

## Feline Leukemia

[Holly Nash, DVM, MS](#)

Veterinary Services Department, Drs. Foster & Smith, Inc.

### What is feline leukemia?

Feline leukemia is a cancerous disease caused by feline leukemia virus (FeLV). FeLV causes diseases other than leukemia including immunodeficiency and additional cancers. Cats may not start to show signs of disease for months or years after being infected with FeLV. Infection with FeLV is a major cause of illness and death in domestic cats.



### What are the characteristics of feline leukemia virus?

FeLV is a type of virus called a retrovirus. That puts it in the same family as **feline immunodeficiency virus (FIV)** and human immunodeficiency virus (HIV, the virus that causes AIDS).

Retroviruses are species-specific. This means a feline retrovirus will only infect cats; a human retrovirus will only infect humans.

Retroviruses are made up of RNA. In the **host**, the RNA is transcribed into DNA and incorporated into the DNA of the host's cells.

Retroviruses are fragile, being easily inactivated by ultraviolet light, heat, detergents, and drying.

Retroviruses are widespread in nature. As a matter of fact, they have been around for so many millions of years, parts of a feline retrovirus are actually incorporated into every cat's DNA. This is called "endogenous" FeLV DNA. This is passed from generation to generation.

There are three subgroups of FeLV and each tends to cause a different type of disease:

1. FeLV-A is found in all naturally infected cats and is easily transmitted. For this reason, this is the FeLV we use for making vaccines against FeLV.
2. FeLV-B is found in about ½ of naturally infected cats. It is formed when FeLV-A combines with the endogenous FeLV DNA.
3. FeLV-C is rare. FeLV-C results from mutations of FeLV-A.

### How common is FeLV infection?

It is estimated that 2-3% of healthy cats are infected with FeLV. Approximately ¼ to ½ of the healthy cats living in infected multi-cat households and catteries are infected.

### How is the FeLV transmitted?

Large amounts of FeLV are excreted in the saliva. Therefore, the most common mode of transmission is through nose-to-nose contact, mutual grooming, and shared food and water bowls. Bites are a very efficient way to transmit FeLV.

FeLV can also be found in lesser amounts in tears, urine, and feces. Thus litter boxes could be a source of infection in multi-cat households or catteries.

FeLV can also be transmitted across the placenta (*in utero*) and through the milk.

It takes large amounts of virus to infect an adult cat, so usually prolonged contact is necessary for transmission.

### What happens to a cat after being exposed to FeLV?

If the cat becomes infected from the exposure, 2-4 weeks later, in the **acute** stage of



infection, large numbers of the virus can be found in the bloodstream (viremia). Cats in the acute phase usually do not show signs of disease. If they do, the signs are usually mild fever, slight lethargy, and [swollen lymph nodes](#) (lymphadenopathy). When an adult cat is exposed to FeLV, four things can happen:

1. Approximately 30% of adult cats will not be infected due to inadequate exposure.
2. 30-35% of adult cats have a transient infection; over the course of 6 months or so, the cats will eventually kill all of the virus.
3. 5-10% of adult cats will develop [latent](#) infections; these cats will not be able to kill all the virus, but will be able to hold it in check. This is called a latent infection. These cats usually show no signs of infection and usually do not shed virus in their saliva or other body secretions. [Queens](#), however, may still pass the virus *in utero* or through the milk.
4. 30% of adult cats will become persistently infected; these cats will not develop an adequate immune response and will remain permanently infected with FeLV. These are the cats who will become ill and die of FeLV-related diseases, usually within 2-3 years of infection. These cats will shed large amounts of virus in their saliva.

Age is a very important factor in determining what will happen after a cat is exposed to FeLV. Almost all FeLV-exposed kittens less than 8 weeks of age will have persistent viremia and show signs of disease during the acute phase. As kittens get older, there is the probability of becoming persistently infected after exposure lessens, until it reaches approximately 30% in adulthood.

The prevalence of FeLV infection is highest in cats between 1 and 6 years of age, with a mean age of 3 years. Males are 1-½ times more likely to be infected than females. This may be due to the frequency in which intact males roam and fight.

## What diseases are caused by FeLV?

FeLV can cause:

- Immunodeficiency
- Anemia
- Immune-mediated diseases
- Reproductive problems
- Gastrointestinal disease
- Neurologic disease
- Platelet disorders
- Lymphadenopathy (enlarged lymph nodes)
- Neoplasia

**Immunodeficiency:** FeLV can decrease the effectiveness of the [immune system](#) and result in increased susceptibility to bacterial, fungal, [protozoan](#), and other viral infections. [Feline Infectious Peritonitis](#) (FIP), for instance, is much more common in FeLV-infected cats. The first indication of FeLV infection in some cats is recurrent bacterial infections of the mouth. Recurrent skin or respiratory infections can also occur.

