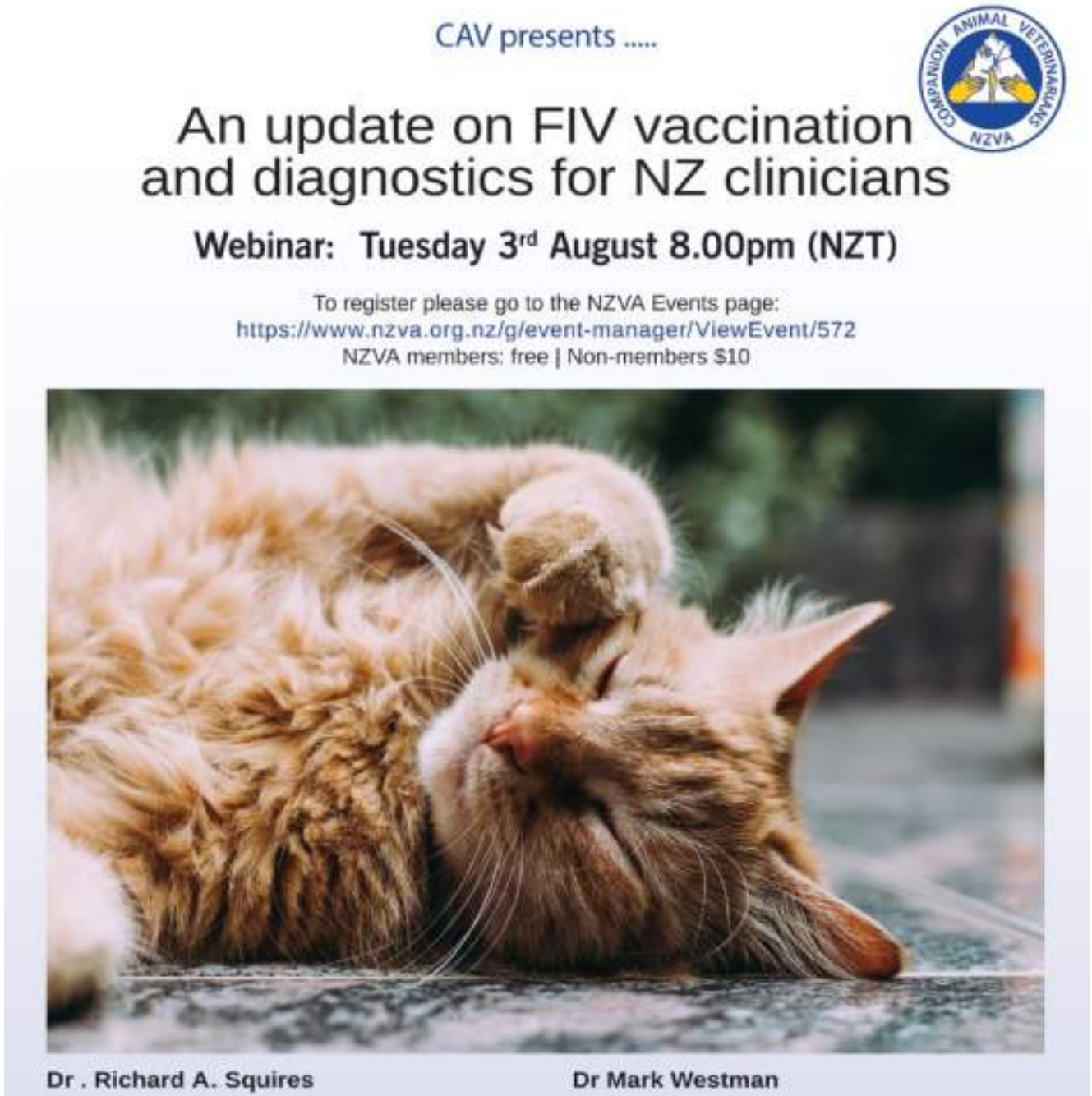

Richard A. Squires

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Conflict of Interests Statement

- I have received funding for research, teaching, authoring of technical documents, and consultancy activities from multiple vaccine manufacturing companies over the years, including Zoetis, Boehringer Ingelheim, and MSD Animal Health.

- I am currently Chairman of the WSAVA Vaccination Guidelines Group. WSAVA VGG currently designates the existing FIV vaccine as “non-core”. I am not speaking on behalf of WSAVA, nor for the VGG, tonight. I am just presenting some of my own views.

My interest in FIV began…

1986

REPORTS

Isolation of a T-lymphotropic virus from domestic cats with an immunodeficiency-like syndrome

NC Pedersen, EW Ho, ML Brown, JK Yamamoto
+ See all authors and affiliations

Science 13 Feb 1987:
Vol. 235, Issue 4790, pp. 790-793
DOI: 10.1126/science.3643650

Abstract

A highly T-lymphotropic virus was isolated from cats in a cattery in which all the animals were seronegative for feline leukemia virus. A number of cats in one pen had died and several had an immunodeficiency-like syndrome. Only 1 of 18 normal cats in the cattery showed serologic evidence of infection with this new virus, whereas 10 of 25 cats with signs of ill health were seropositive for the virus. Tentatively designated feline T-lymphotropic lentivirus, this new feline retrovirus appears to be antigenically distinct from human immunodeficiency virus. There is no evidence for cat-to-human transmission of the agent. Kittens experimentally infected by way of blood or plasma from naturally infected animals developed generalized lymphadenopathy several weeks later, became transiently febrile and leukopenic, and continued to show a generalized lymphadenopathy 5 months after infection.

FTLV = FIV

1987

Feline immunodeficiency virus

by
Margaret Hosie
Andrew Sparkes
Cherida Hopper

Margaret J. Hosie graduated in 1987 from the Royal (Dick) School of Veterinary Studies in Edinburgh, with honours in physiological sciences. Since then she has been working in the department of veterinary pathology at the University of Glasgow Veterinary School, engaged in research for a PhD on feline immunodeficiency virus.

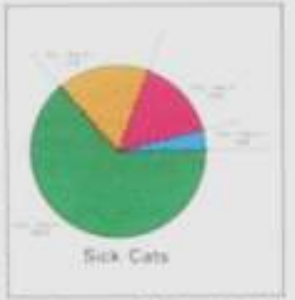
Andrew Sparkes graduated from the Royal Veterinary College (London) in 1983. After spending five years in general practice he joined the department of Veterinary Medicine at Bristol University in 1988 as Feline Advisory Bureau Scholar. Andrew now holds the position of Dupharl Feline Fellow at Bristol University, and his interests include all aspects of feline medicine.

SINCE its discovery three years ago, feline immunodeficiency virus (FIV) has been found to be widespread and to cause significant disease in the cat.

FIV was first isolated from a household in which a group of cats was suffering from what appeared to be an immunodeficiency syndrome (Pedersen and others 1987), similar to that seen previously in cats with feline leukaemia virus (FeLV), or in humans with acquired immune deficiency syndrome (AIDS). The virus was designated feline T lymphotropic lentivirus (FTLV), but its name was recently changed to feline immunodeficiency virus (FIV) to correspond with internationally recognised nomenclature.

FIV has subsequently been isolated throughout the world. There is evidence from stored serum samples that the virus was present in the UK in 1975 (Gruffydd-Jones and others 1988) and in the USA in 1968. It is likely that FIV has been present for much longer. Many clinical cases in the past which apparently displayed classic signs of FeLV infection, but from which FeLV was not isolated, may have been associated with FIV infection.

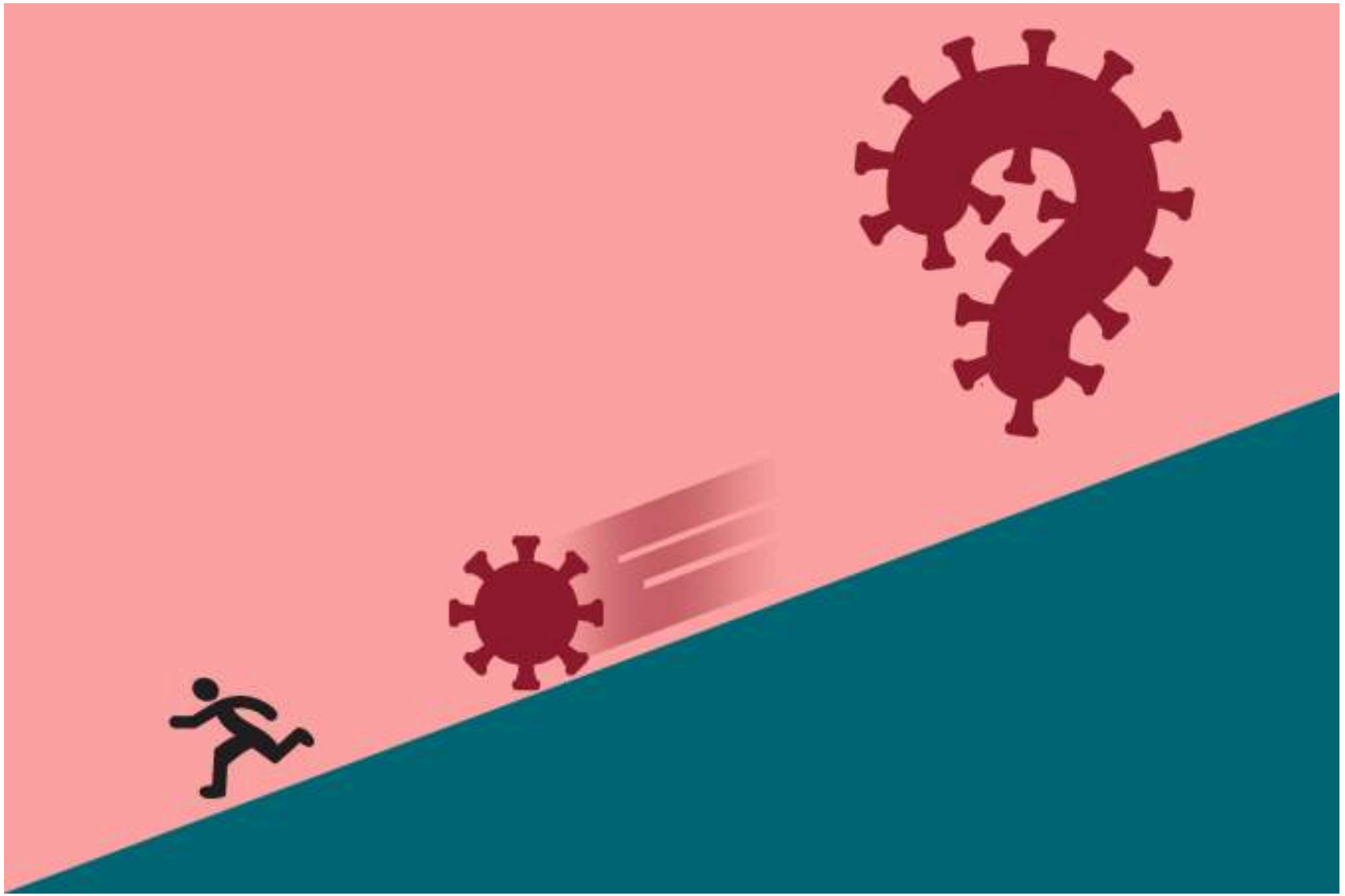
It has been demonstrated that FIV and FeLV can co-exist in the same cat, but infection with one does not appear to affect the likelihood of the other being present. Cats infected with FIV produce antibodies against the viral proteins and, in contrast to FeLV infection, these co-exist with the virus. This antibody response is insufficient to entirely clear the virus and a persistent infection develops, as occurs with other lentiviruses.



