* vaccines provide short-term immunity (e.g. 3–12 months) and the efficacy is often less than 70%. Also *Leptospira* products often prevent clinical disease but fail to protect against infection and shedding of the bacteria, especially when infection occurs more than 6 months after vaccination. The immunity among the serovars varies and immunity varies among vaccinated dogs. Persistence of antibody after vaccination will often be only a few months and immunological memory for protective immunity is short (e.g. 1 year or less). Thus, revaccination may be required as often as every 6–9 months for dogs at high risk.

16. Do any feline leukemia virus vaccines (e.g. killed adjuvanted, subunit, recombinant) provide protection with only one dose of vaccine?

No. All feline leukemia virus vaccines require a minimum of two doses of vaccine. The two doses should preferably be given 2–4 weeks apart, starting at 8 weeks of age or older. Only after that initial series of two vaccines can you then give a single dose to boost the response. When the interval between the initial two doses exceeds 6 weeks or more, it is recommended that the cat be revaccinated, making certain that two doses be given at an interval of 2–4 weeks.

17. Do cats need to be revaccinated with FeLV vaccines more often than every 3 years after they have received the kitten vaccine and a booster at one year?

No. Revaccination more often than every 3 or more years is not necessary and annual revaccination can increase the development of injection site sarcomas, when adjuvanted vaccines are used.

18. Why don't I have the FIV vaccine in my country?

The availability of vaccines is generally determined by the manufacturer and the local or regional licensing authority on the basis of scientific knowledge pertaining to the local disease situation (and marketing considerations). The current FIV vaccine contains two clades (subtypes) of FIV (A and D) and although cross-protection against other clades is claimed there are geographical differences in the clades of virus circulating in a particular country. There also remain issues with the potential for this vaccine to interfere with serodiagnostic testing for FIV infection. Cats given FIV vaccine should be tested for serum antibody before vaccination and identified with a microchip.

19. Can a microchipped cat vaccinated with FIV vaccine be infected with FIV?

Yes. Vaccine will not prevent infection and latency for all subtypes of FIV, thus FIV vaccinated cats can also be infected and act as a source of virus for susceptible cats.

20. Will the current 'kennel cough' vaccines provide any protection from disease caused by the new canine influenza virus (CIV)?

No. The racing greyhounds that have been found infected and that developed disease had been routinely vaccinated 3 or more times a year with commercial 'kennel cough' vaccines. CIV is antigenically unrelated to any other virus of dogs, but related to Equine Influenza Virus (H3N8). A new CIV vaccine has been conditionally licensed in the USA and is recommended for at-risk dogs.

21. Is there a vaccine available to aid in the prevention of disease caused by canine influenza virus (CIV)?

Yes. There is a new vaccine recently licensed (conditionally) in the USA that is designed to aid in the prevention of influenza in dogs caused by the H3N8 virus. The product is an adjuvanted killed vaccine that, like all killed vaccines, requires two initial doses given 2–4 weeks apart. The efficacy and duration of immunity of this CIV vaccine or others that may be developed in the future will be determined in the next few years as information accumulates in the field.

22. Are there vaccines available for dogs and/or cats that are not designed to prevent infectious diseases caused by viruses, bacteria, fungi/yeasts and/or parasites?

Yes. There are vaccines that are used to prevent conception, and to aid in the prevention of death from snakebites with certain species of snakes, and to aid in the prevention or treatment of periodontal disease and to aid in the treatment of melanomas in dogs. Furthermore, additional canine and feline vaccines are being developed that are not designed to prevent infectious diseases.

23. Can nosodes (holistic preparations) be used to immunize pets?

No. Nosodes cannot be used for the prevention of any disease. They do not immunize because they do not contain antigen.

QUESTIONS RELATED TO VACCINATION PROCEDURE

24. May I mix different types of vaccines in the syringe?

No. One should never mix different vaccine preparations in the syringe unless specified by the data sheet.

25. May I co-inject different vaccines (not part of a single commercial product) into the same animal?

Yes. However, different vaccines should be injected into separate sites that are drained by different lymph nodes.

26. May I use smaller vaccine doses in small breeds to reduce the risk of adverse reactions?

No. The volume (e.g. 1.0 ml) as recommended by the manufacturer generally represents the minimum immunizing dose, therefore the total amount must be given.

27. Should the large dog (Great Dane) be injected with the same volume of vaccine as the small dog (Chihuahua)?

Yes. Unlike pharmaceuticals that are dose-dependent, vaccines are not based on volume per body mass (size), but rather on the minimum immunizing dose.

28. May I vaccinate the anaesthetized patient?

It is best not to do this if possible as the patient may develop a hypersensitivity reaction and vomit, leading to an increased risk of aspiration. Also, anaesthetic agents may be immunomodulatory.

