Small animal vaccination: a practical guide for vets in the UK

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Vaccination is an important and fundamental part of veterinary practice and in recent years there have been significant changes in recommendations for how vaccines are given. This article reviews the reasons that these changes have occurred and the scope and purpose of vaccination guidelines. The most recent guidelines were issued by the World Small Animal Veterinary Association (WSAVA) Vaccination Guidelines Group in 2015. The article discusses how veterinarians in the UK might adapt these global guidelines for national use and provides examples of how dogs and cats can best be vaccinated according to WSAVA recommendations. Vaccination should be just one part of a holistic preventive healthcare programme for pets that is most simply delivered within the framework of an annual health check consultation.

What has changed in small animal vaccination and why?

Over the past 20 years, there has been significant change in the way that vaccination is performed in veterinary practice. During that time, there has been a global shift away from the concept that pets make a yearly visit to the veterinarian for an annual vaccine booster that contains as many antigenic components as possible, and that the same vaccination protocol is applied to every dog and cat that visits the practice. Vaccination is an act of veterinary science that should be considered as individualised medicine, tailored for the needs of the individual pet, and delivered as one part of a preventive medicine programme in an annual health check visit. This article describes the latest global recommendations for this new approach to vaccination and how they might best be adapted for use in veterinary practices in the UK.

These changes in vaccination practice have had a number of drivers. The first of these was professional concern by veterinarians over the recognition of new adverse events occurring after vaccination; in particular, the feline injection site sarcoma (FISS) (Hartmann and others 2015) and the possibility that vaccination may be one trigger for canine immune-mediated diseases (Day 2006). The second was concern from the pet-owning public, fuelled at the time by the widely aired media debate about the safety of childhood vaccinations including the combined measles, mumps and rubella vaccine and later the human papillomavirus vaccine (Poland and Spier 2010). These public worries were driven by articles and discussions on the internet and vocal lobby groups and led to the occurrence of significant vaccination hesitancy or 'vaccinophobia' that continues to be of concern in both human and veterinary medicine (Kata 2010, Guidry and others 2015, Lee and others 2016). Against this background of discussion about vaccination safety, the third (and most important) driver for change has been evidence-based veterinary medicine and the growing belief that delivery of fundamental practices such as vaccination should be based in the latest scientific thinking rather than historical anecdote.

The response of the veterinary profession to these drivers was the establishment of expert panels who reviewed current practice and the scientific evidence base, and provided advice to the profession on safer and more scientifically justified delivery of vaccination. A number of such groups have now produced vaccination guidelines, which are broadly similar in content and advice. These include the American Academy of Feline Practitioners, which first produced feline vaccination guidelines in 1998 (most recently updated in 2013) (Scherk and others 2013); the American Animal Hospital Association, which published canine vaccination guidelines in 2003 (most recently updated in 2011) (Welborn and others 2011); and the Advisory Board on Cat Diseases, which first published feline guidelines in 2006 (most recently updated in 2015) (Hosie and others 2015). The most extensive guidelines come from the World Small Animal Veterinary Association (WSAVA) Vaccination Guidelines Group (VGG) who provide global advice on canine and feline vaccination to the 175,000 veterinarians in 86 WSAVA member countries. These guidelines were first produced in 2007, revised in 2010, and were most recently updated in 2015 (Day and others 2016) and are the basis for recommendations made in this article. The WSAVA guidelines for veterinarians are accompanied by a separate document providing information on infectious disease and vaccination to pet owners and breeders. Both documents are available from the WSAVA website (www.wsava.org/educational/vaccination-guidelines-group). National associations, including the British Small Animal Veterinary Association, endorse the principles in the WSAVA guidelines (www.bsava.com/Resources/VeterinaryResources/Positionstatements/Vaccination).

What are the key concepts in vaccination guidelines?

There is often a misunderstanding about the role and purpose of vaccination guidelines. Guidelines are not instructions to the profession or legally binding. Instead, guidelines are a set of recommendations, based on expert interpretation of current scientific information,

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Table 1: WSAVA global classification of canine vaccines

Core	Non-core	Not recommended
Canine distemper virus	Canine parainfluenza virus	Canine enteric coronavirus
Canine adenovirus	*Bordetella bronchiseptica*	
Canine parvovirus type 2	*Leptospira*	
Rabies virus (in countries endemic for the disease)	*Borrelia*	

Note: Some vaccines available in the UK are not discussed by the WSAVA because they are not available in all countries (eg, vaccines against canine herpesvirus and *Leishmania*)

Table 2: WSAVA global classification of feline vaccines

Core	Non-core	Not recommended
Feline parvovirus	Feline leukaemia virus	Feline infectious peritonitis
Feline herpesvirus type 1	*Chlamydia felis*	
Feline calicivirus	*Bordetella*	
Rabies virus (in countries endemic for the disease)	Feline immunodeficiency virus	

Note: Feline immunodeficiency virus and feline infectious peritonitis vaccines are not available in the UK

that are designed to be read, discussed and adapted by veterinarians for use in their own practices. In particular, the WSAVA guidelines were never intended to be globally applicable to veterinary practice in all 86 developed and developing member countries, in which there are vastly different infectious disease prevalences, socioeconomic levels and standards of veterinary practice. WSAVA guidelines are meant to provide an information source that can be adapted for local needs nationally, or in particular geographical regions or individual practices. The latest iteration of the WSAVA guidelines are evidence based, using a purposely designed novel classification of the strength of evidence related to the field of vaccinology.