Prevalence of FIV and FeLV in 1796 sick cats in the UK

https://en.wikipedia.org/wiki/Reptiles_(M._C._Escher)

Clinical decision-making / Lack of Data / Uncertainty



https://www.nytimes.com/2020/04/07/science/coronavirus-uncertainty-scientific-trust.html

Veterinary clinicians must be able to manage cases and make decisions where there is incomplete or unclear data.

[In this respect, I think far more is demanded of veterinarians than of medical doctors]

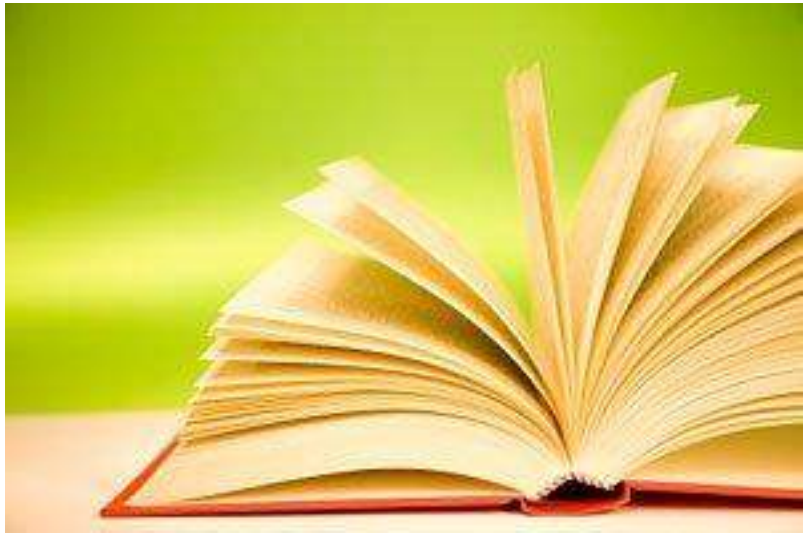
2020

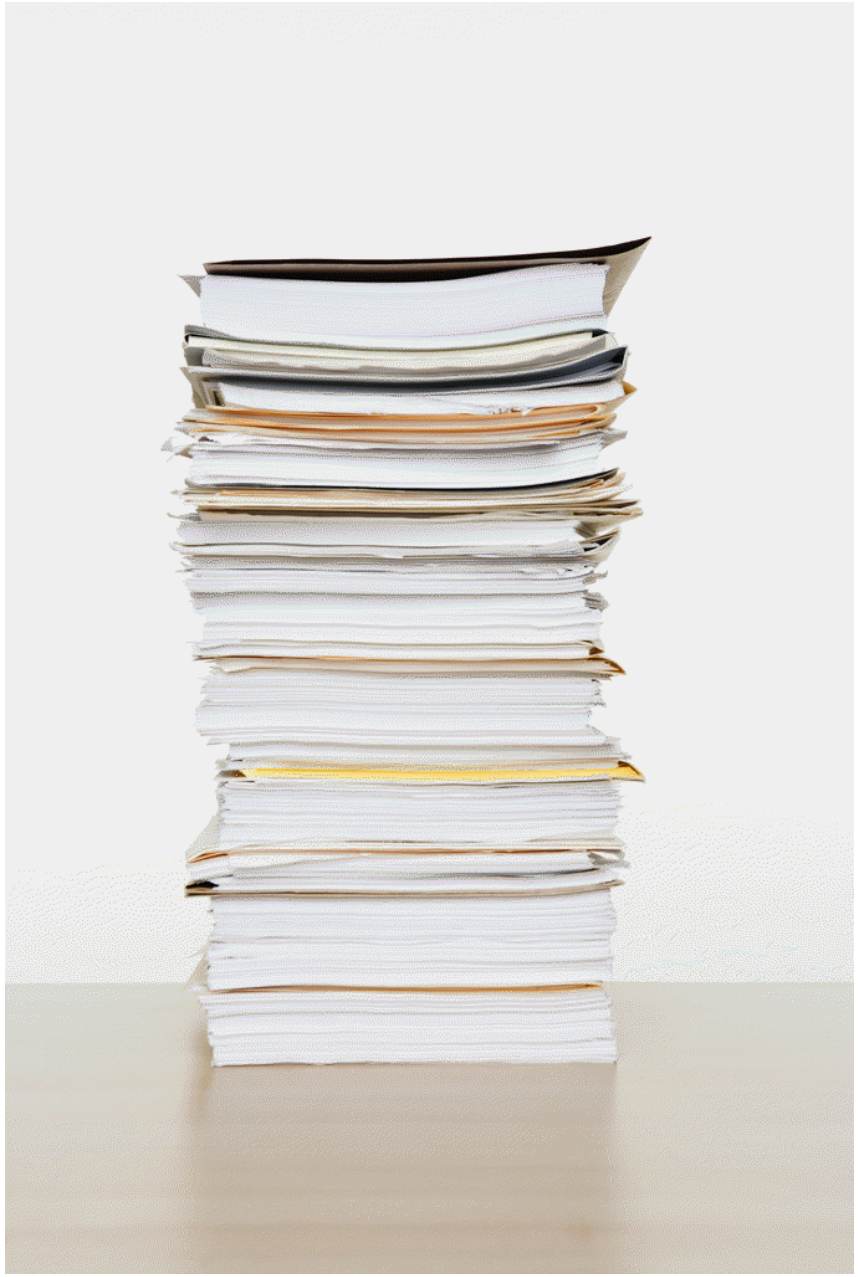
NEW!

3	**Demonstrate the ability to critically review and evaluate evidence, in support of practising evidence based veterinary medicine.**	New graduates must be able to appreciate the difference in value to be attached to different sorts of literature, presentations and evidence, for example, recognising commercial and other forms of bias.
13	**Demonstrate ability to manage in situations where information is incomplete, deal with contingencies, and adapt to change.**	Veterinary surgeons must be able to manage cases and make decisions where there is incomplete or unclear data. For example, it is not always possible to run a full set of tests or range of diagnostic procedures which may preclude the investigation of the 'perfect' case. They need to be able to adapt their approach to fit changing circumstances, know how to cope appropriately when either making other plans or adapting to contingencies and the unexpected, and identify appropriate options for further diagnosis, treatment and/or referral, should a case require it.
26	**Act professionally in complex situations.**	This could be situations where there is ambiguity and/or uncertainty, where there may be no clear diagnoses.
43	**Advise on, and implement, preventative programmes appropriate to the species and in line with accepted animal health, welfare and public health and environmental standards.**	New graduates will need to be able to assess health and welfare records (and production records where appropriate) and implement health plans. This does not only apply to production animals but is important for any kept animals, particularly those kept in groups.

https://www.rcvs.org.uk/document-library/day-one-competences/

Some questions about vaccination of cats against FIV





What commercial FIV vaccines exist in the world? Where are they sold?

Are there any new FIV vaccines in the pipeline? If not, why the dry pipeline?


THERE CAN BE ONLY ONE

Fel-O-Vax® FIV

2002 – 2017 USA

2003 – 2017 Canada

2004 onwards New Zealand, Australia

2008 onwards Japan

1994

Table I
Vaccines which did not protect from FIV infection

	Type of vaccine	*Vaccine*	*Cellular origin of vaccine*	*Virus strain*	*Dose of inoculum*	*Adjuvant*	*Immunization schedule in weeks*	*Challenge virus in id_{50}*	*No. cats infected/no. challenged*
Hosie *et al.* 1992	virus vaccine	FIV	feline T-cells	T-cell-GL-8	10 μg p24&17	iscoms	0,5,18	20 GL-8	5/5
		iscoms controls	–	–	–	–	–	20 GL-8	3/4
	recombinant vaccine	p24 iscoms	E. coli	GL-8	50 μg p24	iscoms	0,3,5,7	20 GL-8	4/4
Verschoor, de Ronde and Hesselink unpublished	inactivated virus vaccines	CrFK virus	CrFK	UT113	100 μg	alu-oil	0,6	10 UT113	5/5
		CrFK virus	CrFK	UT113	100 μg	alu-oil	0,6	1000 UT113	5/5
Hosie *et al.* 1992	inactivated cell vaccine	cellvac-1	feline T-cells	GL-8	2×10^6 cells	quil A	0,3,6,9,12,15	20 GL-8	5/5
		controls	–	–	–	–	–	20 GL-8	4/5
Hosie *et al.* unpublished	inactivated cell vaccine	cellvac-2	Q201	GL-8	10^7 cells	quil A	0,3,6	20 GL-8	4/4
		controls	–	–	–	quil A	0,3,6	20 GL-8	4/4
		controls	–	–	–	–	–	20 GL-8	3/4
Verschoor, de Ronde and Hesselink, unpublished	inactivated cell vaccines	vaccine-1	CrFK	UT113	2.5×10^7 cells	alu/MDP	0,3,6	10 UT113	5/5
		vaccine-2	CrFK	–	2.5×10^7 cells	alu/MDP	0,3,6	10 UT113	3/3
		vaccine-3	thymocytes	UT113	1.5×10^7 cells	alu/MDP	0,3,6	10 UT113	3/5
		vaccine-4	thymocytes	–	1.5×10^7 cells	alu/MDP	0,3,6	10 UT113	2/3
		controls		–	–	–	–	10 UT113	2/2

29

From: Hosie MJ. The development of a vaccine against feline immunodeficiency virus. *Br Vet J.* 1994 Jan-Feb;150(1):25-39

