ABCD: Update of the 2009 guidelines on prevention and management of feline infectious diseases
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What is This?
Feline panleukopenia

This oldest feline viral disease known to the veterinary profession is caused by a typical parvovirus (feline panleukopenia virus, FPV) that infects a wide variety of carnivores including all felids, mustelids, procyonids and most canids. The dog and the coyote are the only carnivores that will not be infected, or will not develop disease, as the receptor on their cells will not bind the virus.1

All parvoviruses are very stable and may stay infectious in the environment for months. They are highly contagious, which means that only a few virus particles are required to induce an infection. As an affected animal sheds enormous amounts of virus, soon the shelter or household is heavily contaminated, which causes a threat to non-vaccinated – or, rather, non-immune – animals, like cats and other carnivores.

Virus replication is restricted to mitotically active tissues, such as the bone marrow, lymphatic cells, the gut epithelium and the developing fetus. The hallmark of infection is a viraemia, which carries the virus from the initially infected cells of the tonsils and other regional cells to the target tissues. Neutralising antibodies can greatly influence the viraemia and are even able to prevent virus spread through the organism. Animals that have survived the disease are protected from reinfection, most likely for their entire life.

Vaccination is highly efficacious, and cats that have actively responded to vaccination and show antibody titres are protected for several years, and probably also life-long. However, the success of vaccination is greatly influenced by neutralising antibodies. In the case of passively acquired antibodies this has severe consequences. Maternal antibodies interfere with vaccination, and the time-point of the first vaccination is therefore important. To minimise the risk of this interference, kittens are vaccinated twice or even three times during their first weeks of life.
Primary vaccination course

- A minimum of two doses – one at 8–9 weeks of age and a second 3–4 weeks later (at a minimum of 12 weeks of age) – should be administered to cats living in low-risk situations.
- In higher-risk situations, a third vaccination, at 16 weeks, is recommended. Maternal antibodies may persist beyond week 12 in some cats, as field data suggest, such that vaccination at 12 weeks may fail to induce protection [EBM grade 1]. Therefore, a third vaccination at 16 weeks of life should be given, for example, to kittens in breeding catteries or cat shelters. This should also be considered for kittens born to queens with high antibody titres, as these may persist for more than 12 weeks (eg, kittens from queens that have recovered from the disease, that have lived in a high-exposure environment, or have received vaccination shortly before or during pregnancy).

Feline herpesvirus infection

Feline herpesvirus (FHV) is the agent of feline viral rhinotracheitis. Together with feline calicivirus and other pathogens, it is involved in the feline upper respiratory tract syndrome. Typical acute FHV disease results in rhinitis, conjunctivitis, and superficial and deep corneal ulcers, in particular dendritic ulcers. Latent chronic infection is the typical outcome of an acute infection, and reactivation gives rise to intermittent viral shedding in oronasal and conjunctival secretions.

Conjunctivitis may be associated with corneal ulcers, which may develop into chronic sequestra. FHV is the most important cause of corneal ulceration. Stromal keratitis is a secondary, immune-mediated reaction due to the presence of virus in the epithelium or stroma. Damage to the nasal

### Table 1

<table>
<thead>
<tr>
<th>Drug/treatment</th>
<th>Rationale</th>
<th>ABCD recommendation</th>
<th>EBM grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal flushing with physiological saline solution and nebulisation</td>
<td>To clean nasal discharge and to prevent dehydration of the upper airways</td>
<td>Recommended several times daily</td>
<td>IV</td>
</tr>
<tr>
<td>Highly palatable food</td>
<td>To ensure sufficient food intake</td>
<td>Necessary if cats do not eat because of pyrexia and/or ulcers in the oral cavity, or because of their loss of smell due to nasal congestion; food can be blended and warmed up to increase smell</td>
<td>IV</td>
</tr>
<tr>
<td>Placement of a feeding tube and enteral nutrition</td>
<td>To ensure sufficient food intake</td>
<td>Necessary if the cat has not been eating for 3 days</td>
<td>IV</td>
</tr>
<tr>
<td>Fluid therapy</td>
<td>To control dehydration and restore electrolyte and acid–base imbalance</td>
<td>Necessary in cats with severe clinical signs</td>
<td>IV</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>To control secondary bacterial infections</td>
<td>Broad-spectrum antibiotics with good penetration into the respiratory tract are recommended for cats with severe disease</td>
<td>IV</td>
</tr>
<tr>
<td>Non-steroidal anti-inflammatory drugs</td>
<td>To decrease fever</td>
<td>Recommended in cats that are severely depressed</td>
<td>IV</td>
</tr>
<tr>
<td>Drugs with mucolytic effects (eg, bromhexine)</td>
<td>To improve mucous nasal discharge</td>
<td>May be helpful</td>
<td>IV</td>
</tr>
</tbody>
</table>