Vaccination guidelines promote several key concepts relating to delivery of vaccination in the 21st century. These include:

- That vaccines may be categorised generically as core (essential for every dog or cat), non-core (may be used in those dogs or cats whose geographical location or individual lifestyle places them at risk of exposure to infection) or not recommended (because there is insufficient scientific evidence to justify the use of these vaccines).
- That core vaccines should be administered to all dogs and cats, but need not be given to adult animals as frequently as was the case in the past, and that serology may be used to inform decision making about the frequency of use of some (but not all) core vaccines.
- That the selection of non-core vaccines must be based on regional or local knowledge of infectious disease prevalence and lifestyle factors of the individual pet (eg, indoor or outdoor living, rural or urban environment, working or companion activity, travel or boarding).
- That vaccination should be delivered as just one part of a holistic preventive healthcare programme for the individual pet, best implemented by use of an annual health check veterinary visit.
- That vaccination is not just about protection of the individual animal, but protection of the population through establishing adequate herd immunity.

The global core, non-core and not recommended vaccines are defined in Tables 1 and 2. Examples of the clinicopathological consequences of the infectious diseases for which protection is conferred by core vaccines are given in Figs 1 to 7.

An excellent example of the need for national or local adaptation of the guidelines relates to the use of *Leptospira* vaccines in the dog. UK veterinarians are often confused by why the WSAVA guidelines do not list this as a core vaccine. The simple reason is that canine leptospirosis does not exist in some parts of the world and the vaccine is therefore never used in those regions and so cannot be listed as core. Additionally, the lifestyle of some dogs within a country endemic for leptospirosis might not place them at risk of exposure and therefore might not necessitate use of this vaccine in those individuals. There is little doubt that leptospirosis occurs in the UK dog population, but although we now have more readily available and improved diagnostics, there are few robust large-scale datasets that show us how significant the problem is, what the spectrum of clinical presentation is, where the geographical hotspots lie and which serogroups and serovars of the organism are circulating and causing disease in UK dogs. However, we do have growing evidence that a more diverse range of serogroups are identified in clinical cases and some of these serogroups are included in the newer tetravalent vaccines. WSAVA guidelines suggest that, in those circumstances, it would be scientifically justified to use the vaccines that provide the broadest possible immunity. UK media interest in these vaccines, which often present an inaccurate interpretation of data and misquoting the WSAVA guidelines, is a perfect example of 'vaccinophobia' that the profession must continue to counteract by emphasising the benefit to individual and population health of pet vaccination. The lack of robust data on diseases such as leptospirosis could be readily addressed in the future by the use of veterinary bioinformatics systems and production of surveillance reports such as those now coming from the SAVSNET project (Sanchez-Vizcaino and others 2016). In the meantime, most UK veterinarians will use a *Leptospira* vaccine in the majority of dogs, as is recommended by the BSAVA (www.bsava.com/Resources/Veterinary-resources/Position-statements/Vaccination).

In response to vaccination guidelines, the manufacturing industry has also made welcome and progressive changes in the licensing of products and advice given within the legal summary of product characteristics (SPC) documents. The major advance has been in the licensing of core vaccines with a three-year duration of immunity (DOI) enabling these products to be used completely in accordance with vaccination guidelines. However, there remain minor points of difference between manufacturer's SPC recommendations and vaccination guidelines. These are not necessarily because manufacturers disagree with guidelines advice, more simply that they have not generated data to support use of their product in that particular fashion and put that data to the licensing authorities. Veterinarians should be aware that manufacturers can only advise the use of their products in accordance with the SPC, but that any veterinarian can use any vaccine according to guidelines recommendations with the informed consent of the client (ie, off-label use). Advice on the off-label use of vaccines is provided by the UK Veterinary Medicines Directorate

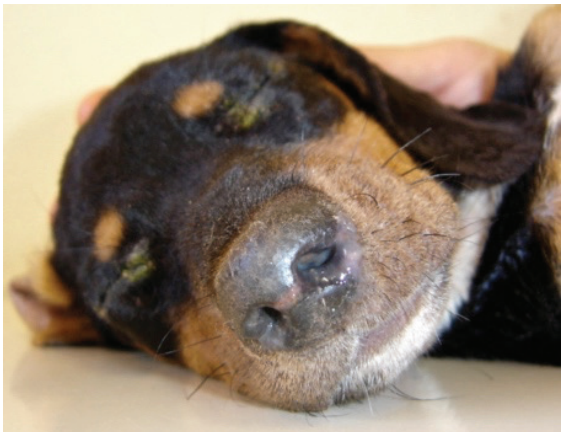


Fig 1: Puppy with canine distemper virus infection showing bilateral ocular discharge and nasal hyperkeratosis. Photograph: M. Marcondes, Sao Paulo State University, Brazil

(www.gov.uk/government/publications/vaccination-of-dogs), but readers should be aware that the information in this 2014 document has not yet been updated to take into account changes made in the 2015 WSAVA vaccination guidelines.

How would I vaccinate a puppy according to WSAVA guidelines?

The greatest changes in recommendations in the 2015 WSAVA guidelines (from the previous 2010 version) come in the advice given for core vaccination of puppies and kittens. There are now studies that show that up to 10 per cent of puppies may fail to respond to elements of primary core vaccination (ie, canine distemper virus [CDV], canine adenovirus [CAV] or canine parvovirus type 2 [CPV2]) when the last of these primary vaccines is given at 12 weeks of age (Friedrich and Truyen 2000, Thibault and others 2015). These puppies have persistent blocking maternally derived antibody (MDA). The new recommendations for primary puppy core vaccination for puppies bred in a developed country with good breeding standards (eg, the UK) are:

- A first vaccine at eight to nine weeks of age;
- A second vaccine three to four weeks later;
- A third vaccine at 16 weeks of age or older.