1997

ELSEVIER

Veterinary Microbiology 58 (1997) 155–165

veterinary microbiology

Effect of dual-subtype vaccine against feline immunodeficiency virus infection

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Received 2 April 1997; accepted 25 July 1997

2018

Dry pipeline?

viruses

MDPI

Review

Lessons Learned in Developing a Commercial FIV Vaccine: The Immunity Required for an Effective HIV-1 Vaccine

Bikash Sahay and Janet K. Yamamoto *

Department of Infectious Diseases and Immunology, College of Veterinary Medicine, University of Florida, P.O. Box 110880, Gainesville, FL 32611-0880, USA; sahayb@ufl.edu

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Received: 30 March 2018; Accepted: 20 May 2018; Published: 22 May 2018

2019

Dry pipeline?

viruses

MDPI

Article

Immunogenicity and Efficacy of a Novel Multi-Antigenic Peptide Vaccine Based on Cross-Reactivity between Feline and Human Immunodeficiency Viruses

Bikash Sahay [1], Alek M. Aranyos [1], Meerambika Mishra [1], Andrew C. McAvoy [1], Marcus M. Martin [2], Riuyu Pu [1], Sayaka Shiomitsu [1], Keijiro Shiomitsu [3], Michael J. Dark [4], Missa P. Sanou [5], Shannon R. Roff [6], Mobeen H. Rathore [7] and Janet K. Yamamoto [1,*]

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5 Merck & Co., 770 Sumneytown Pike, North Wales, PA 19486, USA; missa.sanou@merck.com

6 Charles River Laboratories Inc., 15 Worman's Mill Court, Suite I, Frederick, MD 21701, USA; Shannon.Roff@crl.com

7 Education, and Service (UF CARES), University of Florida Center for HIV/AIDS Research, Jacksonville, FL 32209-6810, USA; Mobeen.Rathore@jax.ufl.edu

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Received: 15 November 2018; Accepted: 31 January 2019; Published: 3 February 2019

2002/3 – 2017

Why was the only commercially-available FIV vaccine taken off the market in North America?

It sold relatively poorly. But why?

https://khpet.com/blogs/cats/whats-a-safe-house-temperature-for-cats-in-the-summer

Courtesy of Dr Hilary Burbidge

“The larger issue” – Vaccination led to diagnostic confusion…

Available online at www.sciencedirect.com
SCIENCE DIRECT®
Biologicals 33 (2005) 215–217
BIOLOGICALS
www.elsevier.com/locate/biologicals

Feline immunodeficiency virus vaccine: Implications for diagnostic testing and disease management

James R. Richards*
Cornell Feline Health Center, Cornell University College of Veterinary Medicine, S3 111 Schurman Hall, Ithaca, NY 14853, USA

Accepted 18 August 2005

2005

5. Conclusion

At this time it is impossible to know whether vaccination with Fel-O-Vax® FIV will be, on balance, beneficial or harmful. To its credit, the vaccine has the potential to protect vaccinates from infection. However, the likelihood that protection will be induced is unknown; field efficacy data are lacking and will probably remain so for the foreseeable future.

The larger issue is the confusion that vaccination causes in determining infection. Accurate diagnosis of FIV infection status is important for both infected and uninfected cats. Misdiagnosis of infection in vaccinated uninfected cats, and kittens born to vaccinated queens, may lead to their being euthanatized. The inability to determine the infection status of a vaccinated cat may have other negative effect on its health; if infection remains undetected, the cat will not receive the specialized care it requires. Likewise, whether vaccination will reduce or even increase the incidence of infection in the cat population at large is unknown (for example, vaccinates, mistakenly assumed to be uninfected, might be permitted outdoors or adopted into households with resident cats, thereby infecting cats to which they would not otherwise be exposed). From both an epidemiologic and an individual cat perspective, the question, “Is it better to vaccinate or better not to vaccinate?” remains impossible to answer with any degree of certainty.

FIV Ab +ve

Vaccinated?

or

Infected?

2005

Accuracy of polymerase chain reaction assays for diagnosis of feline immunodeficiency virus infection in cats

SMALL ANIMALS

P. Cynda Crawford, DVM, PhD; Margaret R. Slater, DVM, PhD; Julie K. Levy, DVM, PhD, DACVIM

JAVMA, Vol 226, No. 9, May 1, 2005

2004

The variability of serological and molecular diagnosis of feline immunodeficiency virus infection

D. Bienzle, F. Reggeti, X. Wen, S. Little, J. Hobson, S. Kruth

Abstract — Diagnosis of feline immunodeficiency virus (FIV) infection by polymerase chain reaction (PCR) has recently become available, but little is known about the performance of this assay. The purpose of this study was to determine the sensitivity and specificity of PCR diagnosis of FIV infection. Replicate aliquots of blood samples from cats identified as FIV positive or negative by 2 previous enzyme-linked immunosorbent assay (ELISA) results, and from clinically healthy dogs, were submitted to different laboratories for FIV serologic diagnosis and PCR. The PCR products obtained in 1 laboratory were sequenced to determine the FIV subtype. The PCR assays correctly identified 100%, 80%, and 50% of the FIV-positive samples, and 100%, 90%, and 70% of FIV-negative samples. Each dog sample was reported as FIV PCR positive at least once, and FIV subtypes A, B, and C were identified. It was concluded that PCR tests currently available for FIV infection are unreliable, with highly variable sensitivity and specificity.

Can Vet J 2004; 45:753-757

Since its discovery, has FIV evolved to become so mildly pathogenic that we need not be concerned about trying to prevent FIV infections or minimise FIV-associated diseases?

Or has it never been particularly pathogenic?

"...it is much harder to associate natural infection with the development of disease and several recent studies in North America have failed to detect significant differences in the life-span of cats infected by FIV and the life-span of uninfected cats."

(Ravi *et al.* 2010)

CLINICAL UPDATE

Study claims no evidence that Fel-O-Vax FIV prevents FIV infection in cats in New Zealand

JOHN MUNDAY, BVSc, PhD, DSc, Diplomate ACVP

Recently the results of a study on the efficacy of the Fel-O-Vax vaccine (Zoetis New Zealand Ltd, Auckland, NZ) in preventing feline immunodeficiency virus (FIV) infection in cats in New Zealand were published in 'Veterinary Microbiology' (Stickney *et al.* 2020;-see abstract at end of this article). This study was supported by Healthy Pets New Zealand (formerly the Companion Animal Health Foundation) and is a great example of the benefits of having a New Zealand companion animal charity supporting New Zealand-based research.

In the study, the FIV infection status of 185 privately owned cats from throughout New Zealand was determined. The health status of none of the cats was known. Of these cats, 26 (14%) were infected by FIV. Surprisingly, the infected cats included 7/82 (8.5%) unvaccinated cats and 19/103 (18.4%) cats that had been vaccinated against FIV according to the recommendations of the manufacturer. Of the 19 FIV-positive vaccinated cats, 11 had been vaccinated as kittens and so had not been confirmed to be uninfected prior to vaccination. However, even with these cats excluded, 8.7% of cats that had been confirmed to be FIV-negative prior to vaccination subsequently became infected by FIV. As the rates of FIV infection were roughly the same in vaccinated and unvaccinated cats, the study provided no evidence that Fel-O-Vax FIV prevented FIV infection in cats in New Zealand. This is consistent with a study in Australia that also showed no significant effect of Fel-O-Vax FIV vaccination in preventing FIV infection (Westman *et al.* 2016). Furthermore a review of the nine previously performed laboratory-based studies of this vaccine revealed an efficacy that varied from 0% to 100% with an overall efficacy of just 66%.

Zann Lee for Unsplash

Quality vs Quantity of Life

Can Vet J 2010;51:271–276

Naturally acquired feline immunodeficiency virus (FIV) infection in cats from western Canada: Prevalence, disease associations, and survival analysis

Madhu Ravi, Gary A. Wobeser, Susan M. Taylor, Marion L. Jackson

Abstract – This retrospective study evaluated epidemiologic features and disease associations of feline immunodeficiency virus (FIV) infection in client owned cats from western Canada. Among 1205 cats that were tested 66 (5.5%) were positive for FIV antibody (FIV^+) with a higher prevalence in males than females. FIV^+ cats were older than the overall population. Epidemiologic features and disease associations were compared between 58 FIV^+, but feline leukemia virus negative ($FeLV^-$) cats and 58 age and sex matched FIV-negative (FIV^-), $FeLV^-$ cats. FIV positivity was associated with a history of bite wounds, increasing age, and male gender. Lethargy and oral diseases were significantly associated with FIV positivity. Although several FIV^+ cats were euthanized, the survival time of FIV^+ cats after diagnosis was not significantly different from that of FIV^- cats. In summary, FIV prevalence was low in cats from western Canada, clinical signs/diseases were mild, and lifespan was not different in FIV^+ cats.

Lethargy and likely painful oral diseases were significantly associated with FIV positivity

Can Vet J 2010;51:271–276

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In this study, the control comparator group were <u>not</u> healthy age- and sex-matched cats. They went to the vet and were judged to need blood sampling. "Most had clinical problem(s)"

Can Vet J 2010;51:271–276

Think about use of *these* cats as controls…

- QUOTE: *Cats were retrovirus tested for one of the following reasons*:-
  - to establish retrovirus status before introduction to a new household;
  - to evaluate possible underlying infection *(presumably because they were ill)*;
  - to evaluate potential exposure to these viruses after a known fight with another cat *(tested, but perhaps too early to detect FIV infection)*;
  - to establish retrovirus status before vaccinating for FeLV *(FIV vaccine was not yet available then)*

Can Vet J 2010;51:271–276

Naturally acquired feline immunodeficiency virus (FIV) infection in cats from western Canada: Prevalence, disease associations, and survival analysis

Madhu Ravi, Gary A. Wobeser, Susan M. Taylor, Marion L. Jackson

1205 cats in western Canada that were taken to the vet, who judged them to need blood sampling. "Most had clinical problems". 58 cats were FIV +ve / FeLV -ve. So 58 FIV -ve / FeLV -ve cats were RANDOMLY selected from the remaining 1147 as controls. It was not the healthy cats chosen as controls. ***Why only 58 controls?***

Can Vet J 2010;51:271–276

- Lethargy
- Stomatitis
- Gingivitis
- Periodontal disease

Why only 58 controls?

- Ocular diseases?
- GI signs?

