Feline Calicivirus: What’s virulent, what’s not, and how worried should we be?

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Why are you here?

- Have you suspected feline calicivirus based on clinical signs?
- Have you diagnosed feline calicivirus in a shelter/foster home based on laboratory testing?
- Have you experienced a severe outbreak in a shelter including pneumonia and/or death caused by calicivirus?
Virus shuts down cat adoptions
Washington County shelter suspends feline placements
By DON BEHM
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Town of Polk - Cat adoptions and drop-offs at the Washington County Humane Society have been suspended for several weeks as shelter workers monitor an outbreak of an uncommon strain of feline calicivirus in cats at the facility, shelter representatives said.

Feline calicivirus can cause upper respiratory illnesses, including pneumonia, and sores on tongues and the inside of a cat's mouth, said humane society Executive Director Mamie Brown.

Though the virus generally is controlled through routine vaccination, infections caused by an uncommon and more virulent strain first seen in the United States in the late 1990s are not prevented by the standard vaccine, Brown said.

About two to three weeks ago, several cats at the shelter at 3650 state Highway 60 were found to have mouth sores and had stopped eating. "We weren't able to save some of them," Brown said.

As a precaution, the shelter suspended adoptions in late June, though the decision was not announced publicly, she said. There have been no reports of feline calicivirus infections in cats adopted earlier in June.

Tissue samples from a dead cat were sent last week to an animal health laboratory in Wyoming for testing. It tested positive for the uncommon strain, and the shelter was notified Monday.

On Tuesday, Brown publicly disclosed the outbreak at the shelter and the temporary suspension of adoptions and drop-offs.

Each of the 250 cats at the shelter has been vaccinated with a new vaccine that controls the rare strain, and those cats will be given a second dose later this month, Brown said. Then shelter staff will watch for infections for an additional two weeks to ensure the outbreak is under control.

The rare strain has not been found at other animal shelters in the region, Brown said.

People who want to give up their cats should call the Ozaukee Humane Society, Wisconsin Humane Society, Elmbrook Humane Society or Fond du Lac Humane Society, according to a statement from the Washington County facility.

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Humane Society puts down 200 cats after mass outbreak

Jun 21, 2007
DVM Newsmagazine

Humane Society puts down 200 cats after mass outbreak Springfield, Mo. - 6/21/07 - Almost 200 cats were euthanized and the remainder quarantined at the Southwest Missouri Humane Society (SMHS) after a suspected outbreak of the fast-spreading calicivirus.

Believed to have come from an infected feral or stray cat dropped off at the shelter, the outbreak was first identified the week of June 11 when one shelter cat died, according to a report by Ozarks First.

Unable to determine how many other felines were infected, workers decided to euthanize its entire feline population and then shutdown the facility for disinfection.

Many cats are vaccinated against the household calicivirus, but not the deadly strain. VS-FCV causes mouth ulcers, swelling and high fever and often leads to a painful death.

Since reopening June 18, SMHS will be vaccinating every cat for VS-FCV.
Calicivirus Vaccine Available for Cats

By Gary D. Norsworthy, DVM, DABVP

Fort Dodge Animal Health recently released a new vaccine that protects cats against the calicivirus and a virulent systemic feline calicivirus (VS-FCV) -- also known as the killer calici or the hemorrhagic calici -- that mutated from the feline calicivirus.

When I started studying about this virus, it seemed rare, with only nine documented outbreaks from 1998 to 2003. Despite the uncommon occurrences, the outbreaks were alarming. In a Los Angeles outbreak, 54 cats became infected. The disease is more severe in adult cats, with about 60 percent of affected adult cats dying.

The really good news is that Fort Dodge Animal Health has recently released a new vaccine that protects cats against the regular calicivirus and against the Killer Calici. Ask your veterinarian about having your cat protected against this deadly virus.
How worried should we be???

Calicivirus mutates often, spreads easily, is hard to disinfect, can be deadly, and vaccination does not always protect.