Table 3: Example puppy vaccination protocol

Weeks of age	Core vaccines	Non-core vaccines	Travelling pet
3 to 4		CPi/Bb intranasal	
8	DHP	*Leptospira*	
12	DHP	*Leptospira*	Rabies
16 or older	DHP		
26	DHP		
52	DHP if not given at 26 weeks	*Leptospira* CPi/Bb intranasal	Rabies

CPi/Bb Canine parainfluenza virus and *Bordetella bronchiseptica* (note this relates to a particular combination give intranasally; there are other options for delivery of these components, either with CPi alone or incorporated with core vaccines by injection and following the core vaccine schedule, or Bb given intranasally alone by the schedule given in the table).
DHP Canine distemper virus, canine adenovirus and canine parvovirus type 2

The protocol does not consider possible use of *Borrelia* vaccine for puppies predicted to be at particular risk of *Ixodes* tick exposure or *Leishmania* vaccine for travelling puppies

The vaccine given at 52 weeks of age can also be given 52 weeks after completion of the initial series of vaccines

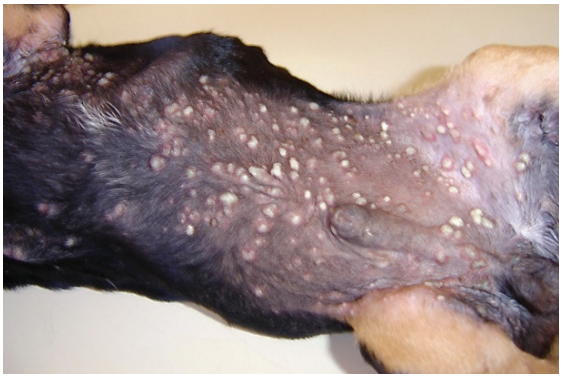


Fig 2: Puppy with canine distemper virus infection showing pustular dermatitis. Photograph: M. Marcondes, Sao Paulo State University, Brazil

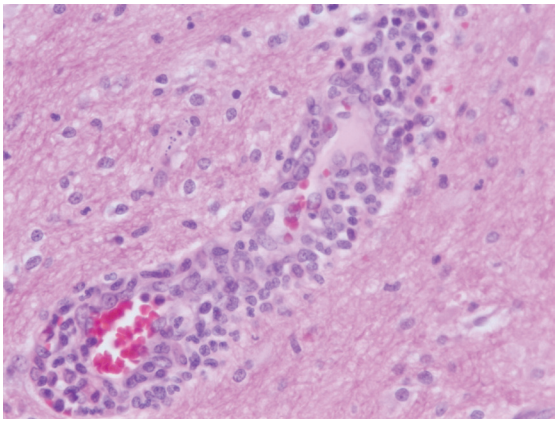


Fig 3: Perivascular cuffing with mononuclear inflammatory cells in the white matter of the brain of a dog with canine distemper virus infection. Haematoxylin and eosin, x 400

The intention of these recommendations are simply to ensure that as many puppies as possible are vaccinated at a time when they are capable of making a primary immune response.

The VGG has also reconsidered the timing of the core vaccine generally given at 12 months of age or sometimes at 12 months after completion of the primary series of vaccines. For simplicity, this core vaccine will be described hereafter as being given at 12 months of age, while covering both possible intervals. There is a misconception that the purpose of this vaccine is to 'boost' the immune response generated by one of the three primary vaccinations. In fact, the main purpose of this vaccine is simply to 'catch' those puppies that failed to respond to any of the primary series and establish immunity to core vaccine antigens. For that reason, the VGG does not believe that it is justified to delay that vaccine, leaving some puppies unprotected for the first vulnerable year of life. The new recommendation is that this vaccine be brought forward to six months of age and simply be considered the last in a primary puppy series of four core vaccines. This could be readily incorporated into practice if this vaccination was delivered at the time of neutering or suture removal after neutering. A puppy receiving a six-month core vaccine does not then require another at 12 months of age, and would go straight into an adult schedule. An alternative to this fourth primary vaccine would be to serologically test the puppy at six months of age. A seropositive pup will have made an endogenous immune response, is protected and may go straight to an adult schedule.

Fig 4: Haemorrhagic diarrhoea in a dog with canine parvovirus type 2 infection. Photograph: M. Marcondes, Sao Paulo State University, Brazil

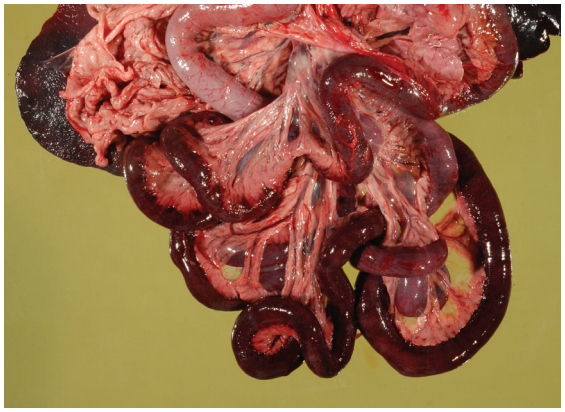


Fig 5: Haemorrhagic enteritis in a dog that had died from canine parvovirus type 2 infection

As the SPC for most core vaccines currently does not include recommendations for vaccination at 16 weeks of age or older, or necessarily specify 12-month vaccination, these new protocols would technically be considered off-label use of vaccines in the UK.