In those with kidney disease, it was more severe in the FIV +ve cats

Table 3. Clinical signs, disease conditions, and lifestyle of FIV⁺ and FIV⁻ cats

Clinical signs, diseases, and lifestyle	FIV⁺ (n = 58)	FIV⁻ (n = 58)	Odds ratio (95% CI)	P-value
Prior bite wounds	17	5	4.4 (1.37–14.98)	0.004[a]
Anorexia	13	14	0.91 (0.35–2.34)	0.83
Lethargy	13	5	3.06 (0.92–10.76)	0.04[a]
Weight loss	7	11	0.59 (0.19–1.81)	0.3
Gastrointestinal signs (vomition and diarrhea)	4	10	0.36 (0.0–1.35)	0.08
Fever	3	0	∞0.24	
Lymphadenopathy	2	2	1 (0.1–10.38)	1
Oral disease (stomatitis/gingivitis/ periodontal disease)	23	6	5.7 (1.94–17.52)	0.0006[a]
Ocular disease	11	4	3.16 (0.85–12.72)	0.053
Respiratory disease	10	11	0.89 (0.3–2.5)	0.8
upper respiratory tract infection	7	10	0.66 (0.2–2.08)	0.43
lower respiratory tract infection	3	1	3.11 (0.27–8.05)	0.31
Renal disease[b]	9	14	0.67 (0.25–1.76)	0.37
Endocrinopathies	7	4	1.85 (0.4–8.1)	0.34
diabetes mellitus	3	2	1.53 (0.2–13.68)	1
hyperthyroidism	4	2	2.07 (0.31–17.1)	0.68
Skin disease	6	5	1.22 (0.31–4.99)	0.75
Otitis externa	6	2	3.23 (0.55–24.34)	0.27
Neoplasia	2	4	0.48 (0.06–3.25)	0.68
Anemia	2	1	2.04 (0.14–5.9)	0.56
Cardiac disease	1	4	0.24 (0.01–2.37)	0.36
Lifestyle[c]				
outdoor	21	9	2.72 (0.7–10.41)	0.14
indoor	6	7	0.37 (0.08–1.69)	0.17

[a] $P < 0.05$ considered significant.
[b] Renal failure was diagnosed in 6 of 9 FIV⁺ cats and 2 of 14 FIV⁻ cats.
[c] Lifestyle information available for 27 FIV⁺ and 16 FIV⁻ cats.

2010

SMALL ANIMALS

Association between naturally occurring chronic kidney disease and feline immunodeficiency virus infection status in cats

Joanna D. White, BVSc; Richard Malik, DVSc, MVetClinStud, PhD; Jacqueline M. Norris, BVSc, MVS, PhD; Nicholas Malikides, BVSc, MVetClinStud, PhD

Objective—To investigate the association between naturally occurring chronic kidney disease (CKD) and FIV infection status in cats in Australia.

Design—Case-control study.

Animals—73 cats with CKD and 69 cats without historical, physical, or clinicopathologic evidence of CKD.

Procedures—Cats were tested for serum antibodies against FIV glycoprotein 40 (gp40) by use of an immunomigration assay. Information regarding age, breed (purebred or domestic), and sex was obtained from medical records. Analysis was performed on data from cats stratified into 2 age categories (< 11 years old and ≥ 11 years old). Univariable and then multivariable analyses were performed to investigate the relationship between CKD and the study variable (FIV infection), the latter analysis accounting for breed (purebred or domestic), sex, and veterinary hospital of origin.

Results—Results of multivariable analysis revealed that younger cats with CKD (< 11 years old) were significantly more likely to have positive test results for serum antibodies against FIV gp40 than were cats without CKD. No significant associations were found between CKD and FIV infection, breed, sex, or hospital of origin among older (≥ 11 years old) cats in the multivariable analysis.

Conclusions and Clinical Relevance—Among cats < 11 years of age, those with CKD were significantly more likely to have positive test results for serum antibodies against FIV gp40 than were cats without CKD. It cannot be definitively established from results of this study whether infection with FIV preceded the development of CKD, and the role, if any, of FIV in the establishment or progression of CKD remains to be determined. (*J Am Vet Med Assoc* 2010;236:424–429)

2020

viruses

MDPI

Review

Feline Morbillivirus, a New Paramyxovirus Possibly Associated with Feline Kidney Disease

Eun Jin Choi [1,†], Victoria Ortega [2,†] and Hector C. Aguilar [1,2,*]

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2 Department of Microbiology and Immunology, College of Veterinary Medicine, Cornell University, Ithaca, NY 14850, USA; vo56@cornell.edu
* Correspondence: ha363@cornell.edu; Tel.: +1-607-253-4029
† These authors contributed equally to this work.

Received: 22 March 2020; Accepted: 28 April 2020; Published: 1 May 2020

Abstract: Feline morbillivirus (FeMV) was first isolated in stray cats in Hong Kong in 2012. Since its discovery, the virus has been reported in domestic cats worldwide, including in Hong Kong, Japan, Italy, US, Brazil, Turkey, UK, Germany, and Malaysia. FeMV is classified in the *Morbillivirus* genus within the *Paramyxoviridae* family. FeMV research has focused primarily on determining the host range, symptoms, and characteristics of persistent infections in vitro. Importantly, there is a potential association between FeMV infection and feline kidney diseases, such as tubulointerstitial nephritis (TIN) and chronic kidney diseases (CKD), which are known to significantly affect feline health and survival. However, the tropism and viral entry mechanism(s) of FeMV remain unknown. In this review, we summarize the FeMV studies up to date, including the discoveries of various FeMV strains, basic virology, pathogenicity, and disease signs.

Keywords: chronic kidney disease; feline morbillivirus; paramyxovirus; persistent infection; tubulointerstitial nephritis

2002

Prevalence of feline leukaemia virus and antibodies to feline immunodeficiency virus and feline coronavirus in stray cats sent to an RSPCA hospital

A. MUIRDEN

A total of 517 stray cats at an RSPCA veterinary hospital were tested for feline leukaemia virus (FeLV), feline coronavirus (FCoV) and feline immunodeficiency virus (FIV). The prevalence of FeLV was 3·5 per cent in all the cats, 1·4 per cent in healthy cats and 6·9 per cent in sick cats. FeLV positivity was associated only with disease of non-traumatic origin. Antibodies to FCoV were present in 22·4 per cent of the cats, and their prevalence was significantly higher in cats over two years old and in feral/semiferal cats. The prevalence of antibodies to FIV was 10·4 per cent in all the cats, 4·9 per cent in healthy cats and 16·7 per cent in sick cats. The prevalence of FIV antibodies was significantly higher in entire males and neutered males than in females, in cats over two years old compared with younger cats, and in cats suffering disease of non-traumatic origin rather than in healthy cats or cats suffering only from trauma. Sex, age and health status were each independently highly associated with FIV antibodies.

Veterinary Record (2002)
150, 621-625

"independently highly associated…"

2011

Feline Immunodeficiency Virus: Disease Association Versus Causation in Domestic and Nondomestic Felids

Joanna White, BVSc, MACVSc[a,*], Alison Stickney, BVSc, MVS, MACVSc[a], Jacqueline M. Norris, BVSc, PhD[b]

KEYWORDS
• Immunodeficiency virus, feline • Animals, domestic
• Animals, nondomestic • HIV

Since its discovery,[1] feline immunodeficiency virus (FIV) has been the focus of substantial and sustained research efforts, partially in recognition of its potential role as an animal model for human immunodeficiency virus (HIV).[2] Whereas there have been considerable insights into the pathophysiology and immunologic responses to FIV infection, important questions remain regarding the impact of FIV infection on an individual cat and its likely association with specific disease syndromes.

PATHOPHYSIOLOGY

FIV-induced immune dysfunction is characterized by a paradoxical state involving immune hyperactivation and immune suppression. As the disease progresses, FIV-infected cats eventually lose the ability to mount an effective cell-mediated immune response against opportunistic pathogens. Early reports of immune dysfunction demonstrated reduced blastogenesis of peripheral blood mononuclear cells following mitogen stimulation in FIV-infected cats compared with uninfected cats.[3–6] Many studies have since attempted to further characterize the immune dysfunction, concluding that it is multifactorial. Loss of $CD4^+$ T cells and associated reductions in cytokines, chronic antigenic stimulation and anergy, activation of immune regulatory Treg cells, and dendritic cell dysfunction are the major mechanisms by which immune dysfunction can occur in FIV-infected cats.[5,7]

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0195-5616/11/$ – see front matter © 2011 Published by Elsevier Inc.

"Oral cavity disease has been identified as an important limitation on quality of life for FIV-positive cats."

"Among all the studies attempting to associate FIV infection with disease, the most convincing are those reports describing neurologic disease and lymphoma."

"Studies of naturally occurring disease may underestimate the role of FIV because of the potentially prolonged asymptomatic period."

Did the commercially available FIV vaccine merit being designated as ***non-core*** *by vaccination guidelines groups?*

Does it still merit that designation?

AAFP 2006 – Non-core

FIV Killed virus, adjuvanted[a] Injectable	Three doses are required: the initial dose is administered as early as 8 weeks of age; 2 subsequent doses should be administered at an interval of 2 to 3 weeks.	Three doses are required: each dose is administered 2 to 3 weeks apart.	When indicated, a single dose is given 1 year following the last dose of the initial series, then annually in cats determined to have sustained risk of exposure.[b]	Noncore • FIV vaccine should be restricted to cats at high risk of infection.[b] • Vaccination induces production of antibodies indistinguishable from those developed in response to FIV infection and interferes with all antibody-based FIV diagnostic tests for at least a year following vaccination. • Cats with positive FIV antibody assay results may have antibodies as a result of vaccination, infection, or both. • Antibodies against FIV are passed from vaccinated queens to their kittens in colostrum. Colostrum-derived antibodies interfere with FIV diagnosis past the age of weaning in most kittens, but this interference appears to wane by 12 weeks of age. • Cats should test negative for antibodies against FIV immediately prior to vaccination. • Permanent identification of vaccinated cats (eg, microchip) will help clarify vaccination status but will not indicate that such cats are free of infection.