29. May I vaccinate pregnant pets?

No. Vaccination with MLV and killed products during pregnancy should be avoided, if at all possible. There are exceptions, especially in shelters, where vaccination would be advised if the pregnant animal has never been vaccinated and there is an outbreak of disease (e.g. CDV or FPV).

30. Does immunosuppressive glucocorticoid treatment in the cat or dog interfere with core vaccine immunity during the primary or secondary (booster) vaccination programs?

Studies of both species suggest that immunosuppressive glucocorticoid treatment prior to or concurrently with vaccination does not have a significant suppressive affect on antibody production to the vaccines. However, revaccination is recommended several weeks (2 or more) after glucocorticoid therapy has ended, especially when treatment occurred during administration of the initial series of core vaccines.

31. May I vaccinate pets that are on immunosuppressive or cytotoxic therapy (other than glucocorticoids) (e.g. for cancer or autoimmune diseases)?

No. Vaccination especially with MLV products should be avoided as they may cause disease; vaccination with killed products may not be effective or may aggravate the immune-mediated disease.

32. How long after stopping immunosuppressive therapy do I wait before revaccinating a pet?

A minimum of 2 weeks.

33. May I vaccinate every week if an animal is at high risk of disease?

No. Vaccines should not be given more often than every other week, even when different vaccines are being given.

34. When should the last vaccine dose be given in the puppy and kitten vaccine series?

The last dose of vaccine should be given at 14–16 weeks of age or older.

35. May I inject a killed vaccine, followed at a later time with a MLV for the same disease?

No. The killed vaccine may induce an effective antibody response that will neutralize the MLV in the vaccine, thereby preventing immunization. It would be preferable to give the MLV vaccine first and if/when needed, revaccinate with the killed vaccine preparation.

36. May I inject a modified live intranasal *Bordetella* vaccine?

No. The vaccine can cause a severe local reaction and may even kill the pet by causing systemic disease (e.g. liver failure).

37. May I give a killed *Bordetella* vaccine destined for parenteral use intranasally?

No. This will not stimulate a protective response to the *Bordetella*, but may cause a hypersensitivity response; you should give a live vaccine via the intranasal route, as specified by the data sheet.

38. Are precautions necessary when using MLV FHV-1/FCV parenteral vaccines in cats?

Yes. Mucosal (e.g. conjunctival and nasal) contact with the preparation must be avoided, because the vaccine virus can cause disease.

39. May I use different vaccine brands (manufacturers) during the vaccination program?

Yes. It may even be desirable to use vaccines from different manufacturers during the life of an animal, because different products may contain different strains (e.g. of feline calicivirus).

40. Should I use a disinfectant (e.g. alcohol) on the injection site?

No. The disinfectant might inactivate an MLV product and it is not known to provide a benefit.

41. May I split vaccines in combination products?

Yes. For example, *Leptospira* bacterins are often used as the diluent for the viral antigen combination. The 'viral cake' may be resuspended in sterile water or buffered saline, and the *Leptospira* bacterin be given separately at another site or time, or discarded.

42. Will a single vaccine dose provide any benefit to the dog or cat? Will it benefit the canine and feline populations?

Yes. One dose of a MLV canine core vaccine (CDV, CPV-2 CAV-2) or a feline core vaccine (FPV, FCV, FHV-1) should provide long term immunity when given to animals at or after 16 weeks of age. Every puppy and kitten 16 weeks of age or older must receive at least one dose of the MLV core vaccines.

If that were done, herd (population) immunity would be significantly improved. Even in the USA with its good vaccination record, probably <50% of all puppies and <25% of all kittens ever receive a vaccine. We must vaccinate more animals in the population with core vaccines to achieve herd immunity (e.g. 75% or higher) and prevent epidemic outbreaks.

43. When an animal first receives a vaccine that requires two doses to immunize (e.g. killed vaccines like *Leptospira* bacterins or feline leukemia virus), and it does not return for the second dose within ≤6 weeks, is there any immunity?

No. A single dose of a two-dose vaccine does not provide immunity. The first dose is for priming the immune system, the second for immunizing. If a second dose is not given within 6 weeks of the first, the regime should start again, making sure the two doses are given within 2–6 weeks. After those two doses, revaccination with a single dose can be done at yearly or greater intervals to boost the response.

44. For how long can a reconstituted MLV vaccine sit at room temperature without losing activity?

At room temperature, some of the more sensitive vaccines (e.g. CDV, FHV-1) will lose their ability to immunize in 2–3 hours, whereas other components will remain immunogenic for several days (e.g. CPV, FPV). The VGG recommends that MLV vaccines, after being reconstituted, should be used within 1–2 hrs.