### Table 2

<table>
<thead>
<tr>
<th>Drug</th>
<th>Rationale</th>
<th>ABCD recommendation</th>
<th>EBM grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotics</td>
<td>To control secondary bacterial infections</td>
<td>Topical antibiotics</td>
<td>IV</td>
</tr>
<tr>
<td>Anti-inflammatory drugs</td>
<td>To decrease local inflammation</td>
<td>Usually not needed; avoid corticosteroids</td>
<td>IV</td>
</tr>
</tbody>
</table>


### Table 3 Antiviral drugs recommended for topical and systemic treatment of acute FHV ocular disease. The drugs are listed in decreasing order of preference

<table>
<thead>
<tr>
<th>Drug</th>
<th>Type of drug</th>
<th>Route of administration and dose</th>
<th>Efficacy in vitro</th>
<th>Efficacy in vivo</th>
<th>Controlled study in vivo?</th>
<th>Comments</th>
<th>EBM grade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topical treatments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trifluridine</td>
<td>Nucleoside analogue</td>
<td>Topical Use every h for 1st day and q4h thereafter</td>
<td>Excellent</td>
<td>ND</td>
<td>No</td>
<td>Topical treatment of choice for ocular FHV manifestations. Some cats averse to topical application. Toxic if given systemically</td>
<td>III</td>
</tr>
<tr>
<td>Cidofovir</td>
<td>Nucleoside analogue</td>
<td>0.5% solution applied topically</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Topical treatment for ocular FHV; potent drug with only two daily applications</td>
<td>III</td>
</tr>
<tr>
<td>Idoxuridine</td>
<td>Nucleoside analogue</td>
<td>Topical Use initially q2–4h</td>
<td>Excellent</td>
<td>ND</td>
<td>No</td>
<td>Topical treatment for ocular FHV. Difficult to source; pharmacists can formulate a 0.1% ophthalmic solution. Toxic if given systemically</td>
<td>III</td>
</tr>
<tr>
<td>Ganciclovir</td>
<td>Nucleoside analogue</td>
<td>Topical</td>
<td>Excellent</td>
<td>ND</td>
<td>ND</td>
<td>Topical treatment for ocular FHV. Good in vitro activity</td>
<td>III</td>
</tr>
<tr>
<td>Aciclovir</td>
<td>Nucleoside analogue</td>
<td>Topical and oral (high doses may be needed to overcome viral resistance)</td>
<td>Poor</td>
<td>Some</td>
<td>Yes</td>
<td>Least in vitro effect of all herpes antivirals Moderate in vivo effect. Synergy in combination with human IFN-α. Toxic if given systemically</td>
<td>III</td>
</tr>
<tr>
<td><strong>Systemic treatments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Famciclovir</td>
<td>Nucleoside analogue (prodrug)</td>
<td>Oral, 90 mg/kg q8h for 21 days</td>
<td>Yes (for penciclovir, as famciclovir is a prodrug of penciclovir)</td>
<td>Yes</td>
<td>Yes</td>
<td>Tested in conventional and SPF cat experimental challenge against primary infection</td>
<td>III</td>
</tr>
<tr>
<td>Feline IFN-ω</td>
<td>Interferon</td>
<td>Systemic: 1 MU/kg SC q24–48h</td>
<td>Yes</td>
<td>ND</td>
<td>Yes</td>
<td>Safe and licensed for use in cats</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oral: 50,000–100,000 Units daily</td>
<td></td>
<td></td>
<td></td>
<td>A combined topical and oral pre-treatment before experimental FHV infection was not beneficial</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Topical: dilute 10 MU vial in 19 ml 0.9% NaCl and use as eye drops: two drops in each eye five times a day for 10 days</td>
<td></td>
<td></td>
<td></td>
<td>Used along with L-lysine in chronic infections</td>
<td></td>
</tr>
<tr>
<td>Human IFN-α</td>
<td>Interferon</td>
<td>SC high dose</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Less bioactive than feline interferon</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PO low dose</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5–35 Units daily reduces clinical signs but not FHV shedding. Used along with L-lysine in chronic infections</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5–35 Units daily</td>
<td></td>
<td></td>
<td></td>
<td>No published evidence of side effects, conflicting efficacy reports; can reduce spontaneous ocular viral shedding rates in latently infected cats experiencing reactivation; to be administered as separate bolus, not added to food</td>
<td>II</td>
</tr>
<tr>
<td>L-lysine</td>
<td>Amino acid</td>
<td>500 mg q12h, not added to food</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ND = not determined, SPF = specific pathogen-free
Feline calicivirus (FCV) remains an important factor for chronic rhinitis.