AAFP 2013 – Non-core

Vaccination categories

Core versus von-core

- The Advisory Panel has revised which vaccines are considered core and non-core, recognizing that antigens other than feline parvovirus, herpesvirus-1 and calicivirus may not be required or available in all situations or in all countries. The specific circumstances in which non-core vaccines may be appropriate vary considerably.
- CORE VACCINES are those recommended for all cats. The Advisory Panel recommends that feline panleukopenia (FPV), feline herpesvirus-1 (FHV-1) and feline calicivirus (FCV) vaccines fall into this category.
- NON-CORE VACCINES should be administered to cats in specific risk categories on the basis of an individual risk/benefit assessment. The Advisory Panel believes that rabies, feline leukemia virus (FeLV), feline immunodeficiency virus (FIV), *Chlamydophila felis*, *Bordetella bronchiseptica*, feline infectious peritonitis (FIP) and dermatophyte vaccines fall into this category.
- Vaccination against rabies is essential in regions where it is required by statute/law or where the virus is endemic.
- The Advisory Panel recommends that all cats under 1 year of age be vaccinated against FeLV and receive a booster vaccination 1 year later. After 1 year of age, the need for subsequent vaccination is determined by risk factors that the individual is exposed to.

The reader is referred to the section on risk/benefit assessment (pages 788–789) and the accompanying Disease Information Fact Sheets (details on page 799) for further specifics regarding each vaccine antigen.

AAFP 2020 – Not mentioned

WSAVA 2016
Non-core

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WSAVA Global Veterinary Community | Vaccination Guidelines Group

GUIDELINES FOR THE VACCINATION OF DOGS AND CATS

COMPILED BY THE VACCINATION GUIDELINES GROUP (VGG) OF THE WORLD SMALL ANIMAL VETERINARY ASSOCIATION (WSAVA)

M. J. Day[1], M. C. Horzinek[2], R. D. Schultz[3] and R. A. Squires[4]

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http://www.wsava.org/guidelines/vaccination-guidelines

Non-core vaccines are those that are required by only those animals whose geographical location, local environment or lifestyle places them at risk of contracting specific infections.

ELSEVIER

Veterinary Microbiology 58 (1997) 155–165

veterinary microbiology

Effect of dual-subtype vaccine against feline immunodeficiency virus infection

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Received 2 April 1997; accepted 25 July 1997

Journal of Feline Medicine and Surgery (2005) 7, 65–70
doi:10.1016/j.jfms.2004.08.005

jfms

Short Communication

Dual-subtype FIV vaccine (Fel-O-Vax® FIV) protection against a heterologous subtype B FIV isolate

Ruiyu Pu PhD, BVSc, James Coleman, James Coisman DVM, Eiji Sato PhD, Taishi Tanabe PhD, DVM, Maki Arai DVM, Janet K Yamamoto PhD*

Department of Pathobiology, College of Veterinary Medicine, University of Florida, P.O. Box 110880, Gainesville, FL 32611-0880, USA

Date accepted: 20 August 2004

Vaccine trials were undertaken to determine whether the Fel-O-Vax® FIV, a commercial dual-subtype (subtypes A and D) feline immunodeficiency virus (FIV) vaccine, is effective against a subtype B FIV isolate. Current results demonstrate the Fel-O-Vax FIV to be effective against a subtype B virus, a subtype reported to be the most common in the USA.

Vaccine 32 (2014) 746–754

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Feline immunodeficiency virus (FIV) vaccine efficacy and FIV neutralizing antibodies

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Vaccine
Neutralizing antibody tests
Efficacy
Passive transfer

ABSTRACT

A HIV-1 tier system has been developed to categorize the various subtype viruses based on their sensitivity to vaccine-induced neutralizing antibodies (NAbs): tier 1 with greatest sensitivity, tier 2 being moderately sensitive, and tier 3 being the least sensitive to NAbs (Mascola et al., J Virol 2005; 79:10103–7). Here, we define an FIV tier system using two related FIV dual-subtype (A+D) vaccines: the commercially available inactivated infected-cell vaccine (Fel-O-Vax® FIV) and its prototype vaccine solely composed of inactivated whole viruses. Both vaccines afforded combined protection rates of 100% against subtype-A tier-1 FIV_{PPR}, 89% against subtype-B tier-3 FIV_{PLV}, 61% against recombinant subtype-A/B tier-2 $FIV_{Petaluma}$, 62% against recombinant subtype-F/C tier-3 FIV_{M2}, and 40% against subtype-A tier-2 FIV_{Shi} in short-duration (37–43 weeks) studies. In long-duration (76–80 weeks) studies, the commercial vaccine afforded a combined protection rate of at least 86% against the tier-2 and tier-3 viruses. Notably, protection rates observed here are far better than recently reported HIV-1 vaccine trials (Sanou et al., The Open AIDS J 2012; 6:246–60). Prototype vaccine protection against two tier-3 and one tier-2 viruses was more effective than commercial vaccine. Such protection did not correlate with the presence of vaccine-induced NAbs to challenge viruses. This is the first large-scale (228 laboratory cats) study characterizing short- and long-duration efficacies of dual-subtype FIV vaccines against heterologous subtype and recombinant viruses, as well as FIV tiers based on in vitro NAb analysis and in vivo passive-transfer studies. These studies demonstrate that not all vaccine protection is mediated by vaccine-induced NAbs.

Short Communications

Limited efficacy of an inactivated feline immunodeficiency virus vaccine

S. P. Dunham, J. Bruce, S. MacKay, M. Golder, O. Jarrett, J. C. Neil

FELINE immunodeficiency virus (FIV) is a widespread pathogen of domestic cats associated with a variety of clinical signs, including gingivitis, stomatitis and recurrent infections (Hosie and others 1989). FIV, like human immunodeficiency virus, is a lentivirus of the family Retroviridae. Isolates of FIV are genetically diverse and are classified into subtypes, designated A, B, C, D and E, based on their nucleotide sequence. The prevalence of these subtypes differs throughout the world; for example, subtype A is prevalent in

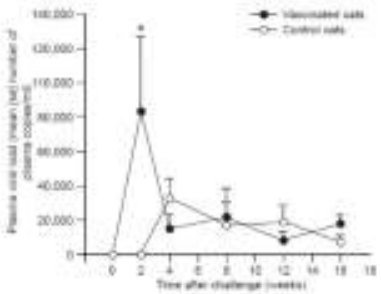

FIG 1: Viral loads in the plasma of vaccinated and unvaccinated cats following a challenge with the Glasgow-8 isolate of feline immunodeficiency virus. * Significant difference (P<0·05) at two weeks after challenge

Vaccine 30 (2012) 4753–4758

Contents lists available at SciencesDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

The protective rate of the feline immunodeficiency virus vaccine: An Australian field study

M.E. Westman [a], R. Malik [b], E. Hall [c], M. Harris [c], J.M. Norris [a,*]

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Vaccine effectiveness
FIV vaccine
FIV vaccine
Cats

ABSTRACT

A case-control field study was undertaken to determine the level of protection conferred to client-owned cats in Australia against feline immunodeficiency virus (FIV) using a commercial vaccine. 448 cats with outdoor access from five Australian states/territories underwent testing, comprising 120 potential cases (complete course of primary FIV vaccinations and annual boosters for three or more years), and 328 potential controls (age, sex and postcode matched FIV-unvaccinated cats). FIV status was determined using a combination of antibody testing (using point-of-care test kits) and nucleic acid amplification, as well as virus isolation in cases where results were discordant and in all suspected FIV-vaccinated/FIV-infected cats (vaccine breakthroughs). Stringent inclusion criteria were applied to both 'cases' and 'controls': 88 FIV-vaccinated cats and 212 FIV-unvaccinated cats ultimately satisfied the inclusion criteria. Five vaccine breakthroughs (3.8%, 95% CI: 1.2–8.7) and 25 FIV-infected controls (25/212; 12%) were identified, giving a vaccine protective rate of 56% (95% CI: −20 to 84). The difference in FIV prevalence rates between the two groups was not significant ($P = 0.14$). Findings from this study raise doubt concerning the efficacy of Fel-O-Vax FIV® under field conditions. Screening for FIV infection may be prudent before annual FIV re-vaccinations and for sick FIV-vaccinated cats. Owners should not rely on vaccination alone to protect cats against the risk of acquiring FIV infection; other measures such as cat curfews, the use of 'modular pet parks' or keeping cats exclusively indoors, are recommended.

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Contents lists available at ScienceDirect

Veterinary Microbiology

journal homepage: www.elsevier.com/locate/vetmic

Lack of protection against feline immunodeficiency virus infection among domestic cats in New Zealand vaccinated with the Fel-O-Vax® FIV vaccine

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ARTICLE INFO

Keywords:
New Zealand
FIV infection
FIV
Fel-O-Vax® FIV vaccine
Feline immunodeficiency virus
Vaccination

ABSTRACT

Infections with feline immunodeficiency virus (FIV) are common in New Zealand, although the impact of these infections on the health status of the cats remains unclear. Although many cats are vaccinated yearly with a commercial FIV vaccine containing FIV subtypes A and D, the effectiveness of this vaccine in protection against infection with field FIV is unclear, as a high proportion of New Zealand viruses belong to subtype C. The objective of the study was to compare the frequency of FIV infection among adult FIV-vaccinated and FIV-unvaccinated domestic cats with access to outdoors. Blood swabs were collected by the participating veterinarians and tested for the presence of FIV proviral by quantitative PCR. Overall, 26/185 (14.0%) samples were positive for FIV, including 7/102 (6.9 %) samples from FIV-unvaccinated and 19/103 (18.4 %) from FIV-vaccinated cats. There was no protective effect of vaccination on FIV infection among sampled cats ($p = 0.01$). Partial sequences of the FIV envelope gene from five New Zealand viruses were analysed by the maximum likelihood method. All clustered with other New Zealand FIV sequences from subtypes A ($n = 3$), C ($n = 1$) or putative recombinant viruses ($n = 1$). While the FIV vaccination did not prevent FIV infection among sampled cats, it may have had an impact on transmissibility of the virus or on disease progression. As neither was addressed in the current study, further research is needed to fully assess the potential benefits of FIV vaccination. Considering the frequency of FIV infection in FIV-vaccinated cats, FIV infection status should be ascertained not only before the first vaccination, but before each yearly booster.

Do you think the FIV vaccine has been held to a higher standard than other non-core feline vaccines?

If you think so, do you know why?

FPV, FHV-1, FCV

- Scott FW, Geissinger CM. (1997) Duration of immunity in cats vaccinated with an inactivated feline panleukopenia, herpesvirus and calicivirus vaccine. *Feline Practice* **25:** 12-19.
- Scott FW, Geissinger CM. (1999) Long-term immunity in cats vaccinated with an inactivated trivalent vaccine. *American Journal of Veterinary Research* **60:** 652-658.

