Younger veterinarians today have no idea what flea control was like just 25 years ago. It was about then that veterinarians received the capability of making a major difference in flea control through products that were placed in or on pets that significantly and very successfully reduced flea populations. This has made a huge difference in how pets are protected from these parasite infestations.

The fleas that typically bother the cat and dog, Ctenocephalides felis (and the less common Ctenocephalides canis) have similar life cycles. Fleas have 6 life stages: eggs, three larval stages that look like caterpillars, a pupal stage, and the adult stage. Within the pupal stage the caterpillar undergoes a metamorphosis and develops into an adult flea, the stage that is familiar to most pet owners. In this life cycle, the eggs produced by the female (up to 50 eggs a day at the maximum reproductive potential of the female flea) fall off the pelage of the host and drop to the ground in the area where the pet rests. If conditions are near perfect, the larvae can hatch from the egg and develop to the adult stage in just over a week. It is in the pupal stage that the flea waits for its next host (this is the stage most resistant to dessication), and the flea will eclose from its cocoon when it senses the heat of a passing host. The adult flea will then jump onto the passing host where it will feed and continue the cycle. The large numbers of eggs produced by a female are the reason why numbers can become massive in a short time. Ten female fleas can produce 3,500 eggs in a week.

The current products work either through interfering with the development of fleas in the egg or the larval stage or by directly affecting the nervous system of the fleas as adults. Some of the products act upon fleas by direct contact, and others require that fleas first bite the host to obtain the active ingredient in the insecticide.

Fleas as vectors
Controlling flea infestation in companion animals facilitates more than just the removal of annoying pests; the flea species that infest our pets play active roles spreading multiple interspecies and zoonotic disease agents. Important among the different agents are cat-scratch disease (Bartonella henselae), murine typhus (Rickettsia typhi) and plague (Yersinia pestis) to humans. All three of these diseases occur in California.

Cat-scratch disease
Bartonella henselae (Gram-negative) is the infectious bacterial agent responsible for cat-scratch disease (CSD). This bacterium is spread between cats and to humans by the cat flea, Ctenocephalides felis. C. felis first becomes infective after ingesting a bloodmeal from a bacteremic cat. The bacteria is then shed through the feces of the flea, which is often stored in the nail bed of the cat, and is inoculated into another cat or person through contamination of an open wound with the contaminated flea feces. An alternative route of transmission is through direct inoculation of a wound with a bacteremic cat’s saliva, such as through a bite. B. henselae then colonizes in erythrocytes and endothelial cells of the infected individual.

Cat-scratch disease is one of the most common causes of regional lymphadenopathy in children and young adults. The majority of cases in the nation occurs between September and January; well after the time that most people believe that flea control is not necessary. However, no flea feces; NO transmission. So, if pets are protected through Fall, there should be a marked reduction in cases. In addition to regional lymphadenopathy, other clinical signs reported included erythema, fever and mild headaches and in 5-15% of patients include encephalitis, retinitis and endocarditis. More severe clinical signs are seen in immunocompromised individuals and may include tumor- like growths of blood vessels on the external skin surface and hepatitis, bacillary angiomatosis.

Control over flea infestation is fundamental towards controlling cat-scratch disease because serologic tests do not properly identify bacteremic cats as potential reservoirs. Most cats have been exposed to B. henselae and will possess residual antibodies against the organism regardless of its bacteremic status so a positive serologic test does not necessarily translate to a bacteremic cat. Furthermore, because the primary route of transmission to humans is through flea feces, eliminating fleas will eliminate the primary source of infection. PCR and blood culture tests can be done to diagnose the presence of Bartonella spp. in a cat but false negatives are not uncommon and positive results do not always correlate with clinical illness. Treatment for cats with Bartonella spp. is generally not recommended as cats do not show clinical signs but if a cat tests positive on a culture test and treatment is indicated (often due to an immunocompromised individual that is in close proximity to the cat), then treatment with doxycycline or amoxicillin-clavulanate in conjunction with flea control for 2 weeks is the recommended therapy.

Murine typhus
Rickettsia typhi is transmitted to humans from animals usually through an intermediate flea vector and by a method similar to the transmission of B. henselae. Rickettsia typhi is the agent known to cause murine typhus in humans, a disease characterized by high fever, headaches, chills and malaise with concurrent gastrointestinal, respiratory and neurologic symptoms and a maculopapillary rash.
that is reported to present in 50% of infected patients. It was long considered to no longer be of any significance in the United States and was relegated to discussions of tropical medicine and squalid hosing in the developing world where rats and rat fleas are common. Then, it the early 1990s, it was recognized to be in California, Los Agneles California, and associated with opossums, cats, and the cat flea (Sorvillo, et al., 1993; Williams et al., 1992).