**Anemia:** FeLV often affects cells in the bone marrow. As a result, most FeLV-infected cats have a nonregenerative anemia.

**Immune-mediated Diseases:** Large amounts of the FeLV [antigens](#) combine with the cat's antibodies and form complexes which can be deposited in the kidneys, blood vessels, or joints.

**Reproductive Problems:** FeLV infection is often associated with infertility in cats. Abortions, stillbirths, and [fetal resorption](#) are also more common in FeLV-infected queens. "Fading kitten syndrome" may result from FeLV infection of the fetuses or newborn kittens.

**Gastrointestinal Disease:** FeLV-caused cancers of the stomach or intestines, as well as FeLV-associated changes in the intestinal wall, can cause [anorexia](#), vomiting, diarrhea,

Approximately 30% of FeLV-infected cats will

and weight loss. Parasites and bacteria more commonly multiply and cause diarrhea in FeLV-infected cats.

**develop cancer.**

**Neurologic Disease:** Seizures, blindness, [paralysis](#), changes in behavior, and [ataxia](#) (loss of balance) can be seen in FeLV-infected cats. These symptoms may be caused directly by FeLV or by parasites ([Toxoplasma gondii](#)) and fungi ([Cryptococcosis](#)), which occur more often in [immunosuppressed](#) animals.

**Platelet Disorders:** A decrease in the number of [platelets](#), ([thrombocytopenia](#)), or a dysfunction of platelets sometimes occurs in cats infected with FeLV.

**Lymphadenopathy:** Lymph nodes in the abdomen and other parts of the body are often enlarged.

**Neoplasia:** Approximately 30% of FeLV-infected cats will develop cancer. Usually, the cancer is in the form of tumors of [lymphocytes](#) or red blood cells, and includes lymphosarcoma, lymphoid leukemia, myeloid leukemia, and erythremic myelosis. Not all cats infected with FeLV will develop leukemia or lymphosarcoma, and not all cases of leukemia and lymphosarcoma are caused by FeLV.

### What are the clinical signs of disease?

The clinical signs of disease are going to be variable because so many body systems can be affected. Loss of appetite, fever, weight loss, and weakness are the first signs most commonly seen in infected cats.

### How is FeLV infection diagnosed?

Serologic (blood) tests are commonly used to test both [asymptomatic](#) and symptomatic cats for FeLV antigen. The ELISA test can be performed in veterinarians' offices. The ELISA test can be performed on blood, [serum](#), saliva, or tears. Using serum will reduce the possibility of obtaining a false positive test (a positive test in an uninfected animal).

**It is estimated that 2-3% of apparently healthy cats are infected with FeLV.**

Another test, the immunofluorescent antibody (IFA) test uses blood smeared on a slide and is performed in special diagnostic laboratories. Fluorescently-tagged [antibody](#) made in the laboratory reacts with the FeLV antigen in the blood and fluoresces when viewed through a special microscope.

In Spring 2001, The American Association of Feline Practitioners (AAFP) revised their guidelines for FIV testing, and made the following recommendations:

	FIV	FeLV
During Sickness	When cats are sick, regardless of previous negative results. While many signs (such as fever, stomatitis, vomiting, and diarrhea) are obvious indicators of illness, other signs are subtle and may include changes in behavior, grooming, and eating habits.	Same as FIV, including sick cats that have been vaccinated for FeLV.
New Adoptions	When cats and kittens (regardless of age) are newly adopted, whether or not they will be entering a household with other cats.	Same as FIV.
Multi-cat Households	When cats live in households with unknown FIV infection status. Infected cats can remain asymptomatic for years, during which time they may transmit the virus to uninfected cats.	Same as FIV when cats live in households with unknown FeLV status.

After Potential Exposures	When cats have had potential exposure, such as a bite inflicted by a cat of unknown infection status. Such cats should be tested a minimum of 60 days post-exposure.	When cats have had known or possible exposure to other cats of unknown infection status (e.g., cats that go outdoors unsupervised). Periodic testing may be justifiable in cats at continued risk of exposure even though adults are relatively resistant to FeLV infection.
Routine Testing	Annually, when cats at high risk of infection. Cats are at high risk of infection include those that fight or those that live with FIV-infected cats.	No recommendation at this time.