2015

Veterinary Microbiology 177 (2015) 123–131

Contents lists available at ScienceDirect

Veterinary Microbiology

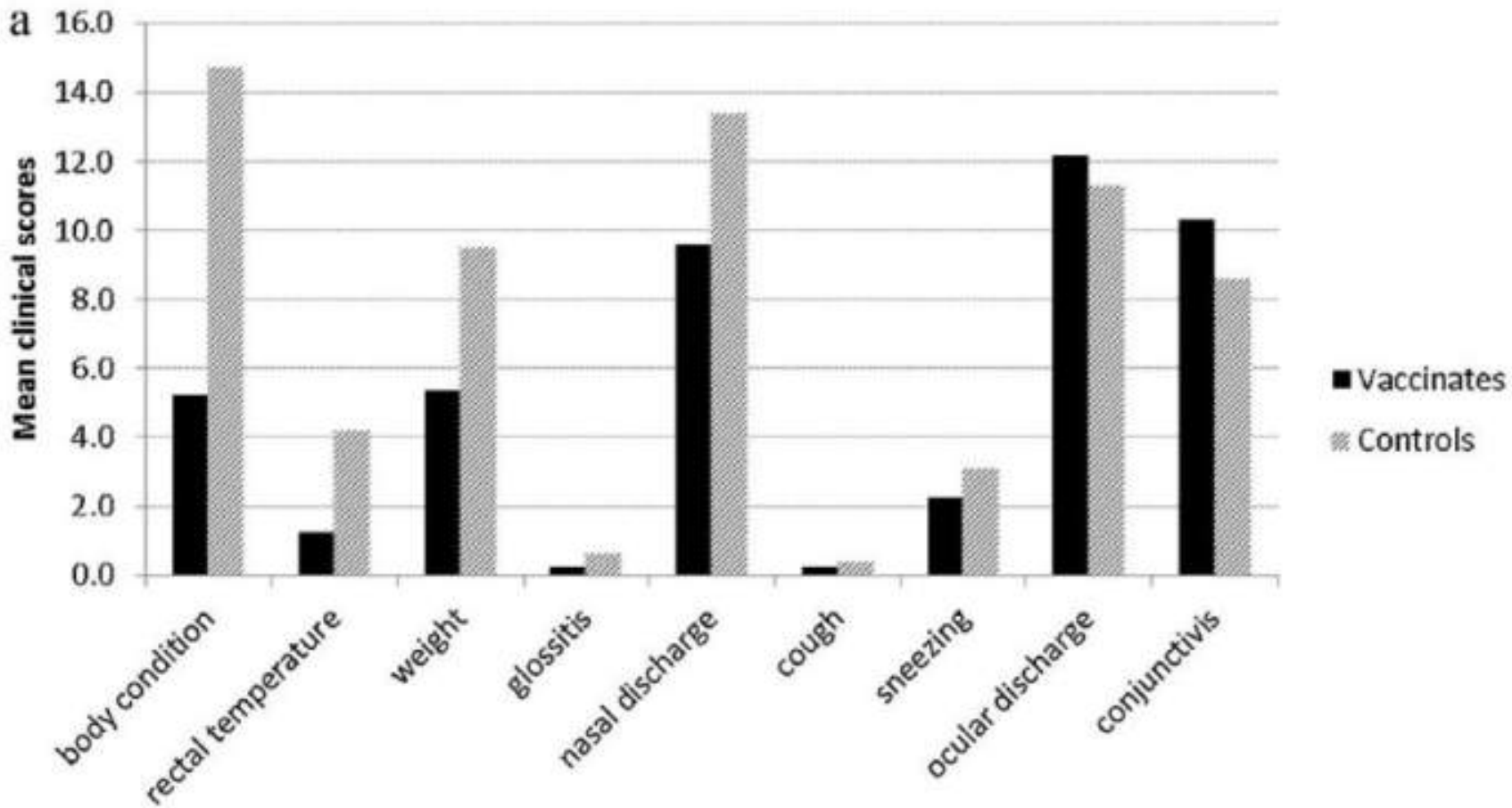
journal homepage: www.elsevier.com/locate/vetmic

Three-year duration of immunity for feline herpesvirus and calicivirus evaluated in a controlled vaccination-challenge laboratory trial

Dominique Jas, Valérie Frances-Duvert, Delphine Vernes, Pierre-Michel Guigal, Hervé Poulet *

Merial S.A.S., R&D, 254 avenue Marcel Mérieux, 69007 Lyon, France

Notwithstanding the title of this paper, vaccinated cats developed more significant illness than did the cats in the much earlier Scott & Geissinger study. Control cats were worse affected than vaccinates, but protection was rather limited, *esp*. against FHV-1



Notwithstanding the title of this paper, vaccinated cats developed more significant illness than did the cats in the much earlier Scott & Geissinger study. Control cats were worse affected than vaccinates, but protection was rather limited, *esp*. against FHV-1

What are your thoughts about recent publications out of Australia and New Zealand addressing the degree of protection afforded by the FIV vaccine?

2016

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The protective rate of the feline immunodeficiency virus vaccine: An Australian field study

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Vaccine protective rate
Vaccine effectiveness
FIV vaccine
HIV vaccine
Cats

ABSTRACT

A case-control field study was undertaken to determine the level of protection conferred to client-owned cats in Australia against feline immunodeficiency virus (FIV) using a commercial vaccine. 440 cats with outdoor access from five Australian states/territories underwent testing, comprising 139 potential cases (complete course of primary FIV vaccinations and annual boosters for three or more years), and 301 potential controls (age, sex and postcode matched FIV-unvaccinated cats). FIV status was determined using a combination of antibody testing (using point-of-care test kits) and nucleic acid amplification, as well as virus isolation in cases where results were discordant and in all suspected FIV-vaccinated/FIV-infected cats ('vaccine breakthroughs'). Stringent inclusion criteria were applied to both 'cases' and 'controls'; 89 FIV-vaccinated cats and 212 FIV-unvaccinated cats ultimately satisfied the inclusion criteria. Five vaccine breakthroughs (5/89; 6%), and 25 FIV-infected controls (25/212; 12%) were identified, giving a vaccine protective rate of 56% (95% CI −20 to 84). The difference in FIV prevalence rates between the two groups was not significant ($P = 0.14$). Findings from this study raise doubt concerning the efficacy of Fel-O-Vax FIV® under field conditions. Screening for FIV infection may be prudent before annual FIV re-vaccination and for sick FIV-vaccinated cats. Owners should not rely on vaccination alone to protect cats against the risk of acquiring FIV infection; other measures such as cat curfews, the use of 'modular pet parks' or keeping cats exclusively indoors, are recommended.

2016

The protective rate of the feline immunodeficiency virus vaccine: An Australian field study

M.E. Westman [a], R. Malik [b], E. Hall [a], M. Harris [c], J.M. Norris [a,*]

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- Aimed for 1 vaccinated cat per 3 controls (unvaccinated cats) to improve statistical power.
- Strict inclusion criteria were applied, 139 cats had to be excluded
- Ended up with only 89 vaccinates and 212 unvaccinated controls
- A questionnaire was used to determine extent of cats' outdoor access and extent of fighting.
- Vaccinates had more "mainly daytime" outdoor access than non-vax
- Suitable PCR / virus isolation / Ab detection methodologies

Online Supplement 2: Summary of reasons for excluding 139 cats from the final analysis. VIC = Victoria, QLD = Queensland. NA = not applicable.

Reason for exclusion	Total no. of cats (n = 139)	
	FIV-vaccinated (n = 49)	FIV-unvaccinated (n = 90)
FIV not found in vaccinates or controls (VIC)	14	40
FIV not found in vaccinates or controls (QLD)	12	26
No outdoor access	6	5
FIV vaccinations not given according to current manufacturer guidelines	10	NA
Unable to match control to vaccinate (either neutering status or postcode)	NA	8[a]
More than two cats sampled from same household	3	4
Too young	1	6
FIV PCR testing performed instead of FIV antibody testing prior to vaccination	3[b]	NA
Questionnaire not completed and unable to contact owner	0	1

[a] including one FIV-infected, entire male cat

[b] including one FIV-infected cat # 19; see online supplement 3 for more detailed explanation

2016

The protective rate of the feline immunodeficiency virus vaccine: An Australian field study

M.E. Westman [a], R. Malik [b], E. Hall [a], M. Harris [c], J.M. Norris [a,*]

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[b] Centre for Continuing Veterinary Education, The University of Sydney, NSW 2006, Australia
[c] Centre for Virus Research, The University of Glasgow, Scotland G61 1QH, United Kingdom

- 56% “protective rate” had a 95% confidence interval of -20 to +84
- The difference in FIV prevalence rates between the two groups was not significant ($P = 0.14$)
- The study ended up being statistically underpowered because of the need to exclude so many cats from consideration
- Nevertheless, this paper has been cited 16 times

2020

Veterinary Microbiology 250 (2020) 108865

Contents lists available at ScienceDirect

Veterinary Microbiology

journal homepage: www.elsevier.com/locate/vetmic

Lack of protection against feline immunodeficiency virus infection among domestic cats in New Zealand vaccinated with the Fel-O-Vax® FIV vaccine

A. Stickney [1], S. Ghosh, N.J. Cave [2], M. Dunowska *,[2]

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ARTICLE INFO

Keywords:
New Zealand
FIV infection
FIV
Fel-O-Vax® FIV vaccine
Feline immunodeficiency virus
Vaccination

ABSTRACT

Infections with feline immunodeficiency virus (FIV) are common in New Zealand, although the impact of those infections on the health status of the cats remains unclear. Although many cats are vaccinated yearly with a commercial FIV vaccine containing FIV subtypes A and D, the effectiveness of this vaccine in protection against infection with field FIVs is unclear, as a high proportion of New Zealand viruses belong to subtype C. The objective of the study was to compare the frequency of FIV infection among adult FIV-vaccinated and FIV-unvaccinated domestic cats with access to outdoors. Buccal swabs were collected by the participating veterinarians and tested for the presence of FIV provirus by quantitative PCR. Overall, 26/185 (14.0 %) samples were positive for FIV, including 7/82 (8.5 %) samples from FIV-unvaccinated and 19/103 (18.4 %) from FIV-vaccinated cats. There was no protective effect of vaccination on FIV infection among sampled cats ($p = 0.05$). Partial sequences of the FIV envelope gene from five New Zealand viruses were analysed by the maximum likelihood method. All clustered with other New Zealand FIV sequences from subtypes A ($n = 2$), C ($n = 2$) or putative recombinant viruses ($n = 1$). While the FIV vaccination did not prevent FIV infection among sampled cats, it may have had an impact on transmissibility of the virus or on disease progression. As neither was addressed in the current study, further research is needed to fully assess the potential benefits of FIV vaccination. Considering the frequency of FIV infection in FIV-vaccinated cats, FIV infection status should be monitored not only before the first vaccination, but before each yearly booster.