It is worth briefly considering the discussion around socialisation of puppies. There is no question that puppies must be adequately socialised, but there is also clear recognition that the window for socialisation overlaps with the window of susceptibility of puppies to the diseases for which core vaccines provide protection. The window of susceptibility is the short period of time for which individual puppies no longer have enough MDA to fully protect them from infection, but still have enough MDA to block the ability of modified live core vaccines to induce an endogenous immune response in the puppy. The WSAVA supports puppy socialisation and recommends that where puppies are exposed to other dogs (ie, puppy parties) that all of those dogs (puppies and adults) are vaccinated and that the event occurs in an environment that is least likely to be contaminated with virus (particularly CPV2). A recent study in the USA documents the low risk from puppy socialisation classes (Stepita and others 2013). In the context of puppy socialisation, the WSAVA does not support the use of 'early finish' core vaccination schedules and advises that all puppies should receive a final core vaccine at 16 weeks of age or older.

If the anticipated lifestyle of that individual puppy indicates a risk of exposure to *Leptospira*, the puppy should be vaccinated against the disease. Here, the 2015 WSAVA guidelines have also changed on the basis of review of new scientific evidence. There is insufficient evidence that delaying administration of bacterial vaccines until after giving the core series provides any safety advantage (Schuller and others 2015, Yao and others 2015). *Leptospira* vaccines may be given from eight weeks of age (two doses given two to four weeks apart; note that some UK products are authorised for use from six weeks of age) with a booster at 12 months (note the six-month vaccination applies only to core viral vaccines).

If the anticipated lifestyle of that puppy involves kennelling or being in other at-risk situations, it may be sensible to provide immunity to some components of the canine infectious respiratory disease complex (CIRDC) ('kennel cough'), which includes at least nine distinct pathogens and elements of husbandry, stress and environment. Canine parainfluenza virus and/or *Bordetella bronchiseptica* antigen may be incorporated into the vaccination schedule according to manufacturer's recommendations for specific products. An example of how an intranasal *B bronchiseptica* and canine parainfluenza virus vaccine might be included into a puppy schedule is given in Table 3.

If the puppy is to travel under the Pet Travel Scheme, the guideline recommendations for rabies vaccination are in accordance with those of the manufacturers and the legislation, with a single dose of vaccine given at over 12 weeks of age. The VGG does still recommend a 12-month booster rabies vaccine, which is not part of the SPC for all rabies vaccines.

An example of how a puppy might be vaccinated according to WSAVA guidelines is given in Table 3. Note that this is purely one example of numerous possible permutations and depends on the product range used in the practice.

Table 4: Example adult dog vaccination schedule

Years of age	Core vaccines	Non-core vaccines	Travelling dog
1	DHP unless this was given at 26 weeks in the puppy schedule	*Leptospira*, CPi, Bb	Rabies
2		*Leptospira*, CPi, Bb	
3		*Leptospira*, CPi, Bb	
4	DHP or serology	*Leptospira*, CPi, Bb	Rabies
5		*Leptospira*, CPi, Bb	
6		*Leptospira*, CPi, Bb	
7	DHP or serology	*Leptospira*, CPi, Bb	Rabies
8		*Leptospira*, CPi, Bb	
9		*Leptospira*, CPi, Bb	
10	DHP or serology	*Leptospira*, CPi, Bb	Rabies

Bb *Bordetella bronchiseptica* (injectable or intranasal options are available), CPi Canine parainfluenza virus (injectable or intranasal options are available), DHP Canine distemper virus, canine adenovirus, canine parvovirus type 2

The protocol does not consider possible use of *Borrelia* vaccine for dogs predicted to be at particular risk of *Ixodes* tick exposure, *Leishmania* vaccine for travelling dogs or canine herpesvirus vaccine for use in breeding bitches

How would I vaccinate an adult dog according to WSAVA guidelines?

Core vaccines must be provided to all adult dogs, but need be given no more frequently than every three years,

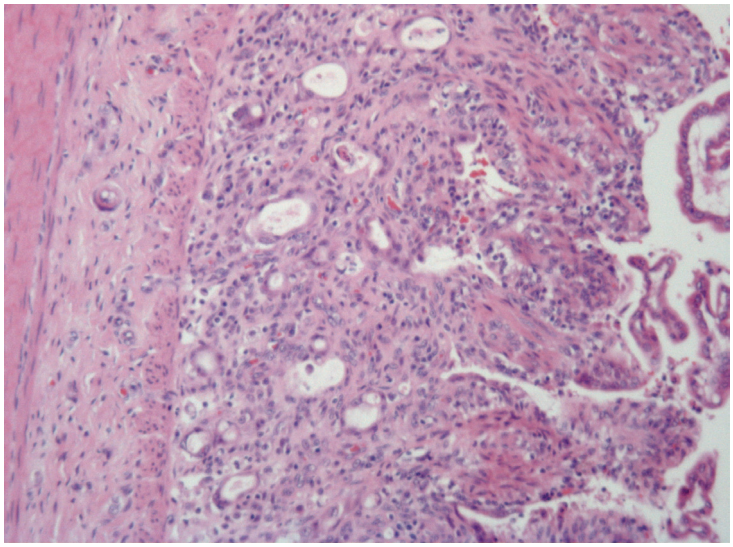


Fig 6: Section of small intestine from an unvaccinated kitten that died from feline parvovirus infection. There is disruption and stunting of villous structures with loss and dilation of crypts accompanied by inflammatory infiltration of the lamina propria. Haematoxylin and eosin, x 200

although serological and challenge studies indicate that the protection conferred by these products is likely much longer (Mitchell and others 2012, Schultz and others 2010). Triennial core revaccination is completely in accordance with the currently available product ranges for most canine core vaccines.