Molecular diagnosis is now in regular use, especially to identify FHV DNA in corneal samples. The practitioner should avoid the use of fluorescein and topical anaesthetics in the eye before sampling because these compounds can affect the sensitivity of some polymerase chain reaction (PCR) methods, unless permitted by the diagnostic laboratory.

The symptomatic treatment for acute respiratory disease where FHV infection may be involved is summarised in Table 1. The symptomatic treatment for acute ocular disease is outlined in Table 2.

Anti-herpesviral drugs have come to the market, which now allow recommendations to be made for the topical and systemic treatment of acute FHV ocular disease (Table 3). The drugs listed may not be readily available or licensed for cats. Other drugs have been proposed, like bromovinyldeoxyuridine, HPMA, ribavirin, valaciclovir, vidarabine, foscarnet and lactoferrin, but their efficacy has not been proven.

Maternally derived (passive) immunity can interfere with the response to vaccination until about 8 weeks of age [EBM grade III].

The primary vaccination course is therefore usually started at around 9 weeks of age, although some products are licensed for earlier use. Kittens should receive a second vaccination 2–4 weeks later, with the second given at around 12 weeks of age. Vaccination provides good protection against clinical signs, and also against viral shedding, within 1 week of administration [EBM grade III].

FHV is common in multicat households, and infections can pose a problem in shelters. Management to limit the spread of infection is as important as vaccination. In shelters where incoming cats are mixed with resident cats, high infection rates are frequent. Newcomers should therefore be quarantined for the first 3 weeks, and kept individually – unless known to come from the same household.

Feline calicivirus infection

Feline calicivirus (FCV) remains an important cause of disease and a frequently diagnosed infection in both ill and healthy carrier animals. The virus evolves quickly and is very variable, particularly at antigenic sites on its surface exposed to the feline immune response. As such, many strains circulate, even at the level of the population of cats seen by a typical veterinary surgery. As well as causing consistent oral ulceration and upper respiratory disease, the virus has also been associated with superficial ocular disease. Nearly all cats with chronic lymphoplasmacytic gingivitis/stomatitis complex test positive for FCV. In addition, outbreaks of highly virulent and often lethal FHV infection in domestic cats have been described in the United States and in Europe; recently, a single outbreak has also been described in exotic captive felids in the USA.

Transmission is usually through contact with infected cats but secretions can remain infectious in the environment for many days. Fleshes that have lived on infected cats have also recently been shown to shed infectious faeces, although how significant this is in the field is unknown. Diagnosis is based on clinical signs, supplemented by virus isolation or PCR. Because of the frequent asymptomatic carrier phase, care should be taken when interpreting any FCV-positive result.