In addition, it is important to note that:

- The vaccine will not interfere with FeLV testing.
- In most cases, the ELISA test should be used as the screening test, and IFA as the confirmatory test.
- Any positive ELISA test should be repeated. If the positive test was obtained using whole blood, saliva, or tears it should be repeated using serum.
- ELISA tests using tears or saliva should not be used to screen individual cats, but to screen large numbers, such as those in a cattery.
- All cats with a negative result should be retested 90 days later to be sure they were not recently infected prior to the first test, when viremia was not yet present.
- All cats with a suspected or known exposure should be tested no sooner than 90 days after the exposure.
- If the ELISA and IFA test results are not the same, the cat should be tested at 4-8 week intervals for at least 90 days.
- If an FeLV-infected cat is found in a multi-cat household or cattery, that cat should be removed from the others. All other cats should be tested at 90-day intervals until all cats have had two consecutive negative tests.
- The vaccine will not affect the course of disease in already infected cats. A "carrier," though, who is vaccinated and develops FeLV-related disease will appear to be a "[vaccine failure](#)".

Finally, a negative FeLV test does not imply the cat is immune to FeLV or was never exposed to it. A negative test could mean the cat:

- Has never been exposed to FeLV
- Is infected, but the number of virus particles is too low to detect. The cat may test positive at a later date.
- Has overcome a previous infection and thus has not become persistently viremic.
- Was infected with the virus previously, but for some reason does not have enough virus in the bloodstream to be detected at the time of testing.

To assist your veterinarian in determining the risk of your cat being exposed to or infected with FeLV, the AAFP has developed a history form you can fill out and give to your veterinarian at your cat's next exam. Click [here](#) to see a sample form.

### How is infection with FeLV treated?

FeLV-infected cats can sometimes live for years. Stress and exposure to ill animals should be avoided. FeLV-positive cats should be kept indoors both to protect them from exposure to disease and also to prevent them from spreading FeLV to other cats.

By knowing a cat is FeLV-positive, your veterinarian may select different vaccination protocols, preventive care, and treatments of other diseases than for an uninfected cat. Any sign of disease will require early recognition and aggressive treatment.

Clinically ill FeLV cats will need to be treated according to the signs of disease they are showing. Supportive care such as fluids, good nutrition, and antibiotics for [secondary infections](#) are essential. Variable but encouraging results have been observed using staphylococcal protein (SPA), *Propionibacterium acnes* (ImmunoRegulin), low doses of oral human alpha interferon, and an aloe derivative called Acemannan.

Lymphosarcoma is treated using [chemotherapy](#) that includes a combination of cytotoxic drugs and prednisolone.

The antiviral drugs such as AZT and ddC which are used in human retrovirus infections (e.g., HIV), have had limited success in cats. Usually these drugs cause too many toxic side effects.

## How is feline leukemia prevented and controlled?

**Vaccination:** There are a number of FeLV vaccines on the market. None of them produce 100% protection. Almost all of them are derived from inactivated (killed) virus or portions of the virus. Most of these vaccines have one or two additives called [adjuvants](#) that enhance the antigenicity (ability of the virus to cause an immune response) of the killed virus. One, Genetivac by Pitman-Moore, is a recombinant vaccine. This means a gene from the virus is placed in bacteria in the laboratory. The bacteria multiply and in doing so produce a large amount of the protein the FeLV gene coded for. This protein is collected and used in the vaccine.

In general, it is recommended that cats who go outdoors, to shows, are boarded, or otherwise have contact with cats other than those in their household should be vaccinated against FeLV. Remember, all cats should be FeLV-tested before they are vaccinated. Cats who are entirely indoors may not need to be vaccinated against FeLV. This is something you should discuss with your veterinarian. (See "What are feline vaccine-associated fibrosarcomas?" below.)

**Limiting Exposure:** As mentioned above, FeLV vaccines do not produce 100% protection. It is essential that the risk of exposure of a FeLV-negative cat to a potentially FeLV-positive cat be minimized. In single cat households this is best accomplished by keeping the cat indoors.

In catteries and multi-cat households:

- Test all cats for FeLV.
- Remove all FeLV-positive cats or totally separate them from the other cats.
- Disinfect all dishes, litter boxes, and bedding. Remember, FeLV can be transmitted through saliva, urine, and feces.
- Prevent or minimize the movement of cats in and out of the household or cattery.
- Retest cats after 90 days. If an FeLV-positive cat is found, all cats should be retested at 90-day intervals until all cats have had two consecutive negative tests.
- Test and quarantine all cats before introducing them into the household or cattery. Ideally, 2 tests at 90-day intervals should be performed.
- Only FeLV-negative cats should be used for breeding.

## What are feline vaccine-associated fibrosarcomas?

A fibrosarcoma is a tumor of the connective [tissue](#). These tumors tend to invade deeply into the underlying tissues. The frequency of these tumors is increasing in cats and has lead researchers to believe some of the tumors may be caused by a local reaction to a vaccine. Although these tumors are seen more frequently, they are still rare. It is estimated one in every 5,000 vaccinated cats a year will develop a vaccine-associated tumor. These tumors are most commonly associated with the FeLV vaccine.