An increasing range of in-practice rapid serological test kits can now determine whether an individual dog is seropositive to, and therefore likely to be protected from, CDV, CAV and CPV2 infection. Such tests are based on the knowledge that there is an absolute correlation between seropositivity for these core viral antigens and protection from infection and disease. These test kits have the advantage of providing rapid results and indicating protection – either as a yes/no answer or by providing a semiquantitative result related to titres obtained in 'gold standard' laboratory virus neutralisation or haemagglutination inhibition tests. In selecting such a test kit to use in your practice, it is worth reviewing the published literature documenting independent testing and reported sensitivity and specificity of the test kit. In accordance with WSAVA guidelines, a number of practices are now offering their clients triennial serological testing (sometimes referred to as titre testing although in-practice kits do not generate a specific titre) in lieu of automatic core revaccination. A positive test indicates protection and no need for core revaccination. A negative test (which will generally be for one vaccine component only) should prompt revaccination; however, a small proportion of dogs may be genetic low responders or non-responders to individual core vaccine components and are never able to seroconvert to those components. It is still the situation that some black and tan dogs, particularly of the rottweiler breed, fall into this category. Current recommendations are for triennial serological testing of adult dogs and then annual testing for geriatric dogs (ie, those over 10 years of age). It should always be remembered that such testing applies only to the core vaccines. There is no correlation between seropositivity and protection for non-core vaccines. For example, *Leptospira* vaccination induces a relatively transient serum antibody response that is unlikely to persist for the full 12-month duration of protection conferred by the vaccine.

An adult dog whose geography or lifestyle places it at risk of CIRDC or leptospirosis, and who may benefit from non-core vaccination, must still receive those vaccines annually as part of their annual health check visit. A regularly travelling dog must be revaccinated against rabies every three years in accordance with manufacturer's recommendations and legal requirements.

An example of how an adult dog might be vaccinated according to WSAVA guidelines is given in Table 4. Note that this is purely one example of numerous possible permutations and depends on the product range used in the practice.

How would I vaccinate a kitten according to WSAVA guidelines?

Recommendations for core vaccination of kittens with feline parvovirus (FPV), feline calicivirus (FCV) and feline herpesvirus type 1 (FHV1) are identical to those for the puppy core vaccination discussed above. The VGG has reviewed the increasing literature that shows that individual kittens may have persisting blocking MDA (against FPV) until up to 20 weeks of age, which underpins the recommendation that the third vaccine in the kitten primary series should be given at 16 weeks or older (DiGangi and others 2011, Jakel and others 2012). Therefore, the recommendation for kittens bred to a good standard in the UK would be:

- A first vaccine at eight to nine weeks of age;
- A second vaccine three to four weeks later;
- A third vaccine at 16 weeks of age or older.

Exactly the same principles apply to the timing of the fourth kitten core vaccine, with the current recommendation that this be brought forward to 26 weeks of age from 52 weeks of age or 52 weeks after the anniversary of the last core vaccine in the primary series. As for puppies, hereafter this will be referred to as the 12-month or 52-week vaccine. As the SPCs for most core vaccines currently do not include recommendations for vaccination at 16 weeks of age or older, and do not necessarily specify 12-month vaccination, these new protocols would be considered off-label in the UK.

Non-core vaccines for kittens should be selected on the basis of the predicted lifestyle and exposure risk of

Table 5: Example kitten vaccination protocol

Weeks of age	Core vaccines	Non-core vaccines	Travelling pet
4		Bb intranasal	
8	RCP	FeLV *Chlamydia felis*	
12	RCP	FeLV *Chlamydia felis*	Rabies
16 or older	RCP		
26	RCP		
52	RCP if not given at 26 weeks	Bb intranasal FeLV *Chlamydia felis*	Rabies

Bb *Bordetella bronchiseptica*, FeLV Feline leukaemia virus, RCP Feline herpesvirus type 1 (rhinotracheitis), feline calicivirus and feline parvovirus

Note that *Chlamydia felis* antigens are always incorporated into combination vaccines in the UK

The vaccine given at 52 weeks of age can also be given 52 weeks after completion of the initial series of vaccines

Table 6: Example adult low-risk cat vaccination schedule

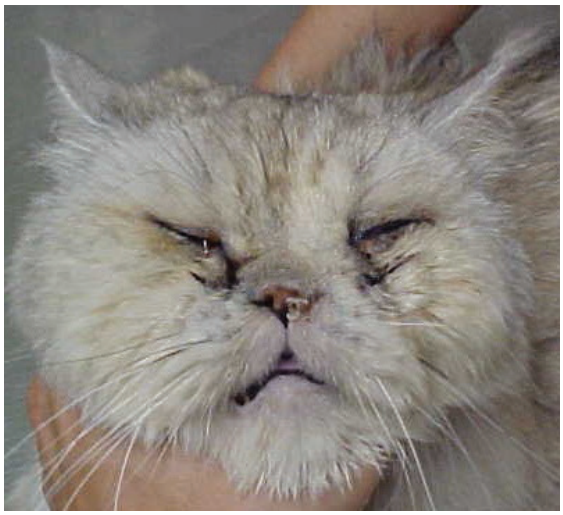
Years of age	Core vaccines	Non-core vaccines
1	RCP unless this was given at 26 weeks in the kitten schedule	Not recommended for low-risk cats
2		
3		
4	RCP or FPV serology and RC vaccine	
5		
6		
7	RCP or FPV serology and RC vaccine	
8		
9		
10	RCP or FPV serology and RC vaccine	