Lack of protection against feline immunodeficiency virus infection among domestic cats in New Zealand vaccinated with the Fel-O-Vax® FIV vaccine

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School of Veterinary Science, Massey University, Private Bag 11 222, Palmerston North 4442, New Zealand

- Extent of outdoor access in vaccinates *vs* in unvaccinated cats was not assessed by questionnaire. Given the study design, it seems likely that vaccinates would have had more outdoor access and be more at risk.

"…we cannot exclude the possibility that cats with more risk-prone behaviours (such as roaming or fighting), and hence higher likelihood of exposure to the virus, were more likely to be FIV-vaccinated…"

Lack of protection against feline immunodeficiency virus infection among domestic cats in New Zealand vaccinated with the Fel-O-Vax® FIV vaccine

A. Stickney [1], S. Ghosh, N.J. Cave [2], M. Dunowska *,[2]

School of Veterinary Science, Massey University, Private Bag 11 222, Palmerston North 4442, New Zealand

- Lack of age and sex matching

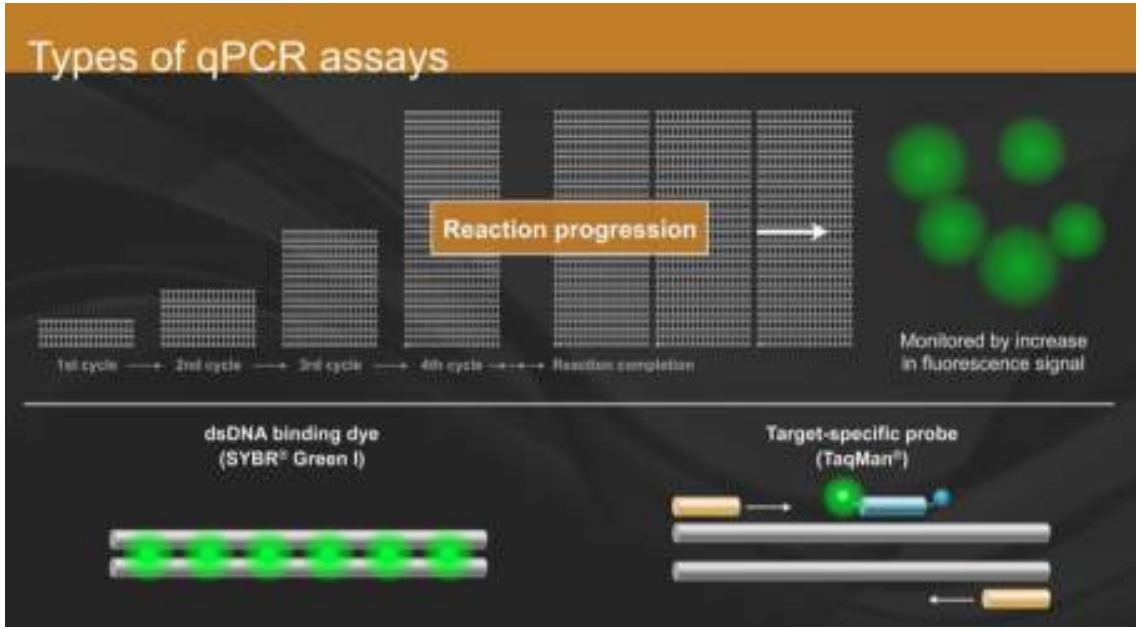
"Ideally, the FIV-vaccinated and FIV-unvaccinated cats would have been age-and sex-matched, but this was considered unrealistic due to differences between participating clinics in the number of cats seen and frequency of FIV vaccination."

Lack of protection against feline immunodeficiency virus infection among domestic cats in New Zealand vaccinated with the Fel-O-Vax® FIV vaccine

A. Stickney [1], S. Ghosh, N.J. Cave [2], M. Dunowska *,[2]

School of Veterinary Science, Massey University, Private Bag 11 222, Palmerston North 4442, New Zealand

- "Confirmatory" qPCR methodology and conventional PCR / sequencing results preclude certainty about what DNA was amplified in 21 of the 26 samples considered positive.

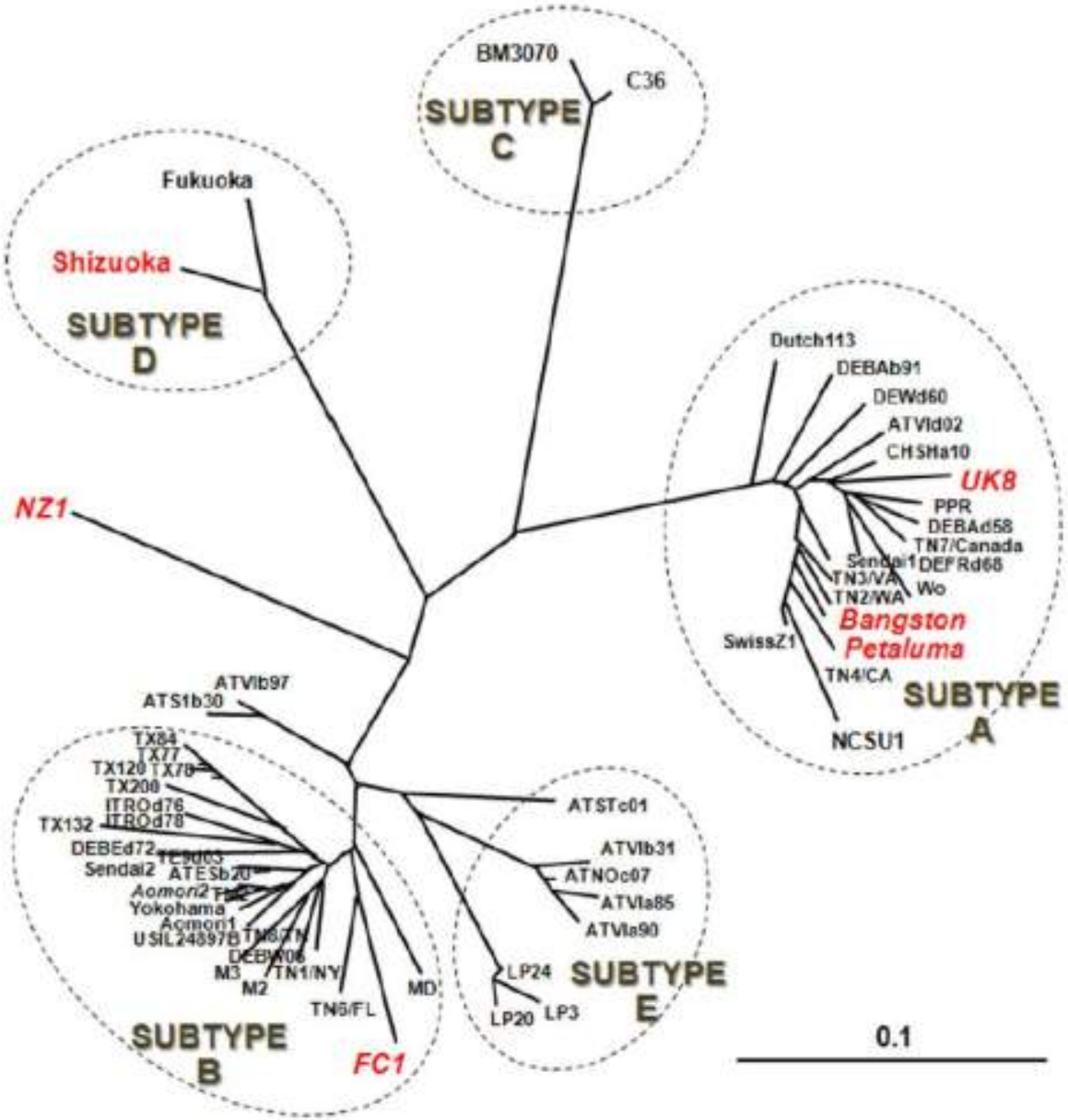


https://www.nebiolabs.com.au/tools-and-resources/video-library/overview-of-qpcr?autoplay=1

"...as conventional PCR and sequencing was not successful on the majority of samples in this study, the specificity of the assay remains uncertain, and infection of these cats cannot be confirmed."

"Given the expected high impact of these results on use of the vaccine in NZ, follow-up testing of samples using a probe based assay is planned prior to disseminated [sic] of these results."

How much do we really know about how well the commercially-available FIV vaccine protects vaccinated cats in the field?


BM3070
C36
SUBTYPE C
Fukuoka
Shizuoka
SUBTYPE D
NZ1
Dutch113
DEBAb91
DEWd60
ATVId02
CHSHa10
UK8
PPR
DEBAd58
TN7/Canada
Sendai1
DEFRd68
TN3/VA
TN2/WA
Wo
Bangston
Petaluma
SwissZ1
TN4/CA
NCSU1
SUBTYPE A
ATVIb97
ATS1b30
TX84
TX77
TX120
TX78
TX200
ITROd76
TX132
ITROd78
DEBEd72
Sendai2
ATESb20
Aomori2
Yokohama
Aomori1
M3
M2
TN1/NY
TN5/FL
MD
FC1
SUBTYPE B
ATSTc01
ATVIb31
ATNOc07
ATVIa85
ATVIa90
LP24
LP20
LP3
SUBTYPE E
0.1

Lack of protection against feline immunodeficiency virus infection among domestic cats in New Zealand vaccinated with the Fel-O-Vax® FIV vaccine

A. Stickney [1], S. Ghosh, N.J. Cave [2], M. Dunowska *,[2]

School of Veterinary Science, Massey University, Private Bag 11 222, Palmerston North 4442, New Zealand

"...the most common subtype among New Zealand cats appears to be subtype C"

Scientific Correspondence

Feline immunodeficiency virus subtypes in domestic cats in New Zealand

"In 20 cats, Subtype A was the only subtype detected, in three cats only Subtype C was detected, and in seven cats both Subtypes A and C were detected."

Table 1. Summary of feline immunodeficiency virus samples reported from 30 cats in New Zealand.