A national Vaccine-Associated Feline Sarcoma Task Force composed of veterinarians, researchers, and vaccine manufacturers are working to determine the exact cause of these tumors and how they can be prevented and treated. Possible explanations for the tumors include abnormal reactions to the adjuvant in vaccines, genetic predisposition, and infections with another virus.

The possible risk of vaccine-associated fibrosarcomas has led to a reevaluation of vaccination protocols. This is why it is recommended that cats without potential exposure to FeLV may not need vaccination. In cats with potential exposure, the risk of FeLV infection is greater than the risk of developing a sarcoma so vaccination is advised.

A small, painless swelling sometimes develops at the site of a recent vaccination. This should disappear in several weeks. If it persists, however, it could mean it is developing into a sarcoma and should be checked by your veterinarian.

If a vaccine-associated fibrosarcoma develops surgical removal is attempted, but generally, this tumor is so invasive it is difficult to remove it all. Radiation or chemotherapy are often recommended in combination with surgery.

Generally, the FeLV vaccine is now given in a rear leg, in an area distinct from where other vaccinations are given. If a tumor would develop, knowing which vaccine was given where will help us determine with which vaccine the tumor is associated. Also, if a tumor would develop, amputation of the leg would, in many cases, be curative. Cats do incredibly well on three legs, and many owners prefer this to having their cat succumb to a tumor.

## I've heard of something called FOCMA. How is it related to FeLV?

The acronym FOCMA stands for Feline Oncovirus-Associated Cell Membrane Antigen. It is a protein present on certain feline cancer cells, especially [lymphoma](#) and leukemia cells. It can be present in both FeLV-infected and noninfected cats. Cats who generated antibodies to FOCMA are protected from developing lymphomas and certain other cancers. They are not, however, protected from FeLV infection or other FeLV-related diseases. The presence of FOCMA antibody in healthy cats may indicate a latent infection with FeLV. FeLV-negative, FOCMA-positive cats are more likely to develop immunodeficiency than FeLV negative, FOCMA negative cats.

## References

- Al-Sarraf, R. Update on feline vaccine-associated fibrosarcomas. *Veterinary Medicine*. 1998: 729-35.
- American Association of Feline Practitioners/Academy of Feline Medicine. Recommendations for Feline Leukemia Virus Testing. *The Compendium on Continuing Education for the Practicing Veterinarian*. 1997: 1105-7.
- Barr, MC. Feline leukemia virus infection. In Tilley, LP; Smith, FWK (eds.) *The 5 Minute Veterinary Consult*. Williams and Wilkins. Baltimore, MD; 1997: 588-9.
- Barr, MC; Olsen, CW; Scott, FW. Feline viral diseases. In Ettinger, SJ; Feldman EC (eds.) *Textbook of Veterinary Medicine*. W.B. Saunders Co. Philadelphia, PA; 1995: 409-435.
- Bell, FW. Recommendations for FeLV- and FIV-positive cats with cancer. In August, JR (ed.) *Consultations in Feline Internal Medicine*. W.B. Saunders Co. Philadelphia, PA; 1997: 572-8.
- Brakeman, L (ed.) Researchers suspect genetic cause for vaccine site sarcomas. *dvm* 1998; July 1; 41-45.
- Jarrett, O. Development of vaccines against feline leukemia virus. In Kirk, RW; Bonagura, JD (eds.) *Current Veterinary Therapy XI*. W.B. Saunders Co. Philadelphia, PA; 1992: 457-60.
- Jarrett, O. Feline leukemia virus. In Chandler, EA; Gaskell, CJ; Gaskell, RM (eds.) *Feline Medicine and Therapeutics*. Blackwell Scientific Publications. Cambridge, MA; 1994: 473-87.

Sherding, RG. Feline leukemia virus. In Birchard, SJ; Sherding, RG (eds.) Saunders Manual of Small Animal Practice. W.B. Saunders Co. Philadelphia, PA; 1994: 82-90.

Squires, RA. What should the busy practitioner know about FeLV vaccines? Presented at the 10<sup>th</sup> Annual Feline Conference sponsored by the University of Wisconsin School of Veterinary Medicine. Madison, WI; September 16, 1995.

Zenger, E; Wolf, AM. An update on feline retrovirus infections. In Kirk, RW; Bonagura, JD (eds.) Current Veterinary Therapy XI. W.B. Saunders Co. Philadelphia, PA; 1992: 272-277.

Copyright © 1997-2008, Foster & Smith, Inc. All Rights Reserved.  
Reprinted from PetEducation.com.