RC Feline herpesvirus type 1 (rhinotracheitis) and feline calicivirus, RCP Feline herpesvirus type 1 (rhinotracheitis), feline calicivirus and feline parvovirus, FPV Feline parvovirus

Table 7: Example adult high-risk cat vaccination schedule

Years of age	Core vaccines	Non-core vaccines	Travelling cat
1	RCP unless this was given at 26 weeks in the kitten schedule	FeLV *Chlamydia felis* Bb	Rabies
2	RC	*Chlamydia felis* Bb	
3	RC	*Chlamydia felis* Bb	
4	RCP or FPV serology and RC vaccine	FeLV *Chlamydia felis* Bb	Rabies
5	RC	*Chlamydia felis* Bb	
6	RC	*Chlamydia felis* Bb	
7	RCP or FPV serology and RC vaccine	FeLV *Chlamydia felis* Bb	Rabies
8	RC	*Chlamydia felis* Bb	
9	RC	*Chlamydia felis* Bb	
10	RCP or FPV serology and RC vaccine	FeLV *Chlamydia felis* Bb	Rabies

Bb *Bordetella bronchiseptica*, FeLV Feline leukaemia virus, FPV Feline parvovirus, RC Feline herpesvirus type 1 (rhinotracheitis) and feline calicivirus, RCP Feline herpesvirus type 1 (rhinotracheitis), feline calicivirus and feline parvovirus



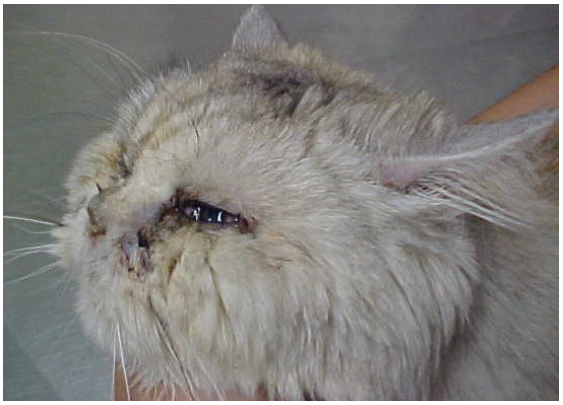


Fig 7: Ocular and nasal discharge in a cat with conjunctival and upper respiratory tract infection attributed to feline calicivirus and feline herpesvirus type 1. Photograph: M. Marcondes, Sao Paulo State University, Brazil

that kitten as an adult cat (see section below). The most commonly considered feline non-core vaccines in the UK are those that protect against feline leukaemia virus (FeLV), *C felis* and *B bronchiseptica*. Although the prevalence of FeLV is now less than in previous years, the risk for an individual kitten should be assessed. If it will go outside and could have close contact with other cats, or perhaps fight with any cats, then vaccination should be considered. It is generally accepted that vaccination of kittens is more important than vaccination of adult cats against FeLV as there is a natural age-associated acquisition of immunity in adults (Willett and Hosie 2012, Wilson and others 2012). FeLV vaccination for kittens requires two doses of vaccine given three to four weeks apart with a 52-week booster vaccine. *Chlamydia felis* vaccines are also given to kittens as two doses two to four weeks apart with a 52-week booster and intranasal *B bronchiseptica* vaccine may be administered as a single dose as early as four weeks of age with a 52-week booster. The use of rabies vaccine for travelling kittens is as described above as for puppies.

An example of how a kitten might be vaccinated according to WSAVA guidelines is given in Table 5. Note that this is purely one example of numerous possible permutations and depends on the product range used in the practice.

How would I vaccinate an adult cat according to WSAVA guidelines?

Core and non-core revaccination of adult cats is now determined by an assessment of the risk of exposure to infection of that animal, taking into account the geographical location and lifestyle factors. Adult cats are considered to be either 'low risk' or 'high risk' and it can sometimes be challenging to decide which group an individual cat falls into. For example, a low-risk cat would be a solitary, indoor-only cat that never visited a boarding cattery. In contrast, a high-risk cat would be an indoor-outdoor cat, a cat that lived in a multicat household or breeding cattery, or a cat that regularly visited a boarding cattery. Core revaccination of adult cats in accordance

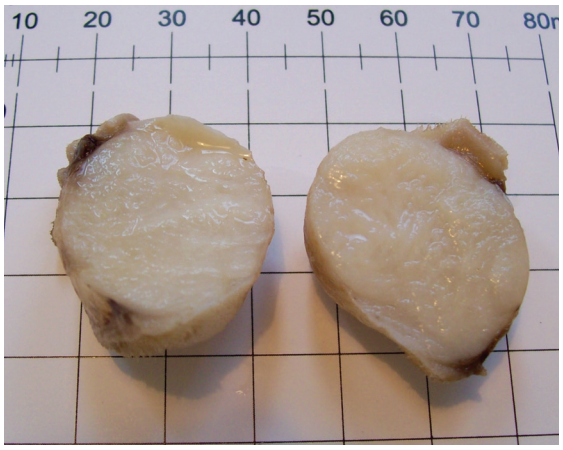


Fig 8: Two halves of a round nodular mass excised from the interscapular region of an adult cat. Histopathological examination confirmed that the lesion was a feline injection site sarcoma