It is important to distinguish between the agents causing the “typhus symptoms” because of the information if provides on the transmission of the disease, particularly the involvement domestic cats play in transmission. Rickettsia typhi is maintained primarily in rat reservoirs and spread by the rat flea, Xenopsylla cheopis but an alternative cycle involving opossums, cats and cat fleas, C. felis, has been proposed. Rickettsia felis, however, is thought to circulate between opossums and cats and has been isolated from cat fleas. Both of these cycles suggest that the domestic cat plays a role in maintaining these bacterial agents however the exact role cats play in transmission of the disease is unclear- identifying the agent causing the symptoms may help clarify their role.

Serological evidence shows that cats can be exposed to these bacteria without showing overt clinical signs but studies using PCR to isolate these agents from serologically positive cats have been unsuccessful. This suggests that it is unlikely that cats directly transmit the agents. What is likely, however, is that cats serve as a feeding and mechanical source for both parasites (X. cheopis and C. felis) acting as a bridge between fleas and people. Prophylactic flea control in cats could help protect them from these parasites and therefore decrease the propagation and spread of these agents. The following quote (Reporter et al., 1996) summarizes the concern that was swirling around in the early 2000s “Between 1984 and 1994, the Los Angeles County Department of Health Services received 75 reports of serologically con-firmed murine typhus. The cases in Los Angeles County are not due to contact with "dead rats teeming with fleas” as in the Third World. Rather, the cases occurred in upper-middle-class and middle-class persons who live in the suburban foothills in central Los Angeles County. Studies in these areas have shown that Rickettsia typhi can be found in opossums, feral and domestic cats, and roof rats as well as in the classic reservoir, Norwegian rats and their fleas. All persons with confirmed murine typhus in 1993 reported contact with one of these animals, while only 80% recalled a history of flea exposure in the month before the onset of illness.”

But is it murine typhus, Rickettsia muris, or feline typhus, Rickettsia felis that also can circulate between opossums, fleas, and cats? Serological diagnostics are typically not confirmative, and molecular diagnosis with PCR is often not successful when examining the blood of patients. There are those who believe strongly that the disease being seen in many of these people is due to Rickettsia felis (Eremeeva et al., 2012), and in 5 pediatric cases from Los Angeles (Green et al., 2011), PCR was not performed. Similarly, in a case of typhus during pregnancy in California was considered to be R. typhi without molecular verification, and a case in a 17 year old girl from Florida who visited Corpus Christ, Texas (Texas is the other state besides California that is reporting typhus cases), and befriended a stray kitten with fleas, was also diagnosed with murine typhus without molecular verification (Carr et al 2014).

Whether the disease is caused by murine typhus or feline typhus, fleas are the vectors. To prevent the infection, easiest way is to kill the fleas. There are lots of great flea control products, but you have to believe that there are fleas.

Plague
This is a life-threatening disease caused by the Gram-negative bacteria, Yersinia pestis. This disease is endemic in the western United States with a southwest focus in northern Arizona, northern New Mexico and southern California and a West Coast focus in California, southern Oregon and western Nevada. Yersinia pestis is maintained mainly in wild rodent reservoirs including rats, rock squirrels, ground squirrels, prairie dogs and chipmunks and is transmitted by two rodent fleas, Xenopsylla cheopis and Oropsylla montana, as well as through direct exposure to the tissues, secretions and respiratory droplets of infected animals.

In the United States, approximately 20 cases of plague are reported each year of which 7.7% are associated with transmission from cats. Plague can present in one of three forms, bubonic, pneumonic or septicemic. Roughly 80-90% of cases reported worldwide are of the bubonic form but in 2006, of the 17 cases reported in the US, 35% were classified as primary septicemic plague. Humans with cutaneous exposure usually develop the bubonic form whereas humans exposed through inhalation develop the pneumonic form. If left untreated the bubonic form can spread to the lungs, develop into the pneumonic form allowing the infected individual to spread the disease to another person. If this form of plague left untreated for 3-4 days it can be fatal.

Domestic cats have been implicated in the transmission of plague to people in two ways. First, people who are exposed to infected cats can directly contract the disease from their tissues and secretions. Importantly, although most cats are very susceptible to plague and show signs of clinical illness, one study that experimentally infected 16 cats with Y. pestis, showed that 19% of the animals did not show clinical signs. This suggests that it is possible that a cat is spreading the bacteria without evidence of infection, making it hard for a person to recognize it as a threat. An alternative way cats propagate the transmission to humans is through their hunting behaviors. Cats that hunt and carry dead rodents into the vicinity of humans expose them to infected rodents and the fleas that they carry. There have been a unnumber of cat associated cases of plague in people (Gage et al., 2000)
We also now know that people get plague from sleeping in the same bed with an unprotected dog that has been roaming about in areas with plague (Gould et al., 2008). The infection is due to the hitchhiker rodent fleas. People in the west and people going west for vacation, who sleep with their dog in the tent or camper need to think about flea protection for their pet.

Summary
There are a number of flea associated pathogens common in California that can be deadly to people, deadly to pets, and to a great extent preventable through the judicious use of flea prevention.

References
Green JS et al 2011 A cluster of pediatric endemic typhus cases in Orange county, California. PIDJ 30 163-165.