Feline interferon-ω (licensed for the treatment of canine parvovirus and feline leukaemia virus infections in some European countries) has been shown to inhibit FCV replication in vitro. However, controlled field studies are lacking to support its use in cases of uncomplicated oral/respiratory disease. There is also some suggestion that strains of FCV may vary in their sensitivity to interferon. In cases of chronic stomatitis, topical oral interferon has been shown to lead to statistical improvement in clinical scores, but this improvement was generally not different from cats receiving steroid alone [EBM grade II].

FCV vaccines provide protection mainly by inducing virus neutralising antibodies. As the virus can mutate quickly, field strains could...
evolve resistance to any vaccine-induced immune response, particularly if a vaccine is used for a prolonged period of time in the population. Some laboratory studies lend support to this hypothesis [EBM grade III].26,27 Such studies are conducted to obtain more information about the strains circulating in Europe, and vaccine companies are seeking to identify newer strains that provide wider cross protection. However, the methodology used in such studies makes it difficult to draw any firm conclusions from these results. In addition, there are issues about how such laboratory studies relate to vaccine-induced immunity in the field situation. Field trials to show whether newer vaccine strains confer improved protection have not been undertaken.

The most commonly used vaccine strains of FCV are F9, which is the oldest, isolated in the 1950s, FCV 255, and two new strains G1 and 431. Maternally derived antibody can interfere with vaccine-induced immunity. The higher the level, the greater the interference. Where a more rapid response to vaccination is required, a modified-live vaccine may be preferred [EBM grade III].28,29 The ABCD recommends that all kittens receive vaccinations at 9 and 12 weeks of age, and for those individuals judged to live in high-risk situations, a further vaccination at 16 weeks.

Dogs and cats in shelter or kennel environments should be housed separately, and flea control should be implemented to minimise the risk of transmission of FCV and other diseases. Point of care assays for identifying cats lacking protective immunity on admission to shelters have been described,30 but their practicality is not known. They should not be used as a replacement for rigorous biosecurity.

Feline leukaemia

Feline leukaemia virus (FeLV) is a gammaretrovirus of worldwide occurrence that is important for all small felids. Infected cats may become persistently viraemic and shed large amounts of virus through saliva and faeces, whereby they can infect other cats in close contact. Several variants of FeLV are known that differ in virulence and host cell spectrum. As is the case for all retroviruses, a DNA copy of replicating FeLV RNA is integrated into the DNA of host cells (as so-called provirus), where it remains for the lifetime of the infected cell.

Infection starts in the oropharynx from where the virus will spread via leukocytes to lymph nodes and the bone marrow. Once the bone marrow is infected, viraemia will develop and, as a consequence, FeLV replication will take place in many organs. In most cases, viraemia will be persistent and lead to clinical signs such as aplastic anaemia, immunosuppression and a variety of tumours. These cats are called progressor cats. In a fraction of infected cats, viraemia will either not develop or will be overcome after several weeks or months (regressor cats). Antibodies to FeLV and/or T lymphocytes are observed in regressor cats, suggesting that a functioning immune system is essential. Regressor cats remain latently infected for some time, and viraemia can be reactivated by stress and/or high doses of corticosteroids.

The diagnosis of FeLV infection is mostly done by in-house tests that detect the viral core protein p27. Presence of p27 is a marker for infection and correlates well with viraemia. In addition, proviral DNA can be detected through PCR techniques in blood, and viral RNA, eg, in saliva. Information that can be drawn from test results is discussed in the box above.

Treatment of viraemic cats can be tried using raltegravir, an antiretroviral drug used in AIDS treatment, at up to 40 mg/kg body weight per day. Under experimental conditions, a 15-week treatment regimen led to a strong decrease in
viral loads; however, viraemia was not overcome completely [EBM grade III].