Calicivirus is very common but serious outbreaks remain rare, isolated events, especially among vaccinated cats.
Key Concepts: Dose Effect

- Thresh-hold depends on:
  - Virulence of pathogen
  - Host immune status (usually)
- Perfection rarely required
Key concept: carrier state

- An animal which is infected *and infectious* but not currently showing signs of disease
  - Pre-clinical, recovered, chronic
  - Healthy adults, moms, kittens
Shelter math problem

Carrier state plus dose effect plus transmission = disease
Feline Calicivirus (FCV)

- Un-enveloped RNA virus
- One of the top 2 causes of URI
- Numerous “semi-stable” strains with variable:
  - Virulence/clinical signs
  - Transmissibility
  - Vaccine susceptibility
    - Partial at best
Feline Calicivirus: clinical signs

- NONE
- Oral ulcers
- URI/conjunctivitis
- Limping
- Chronic oral inflammation
- Pneumonia
- Liver disease, hemorrhagic urinary tract infection, GI disease, neurologic disease, pustular and ulcerative skin disease
- “Virulent systemic disease”

*Kittens normally more severely affected than adults*
Virulent systemic FCV (VS-FCV)

- Swelling of face and limbs, widespread hair loss and ulceration
- Liver disease +/- other organ involvement
- Mortality up to 50%
- More on this later
Bad news

Age, vaccination and good immune function do not protect against virulent systemic FCV
The Many Faces of Feline Calicivirus
The Many Faces of Feline Calicivirus
The Many Faces of Feline Calicivirus
The Many Faces of Feline Calicivirus

Bad strains are the exception… but cats can be mildly infected and transmit the worst strains.
Feline calicivirus: a few more facts with practical implications

• Carrier state is common
• Potentially shed in all body secretions
  – Even hair!
• Aerosol transmission unlikely*
• Fomite transmission very easy
• Resistant to disinfection

How likely is it this cat will culture positive for feline calicivirus?

A. < 5%
B. 20-30%
C. 50-60%
D. > 80%
How likely is it *this* cat will culture positive for feline calicivirus?

A. < 5%
B. 20 - 30%
C. 50 - 60%
D. > 80%
Carrier state for FCV

• 50% shed at least 75 days after recovery
  – Dose decreases after resolution of signs
• Variable by strain
• Variable by cat
  – Kittens
  – Co-infected
  – Immunosuppressed
• Unrelated to stress

Up to 25% of healthy-appearing cats will test positive at any given time
How to give a cat calicivirus

Step 1.

Step 2.

Repeat as necessary 😞
How many fomites are in this picture?
Calici disinfection: what works?

A. Alcohol
B. Sodium hypochlorite
C. Chlorhexidine
D. Potassium peroxymonosulfate
E. Quaternary ammonium
F. Other
Calici Disinfection

- Fomite control
- Bleach 1:32
- Potassium peroxymonosulfate (Trifectant)
- Alcohol: ethanol 62%
  - Gloves when it counts
- Time?
Why does calici cause so much trouble?

- RNA virus + carrier state = many opportunities for mistakes to be made
  - Recombination within a cat or group
  - Immune pressure from vaccination?
- Mutations disappear as well as appear
Rolling the dice
Case study: FCV-Kaos

- West LA, Summer, 2002
- Rescue group
- Practice 1 – separate suites?
  - 1A: general practice – worked with rescue group
  - 1B: surgical referral/emergency
- Practice 2: large referral practice
- Practice 3: general practice – worked with rescue group
Tip of the iceberg

- June 22, 2002: Practice 1A
- 5 year old M/N indoor, vaccinated cat
- Hospitalized for monitoring after GI surgery
- Developed fever, arrested and died within 24 hours

Lucky 😞
June 22 – June 30

- Increased “post-surgical” complications
- “Blown IV catheters”
- Lucky’s housemates become ill???
- Clinic cats become ill
- Technicians’ cats become ill
Investigation

- Calicivirus cultured from multiple swabs and necropsies
- More affected practices identified
- Rescue group connection
- Over 50 cats affected, including vaccinated and unvaccinated kittens and adults
The culprit?