45. If an animal has gone beyond the time that is generally considered to be the minimum DOI for the core vaccine (7 to 9 years for CDV, CPV-2, CAV-2; 7 years for FPV, FCV, FHV-1), do I have to start the series of vaccinations again (multiple doses 2–4 weeks apart)?

No. For MLV vaccines, multiple doses are only required at the puppy or kitten age, when an animal has MDA. The VGG is aware that many data sheets do advise re-starting a vaccination series, but does not endorse this practice which is inconsistent with fundamental immune system function and the principles of immunological memory.

46. Should I vaccinate a cat infected with FeLV and/or FIV infection?

A FeLV or FIV positive cat that is clinically well would ideally be housed indoors away from other cats to minimize the risk of exposure to infectious disease. However, if it were deemed necessary to vaccinate with core components (FPV, FCV and FHV-1) this should be with killed (not MLV) vaccines. Such cats should not be vaccinated against FeLV or FIV. A FeLV or FIV positive cat with clinical illness should not be vaccinated. In some countries there is a legal requirement for rabies vaccination that would also include infected cats.

47. Where should I inject vaccine into a cat?

Feline vaccines (particularly adjuvanted products) should not be given into the inter-scapular region. In the USA the practice of giving separate injections of rabies vaccine into the distal right hind limb and FeLV vaccine into the distal left hind limb has been practiced. Alternative sites for subcutaneous injection are over the lateral thoracic or abdominal wall. Of these, the abdominal wall represents the site from which an injection site sarcoma is most readily resected surgically and is the site recommended by the VGG. Whichever site is chosen, the vaccine must be administered subcutaneously and not intramuscularly. Importantly, the anatomical site of feline vaccination should be rotated so that vaccines are not given repeatedly to one location. This may be achieved by recording the site of vaccination for each individual on each occasion and rotating between these, or by adopting a practice policy to use one anatomical location each year.

48. Does severe nutritional deficiency affect the immune response to vaccines?

Yes. It has been shown that certain severe deficiencies of vitamins and trace minerals (e.g. Vitamin E/Se) can interfere with the development of a protective immune response in puppies. Known or suspected nutritional deficiencies should be corrected by appropriate nutritional supplementation and the animals should be revaccinated to ensure there is adequate protective immunity.

49. If a puppy or kitten fails to receive colostrum will they have any passive antibody protection from the dam?

Depending on the antibody titre of the dam they will have little or, most likely, no protection as approximately 95% or more of the passive antibody for the newborn puppy and kitten is obtained from the colostrum which is absorbed via the intestine into systemic circulation for up to 72 hours after birth.

50. Should a puppy or kitten that fails to receive colostrum be vaccinated during the first few weeks of life since they will not have maternally derived antibody to block active immunization?

No. Puppies and kittens less than 4–6 weeks of age should not be vaccinated with the MLV core vaccines. Certain of the modified live vaccine viruses when given to pups/kittens less than 2 weeks of age and without MDA can infect the central nervous system and/or cause disease and possibly death of the animal. This occurs because there is little or no thermoregulatory control of body temperature during the first week or more after birth, thus innate and adaptive immunity is significantly impaired.

51. How can these colostrum-deprived young animals be protected from the core diseases?

Artificial colostrum can be fed if the puppy or kitten is less than 3 days old and has never been fed a protein diet. Artificial colostrum (AC) is 50% milk replacer (e.g. Esbilac™ or other similar product) and 50% immune serum (preferably from the dam or other well vaccinated animal living in the same environment as the dam). If pups or kittens have received protein (e.g. milk replacer) orally or are 3 days of age or older, serum from a well immunized adult animal can be given subcutaneously or intraperitoneally or citrated plasma can be given intravenously. Depending on size of the animal, approximately 3 to 10 ml of serum or plasma should be administered twice daily for up to 3 days.

QUESTIONS RELATED TO ADVERSE REACTIONS TO VACCINES

52. Is there a risk of over-vaccinating a pet (e.g. injecting it too often, or using vaccines that are not required for the specific pet)?

Yes. Vaccines should not be given needlessly, as they may cause adverse reactions. Vaccines are medical products that should be tailored to the needs of the individual animal. Also, when administering bacterins it is advisable to give them at separate times rather than giving them together.

53. Are certain vaccines or combinations of vaccines more likely to cause adverse reactions than others?

Yes. Although the development of an adverse reaction is often dependent on the genetics of the animal (e.g. small breed dogs or families of dogs), certain vaccines have a higher likelihood of producing adverse reactions, especially reactions caused by Type I hypersensitivity. For example, bacterins (killed bacterial vaccines), such as *Leptospira*, *Bordetella*, *Borrelia* and *Chlamydomphila* are more likely to cause these adverse reactions than MLV viral vaccines.