Good (recombinant) FeLV vaccines are available, which protect from disease but not from infection. The ABCD suggests that cats at risk (eg, with access to outdoors) are primarily vaccinated. Cats living in an apartment with no contact with other cats may not need to be vaccinated. Vaccination should take place at 8–9 weeks, again at 12–13 weeks and 1 year later. Thereafter, vaccination frequency can be lowered to an interval of 2–3 years.

**Feline immunodeficiency virus infection**

Feline immunodeficiency virus (FIV) infection may induce clinical signs of immunodeficiency that lead to opportunistic infections or lymphomas, although in some cats the clinical signs are mild. A few studies have shown that the survival time of infected cats was not decreased; such variable outcomes are likely a result of the heterogeneity of viral isolates as well as management practices. FIV-infected cats kept in single cat households with regular veterinary care are more likely to remain healthy than those in multicat households lacking regular health checks. Prompt supportive treatment dramatically increases the survival time for FIV-infected cats.

The infection is usually diagnosed using in-house serological assays to detect antibodies against major viral proteins, and it is important that such results are properly interpreted. Situations where a confirmatory test should be used are described in the box below.

Several laboratories offer PCR tests for the diagnosis of FIV but these tests are not necessarily more reliable than serological tests. PCR tests are highly prone to contamination and must be conducted under rigorous conditions with appropriate controls to minimise false-positive results. False-negative results may arise in situations where the primers are not homologous to the infecting field strain and, therefore, infection is not detected.

Few antiviral drugs are effective against FIV and do not induce adverse side effects. Treatment with nucleoside analogues that inhibit the reverse transcriptase, such as AZT or PMEA, may reduce clinical signs but these drugs, as well as derivatives such as PMPDAAP, induce anaemia. Bicyclams bind to the FIV co-receptor molecule CXCR4, thereby inhibiting viral replication. Treatment with the bicyclam AMD3100 leads to a significant decrease in proviral load in cats naturally infected with FIV and may be a useful therapy, but this treatment should not be combined with PMEA [EBM grade I].

A whole inactivated virus vaccine has been available commercially to veterinarians in the USA since 2002, and in Australia and New Zealand since 2004. However, its use is not recommended in Europe by the ABCD since the antibodies induced interfere with the serological diagnosis of infection. Also, the vaccine has not proven effective against primary field strains of FIV circulating in Europe.

**Feline rabies**

Rabies is still endemic in some middle and east European countries, and in 2011 the total number of animal cases in Europe was 5801, mainly involving foxes (source WHO). However, on very rare occasions isolated rabies cases in companion animals appear also in western European countries that are considered as rabies free. Often the source of these is illegal importation of a pet from endemic areas.

Due to testing of pets for neutralising antibodies, which has been required by some countries before entering their territory, interesting data have been published about duration of the antibody response after vaccination. Though differences in efficacy between some commercial rabies vaccines used in Europe have been demonstrated, following a single vaccination these products have been shown to induce in most animals a titre above 0.5 IU/ml, the internationally accepted threshold antibody level [EBM grade III]. In cats and dogs, the peak of rabies neutralising antibodies is generally reached 4–8 weeks after the first immunisation [EBM grade III]. Nevertheless, the titre decreases with time. When tested 6–12 months after the first vaccination, about 8% of cats have a titre below 0.5 IU/ml [EBM grade III]. In an
another study involving thousands of dogs tested 120–360 days post-vaccination, the proportion of animals with a titre below 0.5 IU/ml was 12.6%, or 3.1%, depending on the vaccine brand used [EBM grade III].

There is increasing evidence that the persistence of antibody after the first rabies vaccination may be much shorter than generally believed, especially in dogs. It has been demonstrated that antibody titres fall below 0.5 IU/ml in almost 21% of dogs within 4–6 months after a single vaccination [EBM grade III].

In another study the proportion of dogs with titres below 0.5 IU/ml 6 months after the first vaccination reached 30% and then stabilised at above 30% during the next 6 months [EBM grade III]. Thus, a new regimen for rabies vaccination, consisting of double primary vaccination with a short interval of 7–10 days and a 1-year booster, has been postulated. This procedure reduced the proportion of cats developing a titre below 0.5 IU/ml to almost zero, when tested within 6 months, and in dogs this proportion was also significantly lower than in animals given a single primary vaccination [EBM grade III].