- Spay 6/17-6/24 at 1A
- Febrile, mild URI upon release
- 23/25 (92%) exposed rescue kittens developed VS-FCV-Kaos
- No cases in 15 unexposed rescue kittens

“Babs”: 3 month old female rescue group kitten
Important point: Strains are not “antigenically” or genetically related based on clinical signs.
Implications of viral characterization

• There is no way to distinguish virulent from less virulent strains based on genetic sequence
  – Unless comparing to a known virulent strain from a single outbreak

• There is no particular reason to think exposure/vaccination with a virulent strain will confer protection against another virulent strain
FCV-Kaos Shedding

Weeks post infection

Frequency

- Positive
- Negative
Important point

Spread fatal disease during acute outbreak

No spread 3 months after recover
Implications?
Suspicion of VS-FCV

• Preceded by “typical” FCV signs
• Swelling, *widespread* alopecia and ulceration
• Pathology
  – Peracute hepatocellular necrosis
  – Variable other organ involvement (pancreas, lung, spleen, lymph nodes, colon)
  – Identification of virus in tissue by immunohistochemistry
Oral ulcers do not equal VS-FCV

And not all cats with calicivirus have oral ulcers
Oral ulcers do not equal calicivirus!

Calici

Multiple pathogens

Quaternary ammonium toxicity

Herpes
FCV diagnostic samples: viral culture or PCR

- Acute oral and conjunctival swabs negative: probably not FCV
- Acute oral and conjunctival swabs positive: FCV carrier or FCV-associated disease
- Serum positive: probably FCV-associated disease
  - But not necessarily VS-FCV
  - And not necessarily the only infection
- Serum negative: FCV not ruled out
- Necropsy and immunohistochemistry required for definitive diagnosis of calici-associated disease
Recognition of VS-FCV

- Suggestive clinical signs
- Consistent diagnostic test results
- Adult cats severely affected
- Severe illness/death in some
- History of exposure
- Vaccine resistant?
- Highly transmissible?
Definitive diagnosis
What would you rule out first?

- I have a kitten who may have succumbed to the virulent calici virus. Kitten has been in a foster home for 3 months. Three kittens in the foster home have died suddenly within the past 1-2 weeks. I saw a 5-month old today, who, according to the foster home, was normal yesterday, laterally recumbent today. Some history of respiratory signs throughout the foster home cats. If I want to determine if calici was a factor here, where do I send tissues?
What would you rule out first?

A. Virulent calicivirus

B. *Bordetella* pneumonia

C. Panleukopenia

D. Disinfectant toxicity
Virulent calici lookalikes

- Strep canis
- Herpes
- Panleukopenia
- Quat toxicity
ALWAYS RULE OUT PANLEUKOPENIA FIRST
FAQ: When this cat has recovered, will she be a particular risk to others?
The answer depends on the signs in *these* cats...
...and on how long she’s been recovered

- Remember carrier state average 75 days
- Risk reduces with complete resolution of symptoms
- Virulence may decrease over time
  - 1-3 months?
FCV risk assessment

• Evaluate risk posed by *individual* based on disease manifestations in *group*:
  – Severity of worst disease
  – Health, age and vaccine status of affected individuals
  – Presence or absence of co-factors
  – Apparent ease of spread

• Risk likely reduces over time and with full resolution of signs

• **Highest risk** if healthy, vaccinated adults from clean environment are affected
Worst case scenario: outbreak management

- Diagnostic testing
  - Rule out controllable co-factors!
- Risk assessment
- Prolonged quarantine or euthanasia for ALL EXPOSED cats if high risk virulent calicivirus
  - Contact me
Quarantine check list

• 1-3 months after complete resolution of signs
• Ideally separate staff
• Absolutely separate clothing, boots or shoe covers, equipment, gloves
• 2-3 negative PCR/cultures at least 1 week apart to speed release
• Humane housing for long term care!
Implications for foster care?