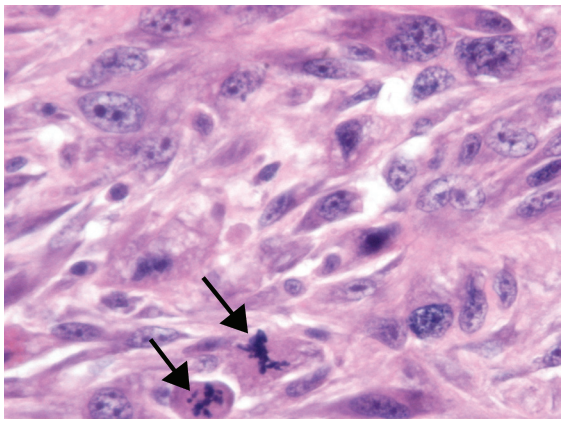


Fig 9: Section from a feline injection site sarcoma. There is a population of markedly pleomorphic spindle cells showing anisokaryosis, variation in the number of nucleoli and bizarre mitotic activity. Arrows show two mitoses. Haematoxylin and eosin, x 400

with WSAVA guidelines necessitates having access to a product range that provides the option of having all three core components together, or separate FPV and FCV/FHV1 vaccines. Current UK feline core vaccines generally offer a licensed three-year DOI for FPV with a one-year licensed DOI for FCV and FHV-1, with the exception of one product that carries a three-year license for all three components.

A low-risk adult cat requires core vaccines no more frequently than every three years given as part of the annual health check visit. A low-risk cat should not require non-core vaccines. A high-risk cat does not require a FPV vaccine any more frequently than every three years, but may benefit from annual boosting for FCV and FHV1. A cat at high risk of contracting *C felis* or *B bronchiseptica* infection will require annual revaccination with these non-core vaccines. Although current UK FeLV vaccines offer a licensed one-year DOI, WSAVA guidelines recommend that at-risk adult cats only require revaccination every second or third year.

Because there is a very strong correlation between FPV seropositivity and protective immunity, the WSAVA guidelines also suggest the option of FPV serological testing in lieu of triennial revaccination of adult cats. The same provisos apply as discussed above for the dog, and for geriatric cats (ie, more than 15 years of age) the recommendation is for annual testing. Note that there is no correlation between seropositivity for FCV and FHV1 and protection and the VGG does not recommend the use of these tests for determining vaccine requirements.

Examples of how low- and high-risk adult cats might be vaccinated according to WSAVA guidelines is given in Tables 6 and 7. Note that these are purely examples of numerous possible permutations and depends on the product range used in the practice.

The WSAVA guidelines provide an evidence-based discussion about alternative anatomical sites for the repeated administration of injectables (including vaccines) in order to minimise the risk of developing FISS (Figs 8, 9) or injection site lymphoma (Roccabianca and others 2016). The guidelines do not recommend one particular approach over another, but describe the options that include flank, limb or tail vaccination, or the simple option of rotating and recording injection sites in the medical record of the individual cat.

For further information on vaccination, including the full guidelines document, useful infectious disease summary sheets and a series of answers to 110 frequently asked questions, visit the WSAVA website (www.wsava.org/educational/vaccination-guidelines-group).

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References

DAY, M. J. (2006) Vaccine side effects: fact and fiction. *Veterinary Microbiology* **117,** 51-58

DAY, M. J., HORZINEK, M. C., SCHULTZ, R. D. & SQUIRES, R. (2016) Guidelines for the vaccination of dogs and cats. *Journal of Small Animal Practice* **57,** E1-E45

DIGANGI, B. A., LEVY, J. K., GRIFFIN, B., REESE, M. J., DINGMAN, P. A., TUCKER, S. J. & DUBOVI, E. J. (2011) Effects of maternally-derived antibodies on serologic responses to vaccination in kittens. *Journal of Feline Medicine and Surgery* **14,** 118-123

FRIEDRICH, K. & TRUYEN, U. (2000) Untersuchung der wirksamkeit von parvovirusimpfstoffen und der effektivaitat zweier impfschemata. *Praktischer Tierarzt* **81,** 988-994

GUIDRY, J. P. D., CARLYLE, K., MESSNER, M. & JIN, Y. (2015) On pins and needles: how vaccines are portrayed on Pinterest. *Vaccine* **33,** 5051-5056

HARTMANN, K., DAY, M. J., THIRY, E., LLORET, A., FRYMUS, T., ADDIE, D. & OTHERS (2015) Feline injection site sarcoma: ABCD guidelines on prevention and management. *Journal of Feline Medicine and Surgery* **17,** 606-613

HOSIE, M. J., ADDIE, D. D., BOUCRAUT-BARALON, C., EGBERINK, H., FRYMUS, T., GRUFFYDD-JONES, T. J. & OTHERS (2015) 2015 ABCD recommendations for indoor/outdoor cats, rescue shelter cats and breeding catteries. *Journal of Feline Medicine and Surgery* **17,** 583-587