54. Should dogs and cats with a history of adverse reaction or immune-mediated diseases (hives, facial oedema, anaphylaxis, injection site sarcoma, autoimmune disease etc.) be vaccinated?

If the vaccine suggested to cause the adverse reaction is a core vaccine, a serological test can be performed and if the animal is found to be seropositive (antibody to CDV, CPV-2, FPV) revaccination is not necessary. If the vaccine is an optional non-core vaccine (e.g. *Leptospira* or *Bordetella* bacterin) revaccination is discouraged. For rabies, the local authorities must be consulted to determine whether the rabies vaccine is to be administered by law or whether antibody titre may be determined as an alternative.

If vaccination is absolutely necessary then switching product (manufacturer) may be helpful. Hypersensitivity reactions are known to be related to excipients contained within the vaccine (e.g. traces of bovine serum albumin used in the virus culture process). The use of antihistamines pre-revaccination is acceptable and does not interfere with the vaccinal immune response. Revaccinated susceptible animals should be closely monitored for up to 24 hours post-vaccination although such reactions (Type 1 hypersensitivity) generally occur within minutes of exposure. Other types of hypersensitivity (II, III, IV) can occur much later (e.g. hours to months).

55. Can vaccines cause autoimmune diseases?

Vaccines themselves do not cause autoimmune disease, but in genetically predisposed animals they may trigger autoimmune responses followed by disease – as can any infection, drug, or a variety of other environmental factors.

56. How common are adverse reactions to vaccines?

There is no definitive answer to this question as it is difficult to obtain accurate data. Determining the frequency of adverse reactions relies upon the veterinarian or owner reporting such reactions to the manufacturer or national authority (where such routes exist). It is currently accepted that the vaccines that we use are very safe with a very low incidence of possible side effects. The benefits of protection from serious infectious disease far outweigh the risks of developing an adverse reaction. Recent analysis of a major US hospital group database has allowed publication of data based on very large numbers of vaccinated dogs and cats. Adverse reactions (of any kind, including very minor reactions) were documented within the first 3 days following vaccination in 38 of 10,000 vaccinated dogs. Adverse reactions (of any kind, including very minor reactions) were documented within the first 30 days

following vaccination in 52 of 10,000 vaccinated cats. However, many other animals had reactions that were not reported to the practice, but were reported to other practices or emergency practices where the animal was seen. Some breeds and families of pets will have a much higher evidence of adverse reactions than the general population of animals.

57. Are there dogs and cats that cannot develop an immune response to vaccines?

Yes. This is a genetic characteristic seen particularly in some breeds, and these animals are called 'non-responders'. Genetically related (same family or same breed) animals will often share this non-responsiveness. If the animal is a non-responder to a highly pathogenic agent, like canine parvovirus or feline panleukopenia virus, the infected animal may die if infected. If it is a non-responder to a pathogen that rarely causes death, it may become sick but will survive (e.g. after a *Bordetella bronchiseptica* infection).

58. Do puppies develop immunosuppression after the initial series of core vaccines?

Yes. If a combination product containing MLV-CDV and MLV-CAV-2 with other components is used, a period of immunosuppression lasting approximately 1 week develops, beginning 3 days after vaccination. If the combination vaccine does not contain either MLV-CDV or MLV-CAV-2, then such suppression does not occur.

59. What can be done to avoid the immunosuppression in puppies, as all should receive the core vaccines (CDV, CPV-2, CAV-2)?

The puppies could receive a bivalent vaccine containing CDV and CPV-2 parenterally and the CAV-2 could be given later or given intranasally as part of a vaccine for kennel cough that also contains *B. bronchiseptica* and canine parainfluenza. You could also use a combination vaccine containing canary pox vectored CDV and MLV CPV-2 and CAV-2 vaccines, as this combination does not cause immunosuppression.

60. Is the immune response to *Leptospira* responsible for causing a hypersensitivity response in certain dogs also short lived (e.g. <1 year), like immunity from infection?

No. Unlike immunity and IgG memory, which are relatively short lived (≤ 1 year), memory for immediate hypersensitivity, as determined by skin testing, is long lived (≥ 4 years).

IMAGE BANK FOR MAJOR CANINE AND FELINE INFECTIOUS DISEASES

An electronic image bank accompanied by key bullet points related to each of the major canine and feline vaccine-preventable infectious diseases will be made available through the WSAVA website.

The abbreviated pictorial data sheets are designed for veterinarians to download and use in the consultation room when discussing vaccination with clients.