- Fomite control ALWAYS for URI fosters
- Clothes, shoes and supplies
- Annual booster vaccine and/or 2-way vaccine?
- Caution with high risk cases/populations
Caution: *disease may not be expressed in the same population from which it arises*
Community risk

- Community risk is not dependent on whether a case or outbreak has occurred in that community.
- Population risk is dependent on the usual factors: crowding, presence of kittens, stress, immunosuppression, concurrent disease, poor sanitation, high turnover mixed with low turnover.
- Shelter and clinic risk is dependent on interaction with individuals from high risk populations and precautions taken when handling these.
Role of vaccination

- Vaccination reduces severity from susceptible strains
- Vaccine strains can establish carrier state
- Vaccine strains may cause disease
  - Limping kittens
  - Oral administration of SC vaccine
Types of FCV vaccines

• Killed vs. modified live
  – Speed of onset
  – Safety
• Subcutaneous vs. Intranasal
  – Speed of onset
  – Local immunity/infection
  – Shedding and mild signs
**Caution**

- SC MLV FCV can cause severe disease when ingested or inhaled
- Do not draw up vaccine near cat’s face
- Wipe spills with Trifectant, bleach or alcohol
More bad news

<table>
<thead>
<tr>
<th>Date</th>
<th>Susceptible to F9*</th>
<th>Susceptible to 2280*</th>
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<tbody>
<tr>
<td>1958-1979 (USA)</td>
<td>88% (11/13)</td>
<td>92% (12/13)</td>
</tr>
<tr>
<td>1980-1989 (USA)</td>
<td>56% (2/9)</td>
<td>78% (7/9)</td>
</tr>
<tr>
<td>1990 – present (USA)</td>
<td>43% (26/61)</td>
<td>71% (43/61)</td>
</tr>
<tr>
<td>1980-present (UK)</td>
<td>10% (10/98)</td>
<td>42% (41/98)</td>
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*10 units of antibodies
Vaccine strategies

- Broad, rapid protection from non-replicating vaccine probably optimal
- Vectored/recombinant
- “Multivalent”
- Safety versus efficacy?

Multivalent vaccination?
Mutivalent vaccines

- All strains
- Nasty strains
- Vaccine strain A

Diagram:
- B
- C
- Nasty strains


Vaccination in the meantime

• Most shelters: MLV as part of FVRCP
  – 2-way IN herpes/calici short term during outbreak?
  – Will cause culture/PCR positive

• Long term/low turnover shelters/sanctuaries with low panleukopenia risk: 2 way killed (Fort Dodge calicivax) ?
  – Remember booster in 3-4 weeks

• Foster homes: annual booster, Fort Dodge calicivax if you already use killed?
A very short slide about treatment

- Supportive care
- Steroids?
- Interferon?
- IN vaccine for exposed?
- Don’t give up!
Reason for optimism


- Two visits, six weeks apart, were made to a cat rescue shelter and single oropharyngeal swabs were taken from all the compliant cats. Feline calicivirus was isolated from 14 of 45 swabs (31 per cent) taken on the first visit and 12 of 46 swabs (26 per cent) taken on the second visit. All the isolates obtained from cats sharing the same pen or isolates obtained from the same cat on successive visits, were less than 5 per cent distant, whereas most of the isolates from cats in different pens were more than 20 per cent distant. Phylogenetic analysis showed that at least seven distinct field isolates were present in the cattery. *The only good evidence for virus transmission within the cattery was a case* in which two viruses isolated from cats in different pens had sequences that were less than 5 per cent distant.
FCV: key strategies for prevention

- Attention to fomites
- Effective disinfectants
- Double-sided housing
- Segregation of kittens
- Speedy release of recovered cats
- MLV vaccination for most
- Diagnosis and management of outbreaks
Thank You!!!

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