A non-adjuvanted recombinant rabies vaccine for cats was recently marketed in some European and other countries. It has been shown to induce immunity lasting 3 years [EBM grade I]. During efficacy studies it has been observed that even two cats with a titre at the time of challenge below 0.5 IU/ml survived without developing rabies, suggesting that mechanisms other than induction of antibody play a role in protection.

**Feline infectious peritonitis**

The pathogenesis and epidemiology of feline infectious peritonitis (FIP), a bone of contention until recently, have been further elucidated. The hypothesis of mutants arising in individual cats upon bursts of replication (eg, under immune-suppressive stress) has been experimentally corroborated and explains the sporadic, non-epidemic occurrence of FIP. Functional expression of one of the non-structural proteins (3c) is crucial for feline coronavirus (FCoV) replication in the gut, but dispensable for systemic replication of the feline infectious peritonitis virus (FIPV) mutant. While intact in all FCoVs, the 3c gene was found mutated in >70% of FIPV strains – but not in all, implying that mutation in 3c is not the (single) cause of FIP.

Most cats with FIP had no detectable intestinal FCoV and had seemingly cleared the primary infection. In those with detectable intestinal FCoVs, the virus always had an intact 3c and seemed to have been acquired by FCoV superinfection. Apparently, 3c-inactivated viruses replicate not at all – or only poorly – in the gut, explaining the rare incidence of FIP outbreaks. After experimental infection with FIPV strains with an intact 3c gene, the virus was shed in the faeces. Also, faecal virus from these cats was not infectious for other cats.

Sequencing of many different FIPV and FCoV strains revealed two alternative codons in the S gene that correlated with the FIP phenotype in >95% of cases. This again supports the internal mutation theory and might also be a basis for identifying the virulent FIPV phenotype in cats suspected of having FIP.

**Chlamydophila felis infection**

*Chlamydophila felis* is primarily an ocular pathogen, causing both acute and chronic conjunctivitis. Serological surveys have shown that infection is widespread in cats but most clinical cases occur in young cats under 9 months of age, particularly pedigree kittens from multicat households. Conjunctivitis is a common reason for presentation of cats to practitioners and *Chlamydophila* is the single most common infectious cause and possibly the most common cause overall. The conjunctivitis is usually bilateral but may be unilateral early in infection or in chronic cases. *Chlamydophila* will not usually cause corneal lesions.

PCR testing of ocular swabs is now the preferred method of diagnosis. Care is necessary in collecting swabs as the organism is essentially intracellular and some conjunctival cellular material is required to optimise the chance of detecting the organism.

While other antibiotics, such as fluoroquinolones, have some activity against *Chlamydophila*, systemic doxycycline (10 mg/kg q24h) is regarded as the treatment of choice [EBM grade III] and should be continued for a minimum of 3 weeks to ensure that the infection is eliminated and signs do not recur when treatment is stopped. Local ocular preparations to relieve ocular inflammation may also be beneficial.

Both inactivated and modified-live vaccines are available to assist in control. These are only available as part of multivalent vaccines. Both types of vaccines will prevent or reduce the severity of clinical signs but do not prevent infection. These are not always included in routine vaccination programmes for pet
cats but may be particularly indicated in cat-
teries with endemic infection or in high-risk
(most frequently multicat) situations such as
breeding catteries and rescue shelters. Chlamydial
polymeric membrane proteins have been
identified as immunodominant and con-
sidered as potential serodiagnostic anti-
gens and novel vaccine candidates.

**Bordetella bronchiseptica infection in cats**

*Bordetella bronchiseptica* is primarily a respira-
tory pathogen. The bacterium may particular-
ly play a role in multicat environments, where
other factors like overcrowding, stress and
poor hygienic conditions exist. In general,
clinical signs are mild, although pneumonia
has been reported, especially in young kittens
less than 10 weeks old.