JAKEL, V., CUSSLER, K., HANSCHMANN, K. M., TRUYEN, U., KONIG, M., KAMPHUIS, E. & DUCHOW, K. (2012) Vaccination

against feline panleukopenia: implications from a field study in kittens. *BMC Veterinary Research* **8,** 62
KATA, A. (2010) A postmodern Pandora's box: anti-vaccination misinformation on the internet. *Vaccine* **28,** 1709-1716
LEE, C., WHETTEN, K., OMER, S., PAN, W. & SALMON, D. (2016) Hurdles to herd immunity: distrust of government and vaccine refusal in the US, 2002-2003. *Vaccine* **34,** 3972-3978
MITCHELL, S. A., ZWIJNENBERG, R. J., HUANG, J., HODGE, A. & DAY, M. J. (2012) Duration of serological response to canine parvovirus-type 2, canine distemper virus, canine adenovirus type 1 and canine parainfluenza virus in client-owned dogs in Australia. *Australian Veterinary Journal* **90,** 468-473
POLAND, G. A. & SPIER, R. (2010) Fear, misinformation, and innumerates: how the Wakefield paper, the press, and advocacy groups damaged the public health. *Vaccine* **28,** 2361-2362
ROCCABIANCA, P., AVALLONE, G., RODRIGUEZ, A., CRIPPA, L., LEPRI, E., GIUDICE, C. & OTHERS (2016) Cutaneous lymphoma at injection sites: pathological, immunophenotypical, and molecular characterization in 17 cats. *Veterinary Pathology* **53,** 823-832
SANCHEZ-VIZCAINO, F., JONES, P. H., MENACERE, T., HEAYNS, B., WARDEH, M., NEWMAN, J. & OTHERS (2016) Small animal disease surveillance: respiratory disease. *Veterinary Record* **178,** 361-364
SCHERK, M., FORD, R. B., GASKELL, R. M., HARTMANN, K., HURLEY, K., LAPPIN, M. R. & OTHERS (2013) 2013 AAFP Feline Vaccination Advisory Panel report. *Journal of Feline Medicine and Surgery* **15,** 785-808
SCHULLER, S., FRANCEY, T., HARTMANN, K., HUGONNARD, M., KOHN, B., NALLY, J. E. & SYKES, J. (2015) European consensus statement on leptospirosis in dogs and cats. *Journal of Small Animal Practice* **56,** 159-179
SCHULTZ, R. D., THIEL, B., MUKHTAR, E., SHARP, P. & LARSON, L. J. (2010) Age and long-term protective immunity in dogs and cats. *Journal of Comparative Pathology* **142,** S102-S108
STEPITA, M. E., BAIN, M. J. & KASS, P. H. (2013) Frequency of CPV infection in vaccinated puppies that attended puppy socialization classes. *Journal of the American Animal Hospital Association* **49,** 95-100
THIBAULT, J. C., BOUVET, J., CUPILLARD, L. & GUIGAL, P. M. (2015) Evaluation of the impact of residual maternally-derived antibodies against canine parvovirus on the efficacy of a standard primary vaccination protocol. Proceedings of the 25th Congress of the European College of Veterinary Internal Medicine. Lisbon, September 10 to 12, 2015
WELBORN, L. V., DEVRIES, J. G., FORD, R., FRANKLIN, R. T., HURLEY, K. F., MCCLURE, K. D. & OTHERS (2011) 2011 AAHA canine vaccination guidelines. *Journal of the American Animal Hospital Association* **47,** 5
WILLETT, B. J. & HOSIE, M. J. (2012) Feline leukaemia virus: half a century since its discovery. *Veterinary Journal* **195,** 16-23
WILSON, S., GREENSLADE, J., SAUNDERS, G., HOLCROFT, C., BRUCE, L., SCOBEY, A. & OTHERS (2012) Difficulties in demonstrating long term immunity in FeLV vaccinated cats due to increasing age-related resistance to infection. *BMC Veterinary Research* **8,** 125
YAO, P. J., STEPHENSON, N., FOLEY, J. E., TOUSSIENG, C. R., FARVER, T. B., SYKES, J. & FLEER, K. A. (2015) Incidence rates and risk factors for owner-reported adverse events following vaccination of dogs that did or did not receive a *Leptospira* vaccine. *Journal of the American Veterinary Medical Association* **247,** 1139-1145

Self-assessment quizzes

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Quiz: Small animal vaccination: a practical guide for vets in the UK

1. Which of the following are the CORE vaccines recommended for dogs by the WSAVA?
   a. Canine distemper virus, canine adenovirus and canine parvovirus type 2
   b. Canine distemper virus, canine adenovirus, canine parvovirus type 2 and canine parainfluenza virus
   c. Canine distemper virus, canine adenovirus, canine parvovirus type 2, canine parainfluenza and leptospirosis
   d. Canine distemper virus and canine parvovirus type 2

2. Which of these canine vaccines has the longest licensed duration of immunity?
   a. Canine parainfluenza injectable
   b. Canine distemper virus injectable
   c. *Leptospira* injectable
   d. *Bordetella bronchiseptica* intranasal

3. According to WSAVA guidelines, at what age should the final vaccine in the primary puppy or kitten series of CORE vaccines be given?
   a. 10 weeks of age
   b. 12 weeks of age
   c. 14 weeks of age
   d. 16 weeks of age or older

4. Which of these protocols is consistent with WSAVA guidelines for giving NON-CORE *Leptospira* vaccine to puppies?
   a. Vaccinate at eight and 12 weeks with a 52-week booster.
   b. Vaccinate at four and 8 weeks with a 52-week booster.
   c. Vaccinate at 8 and 12 weeks with a 26-week booster.
   d. Vaccinate at 8, 12 and 16 weeks with a 26-week booster.

5. Ideally, how should CORE vaccines be given to a high-risk adult cat according to WSAVA guidelines?
   a. Feline parvovirus, feline herpesvirus and feline calicivirus every year
   b. Feline parvovirus, feline herpesvirus and feline calicivirus every three years
   c. Feline parvovirus every three years and feline herpesvirus and calicivirus every year
   d. Feline parvovirus every year and feline herpesvirus and calicivirus every three years

Answers: a, b, d, a, c