Sample	Age (years)	Sex	Breed	Clinical findings	Subtype[a]
Auck 1	2	NR	NR	NR	A[b]
Auck 2	13.5	MC	DSH	NAD	A[b]
Auck 3	11	MC	DSH	NAD	A
Auck 4	9	M	DMH	Gingivitis, stomatitis, inappetence, cough	A[b]/C
Auck 5	4	F	DSH	Dehydration, renal disease	A[b]/C
Auck 6	NR	NR	NR	NR	A/C
Auck 7	NR	MC	NR	NR	A/C[b]
Auck 8	8	FS	DSH	Chronic gingivitis, stomatitis	A[b]
Auck 9	13	FS	DSH	Recurrent abscesses, stomatitis	A
Auck 10	8.5	MC	DLH	Stomatitis, upper respiratory tract disease (snuffles)	A
Auck 11	3.5	FS	DSH	Lymphadenopathy	C
Auck 12	15	MC	DSH	Skin disease	A
Auck 13	12.5	MC	DSH	NAD	A
Auck 14	15	M	DSH	Weight loss, pyrexia, stomatitis, upper respiratory tract disease (snuffles), epiphora	A
ChCh 1	2	NR	NR	NR	A
ChCh 2	17	F	DSH	NR	A[b]
ChCh 3	15	M	DSH	Stomatitis	A[b]
ChCh 4	12	MC	DSH	Squamous cell carcinoma, tachycardia, heart murmur, weight loss, dehydration	A[b]
ChCh 5	NR	MC	DLH	Lymphadenopathy	A[b]
ChCh 6	3	MC	DSH	Cellulitis, inappetence, lethargy	A[b]/C
ChCh 7	8.5	M	DSH	NAD	A[b]
ChCh 8	19	MC	DLH	Chronic stomatitis	A[b]
ChCh 9	NR	NR	NR	NR	A[b]
ChCh 10	19	MC	DSH	Gingivitis, gastrointestinal disease	C
Well 1	4.5	MC	DSH	Recurrent fight wounds, pyrexia	A
Well 2	NR	FS	DSH	Stomatitis	C
Well 3	7.5	MC	DSH	Mild gingivitis	A[b]/C
Well 4	5.5	MC	DSH	Stomatitis	A
Well 5	8	MC	DLH	Gingivitis, dermatitis	A/C
Well 6	6.5	MC	DSH	NAD	A

[a] From Kann et al (2007). Subtypes determined from phylogenetic analysis of sequences from 1–3 fragments of the V3–V5 region of the env gene
[b] Also from 467 base pairs of the gag gene
Auck = Auckland; ChCh = Christchurch; Well = Wellington; NR = not recorded; MC = male castrated; FS = female spayed; DSH = domestic shorthaired; DMH = domestic medium-haired; DLH = domestic longhaired; NAD = no abnormalities detected

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Phylogenetic Analysis of Feline Immunodeficiency Virus in Feral and Companion Domestic Cats of New Zealand[▽]

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Nested PCR was used to amplify envelope V3-V6 gene fragments of feline immunodeficiency virus (FIV) from New Zealand cats. Phylogenetic analyses established that subtypes A and C predominate among New Zealand cats, with clear evidence of intersubtype recombination. In addition, 17 sequences were identified that were distinct from all known FIV clades, and we tentatively suggest these belong to a novel subtype.

"Subtypes A and C predominate among NZ cats"

TABLE 1. FIV-infected NZ cat samples, showing cat lifestyle, location, and FIV subtype

Sample	Lifestyle	Location[a]	Subtype[b]	Sample	Lifestyle	Location[a]	Subtype[b]
190	Domestic	Auckland	A	EV09	Stray	Auckland	C
192	Domestic	Canterbury	A	WSPCA05	Stray	Northland	C
256	Domestic	Hawke's Bay	A	WSPCA15	Stray	Northland	C
PN1	Domestic	Wellington	A	BP07	Feral	Canterbury	C
PN2	Domestic	Wellington	A	BP08	Feral	Canterbury	C
PN6	Domestic	Manawatu-Wanganui	A	BS03	Feral	Hawke's Bay	C
PN10	Domestic	Wellington	A	BS11	Feral	Hawke's Bay	C
PN13	Domestic	Taranaki	A	BS13	Feral	Hawke's Bay	C
PN14	Domestic	Manawatu-Wanganui	A	BS14	Feral	Hawke's Bay	C
PN16	Domestic	Taranaki	A	BS16	Feral	Hawke's Bay	C
PN19	Domestic	Wellington	A	BS44	Feral	Hawke's Bay	C
WST01	Domestic	West Coast	A	GBI11	Feral	Auckland	C
WST02	Domestic	West Coast	A	GBI25	Feral	Auckland	C
WST04	Domestic	NA	A	GBI31	Feral	Auckland	C
WST05	Domestic	NA	A	GBI43	Feral	Auckland	C
WSPCA11	Stray	Northland	A	GBI46	Feral	Auckland	C
BP01	Feral	Canterbury	A	GBI47	Feral	Auckland	C
BP09	Feral	Canterbury	A	MF07	Feral	Otago	C
BP12	Feral	Canterbury	A	MF09	Feral	Otago	C
BP18	Feral	Canterbury	A	MF11	Feral	Otago	C
BP26	Feral	Canterbury	A	MF12	Feral	Otago	C
BP28	Feral	Canterbury	A	MF16	Feral	Otago	C
GBI04	Feral	Auckland	A	TKP05	Feral	Northland	C
GBI06	Feral	Auckland	A	TKP07	Feral	Northland	C
GBI14	Feral	Auckland	A	TKP08	Feral	Northland	C
GBI37	Feral	Auckland	A	TKP18	Feral	Northland	C
GBI49	Feral	Auckland	A	TKP43	Feral	Northland	C
GBI72	Feral	Auckland	A	TKP52	Feral	Northland	C
GBI84	Feral	Auckland	A	TKP54	Feral	Northland	C
MF01	Feral	Otago	A	TKP60	Feral	Northland	C
MF02	Feral	Otago	A	TKP64	Feral	Northland	C
MF04	Feral	Otago	A	TKP87	Feral	Northland	C
MF05	Feral	Otago	A	TKP93	Feral	Northland	C
MF33	Feral	Otago	A	TKP95	Feral	Northland	C
MF34	Feral	Otago	A	TKP104	Feral	Northland	C
MF37	Feral	Otago	A	TKP105	Feral	Northland	C
MF40	Feral	Otago	A	168	Domestic	West Coast	PR
MF42	Feral	Otago	A	197	Domestic	Nelson	PR
TKP74	Feral	Northland	A	214	Domestic	Waikato	PR
164	Domestic	Wellington	C	258	Domestic	Bay of Plenty	PR
177	Domestic	Southland	C	259	Domestic	Taranaki	PR
193	Domestic	Canterbury	C	260	Domestic	Bay of Plenty	O
229	Domestic	Auckland	C	PN17	Domestic	Wellington	PR
240	Domestic	NA	C	PN21	Domestic	Manawatu-Wanganui	PR
253	Domestic	Waikato	C	PN22	Domestic	Manawatu-Wanganui	O
266	Domestic	Taranaki	C	PN23	Domestic	Wellington	PR
282	Domestic	NA	C	MF14	Feral	Otago	PR
298	Domestic	NA	C	EV01	Stray	Auckland	U
B	Domestic	Auckland	C	WSPCA01	Stray	Northland	U
BD1	Domestic	Auckland	C	BS08	Feral	Hawke's Bay	U
NZVP01	Domestic	Wellington	C	MF19	Feral	Otago	U
NZVP02	Domestic	Wellington	C	MF21	Feral	Otago	U
NZVP03	Domestic	NA	C	MF29	Feral	Otago	U
PN3	Domestic	Hawke's Bay	C	TKP02	Feral	Northland	U
PN4	Domestic	NA	C	TKP14	Feral	Northland	U
PN5	Domestic	Wellington	C	TKP15	Feral	Northland	U
PN7	Domestic	Wellington	C	TKP17	Feral	Northland	U
PN8	Domestic	Manawatu-Wanganui	C	TKP20	Feral	Northland	U
PN9	Domestic	Manawatu-Wanganui	C	TKP21	Feral	Northland	U
PN11	Domestic	Wellington	C	TKP22	Feral	Northland	U
PN12	Domestic	Manawatu-Wanganui	C	TKP57	Feral	Northland	U
PN15	Domestic	Wellington	C	TKP73	Feral	Northland	U
PN20	Domestic	Wellington	C	TKP88	Feral	Northland	U
WST03	Domestic	West Coast	C	TKP94	Feral	Northland	U
EV07	Stray	Auckland	C				

[a] NA, not available. Locations by region are shown on the map in Fig. 1.
[b] U, unknown subtype; O, outlier but not labeled putative recombinant since not significant as determined by KH test; PR, putative recombinant.

2005

Fel-O-Vax® FIV contains whole, inactivated FIV_{Pet}-infected T-cells (FL-6 cells) and whole, inactivated FIV_{Shi}-infected T-cells (FeT-J cells). Two different subtypes of FIV growing in two different feline cell lines. The commercially-available vaccine containing feline whole cells. FD-1 adjuvant is present.

2005

Fel-O-Vax® FIV contains whole, inactivated FIV_{Pet}-infected T-cells (FL-6 cells) and whole, inactivated FIV_{Shi}-infected T-cells (FeT-J cells). Two different subtypes of FIV growing in two different feline cell lines. The commercially-available vaccine containing feline whole cells. FD-1 adjuvant is present.

Kumar et al. Retrovirology 2010, 7:49
http://www.retrovirology.com/content/7/1/49

RETROVIROLOGY

RESEARCH Open Access

Prior mucosal exposure to heterologous cells alters the pathogenesis of cell-associated mucosal feline immunodeficiency virus challenge

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Abstract

Background: Several lines of research suggest that exposure to cellular material can alter the susceptibility to infection by HIV-1. Because sexual contact often includes exposure to cellular material, we hypothesized that repeated mucosal exposure to heterologous cells would induce an immune response that would alter the susceptibility to mucosal infection. Using the feline immunodeficiency virus (FIV) model of HIV-1 mucosal transmission, the cervicovaginal mucosa was exposed once weekly for 12 weeks to 5,000 heterologous cells or media (control) and then cats were vaginally challenged with cell-associated or cell-free FIV.

Results: Exposure to heterologous cells decreased the percentage of lymphocytes in the mucosal and systemic lymph nodes (LN) expressing L-selectin as well as the percentage of CD4+ CD25+ T cells. These shifts were associated with enhanced ex-vivo proliferative responses to heterologous cells. Following mucosal challenge with cell-associated, but not cell-free, FIV, proviral burden was reduced by 64% in cats previously exposed to heterologous cells as compared to media exposed controls.

Conclusions: The pathogenesis and/or the threshold for mucosal infection by infected cells (but not cell-free virus) can be modulated by mucosal exposure to uninfected heterologous cells.