*B. bronchiseptica* is shed with oral and nasal
secretions of infected cats. After experimental
infection, *B. bronchiseptica* could be isolated for
19 weeks after infection. Transmission is
through direct contact, although indirect
transmission cannot be excluded. However,
*B. bronchiseptica* is susceptible to common dis-
fectants. Epidemiological studies suggest
that dog-to-cat transmission occurs. Also, a
few reports describe cats as a possible source
of infection of immunocompromised human
patients. It is therefore justified to consider
*B. bronchiseptica* as a rare but potential zoonotic
infection.

For a diagnosis of *B. bronchiseptica* infection,
both bacterial culture and PCR are available.
*B. bronchiseptica* can be isolated from oropha-
ryngeal or nasal secretions; alternatively,
transtracheal wash/bronchoalveolar lavage
are used. Nasal swabs were shown to be more
often positive then oropharyngeal swabs.
Both methods lack sensitivity.

Antibacterial therapy is indicated, including
in cases with mild clinical signs, to prevent
more severe disease due to colonisation of the
lower respiratory tract. The choice of antibiotic
should be based on antibiotic sensitivity testing.
If not available, tetracyclines, and in particular
doxycycline, are the antibiotics of choice.
Resistance has been detected against
clavulanate-potentiated amoxicillin, and to a
higher extent against ampi-
cillin and trimethoprim [EBM grade
III]. Supportive therapy and intense
nursing care are required in severely
affected animals.

The control of *B. bronchiseptica*
infections requires similar measures
as used for other respiratory
pathogens (ie, FCV and FHV). These
are aimed at preventing spread of the
infectious agents and reducing their con-
centration in the environment. An intranasal
modified-live vaccine is available but not con-
sidered a core vaccine. Vaccination should be
limited to cats living in high-risk environments
such as shelters and boarding catteries, and
where *B. bronchiseptica* has been identified as
the problem. The modified-live vaccine is
licensed for use as a single vaccination with
annual boosters. Interestingly, vaccination with
an intranasal live FCV and FHV vaccine also
reduced the signs of an experimental *B.
bronchiseptica* infection [EBM grade III].
Whether this non-specific effect is also beneficial for pro-
tection under field conditions is unknown.

**Influenza A virus infection in cats**

Felids can be naturally and experimentally
infected with influenza A viruses; outcomes
range from subclinical infection to fatal dis-
ease. The virulence of H5N1 highly pathogen-
ic avian virus strains for the domestic cat was
established at the very beginning of the
avian flu epidemics in Asia. During the
same period, infection of household
cats and outbreaks of fatal disease in
tigers and leopards were reported
from Thailand. Then, in Europe,
three cats were found dead on the
island of Rügen, Germany. The
susceptibility of the cat to influen-
za A viruses was confirmed during
the H1N1 pandemic in 2009/2010;
indeed, several cases of respiratory
disease in domestic cats were linked to
the pandemic H1N1 virus. Luckily nei-
ther H5N1 nor H1N1 virus infections spread
among domestic cats in Europe.

Cats can be infected via the intratracheal
and oral routes and, for H5N1 virus, by feed-
ing them infected chickens. Infection with the
H5N1 virus may occur through contact with
infected birds, and with H1N1 likely with
infected owners. Therefore, a cat living in a
household with human cases of influenza is at
risk. To date, no cat-to-person transmission
has been reported, but the risk for persons can
presently not be predicted.

If influenza in cats is suspected, their case
histories need to be recorded. Differential
diagnosis should exclude other infections
leading to similar systemic and respiratory
signs, including infections with FHV, FCV and
*B. bronchiseptica*. Diagnosis should always be
confirmed by laboratory testing. In the
absence of specific preventive measures, the
risk of a cat acquiring an influenza A virus
infection must be minimised through
management measures. Especially for H1N1,
but also for other human influenza A virus
infections, patients must be advised to avoid
physical contact with cats.
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Influenza A virus infection in cats

