OVERVIEW OF FELINE BIOLOGICS

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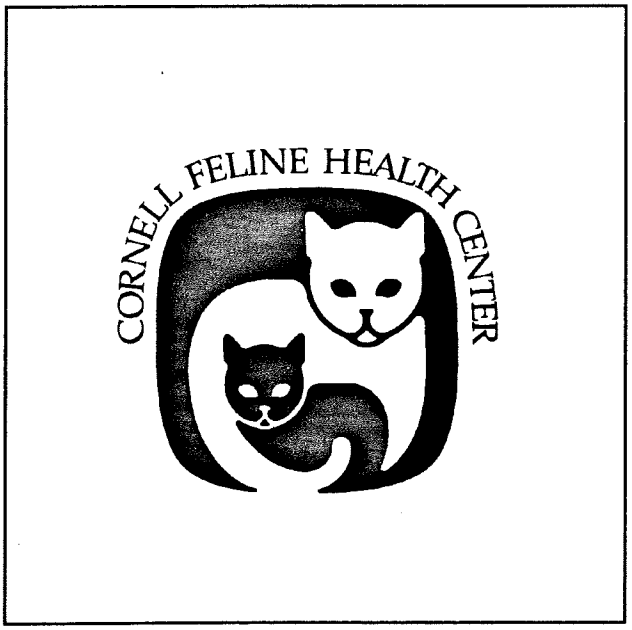

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I. Overview

A. Historical Perspective of Feline Vaccines

1. First feline vaccines developed in 1930s for feline "distemper" (feline panleukopenia, FP). These vaccines were tissue origin vaccines prepared from infected cat tissues which were inactivated with formalin.
2. Pneumonitis vaccines appeared in 1950s for feline respiratory disease.
3. First cell culture origin inactivated and MLV FP vaccines developed in late 1960s.
4. Feline viral rhinotracheitis (feline herpesvirus, FHV) and feline calicivirus (FCV) vaccines first licensed in 1970s.
5. First FeLV vaccine appeared in 1985.
6. Intranasal FIP vaccine licensed in 1991.
7. Rabies vaccines developed more than 100 years ago.
8. Ringworm vaccine licensed in 1990s.

B. Current situation:

1. Multivalent vaccines used routinely in feline medicine.
   a. FP/FHV/FCV used for all cats.
   b. Some cats also receive chlamydia or FP/FHV/FCV/Chlamydia multivalent vaccine.
   c. Most cats routinely vaccinated for FeLV.
   d. Rabies vaccination mandatory in many states or rabies endemic areas.
   e. FIP vaccine is used sparingly in high-risk situations. A more effective vaccine is needed.
   f. Ringworm vaccine has received mixed reviews to present.

C. Potential Additional Vaccines

1. Toxoplasmosis vaccine - nearing release.
2. Bordetella respiratory vaccine - will be added to respiratory vaccines.
3. Bartonella vaccine - for public health benefits?
4. Helicobacter vaccine - possible public health benefits?
5. Endoparasite vaccines?

D. Licensure of Feline Vaccines

1. All veterinary biologics are licensed by the "Veterinary Biologics" (VB) division of the "Biotechnology, Biologics, and Environmental Protection Agency" of the "Animal and Plant Health Inspection Service" (APHIS) of the "United States Dept. of Agriculture" (USDA).
2. Licensure is covered by the Virus-Serum-Toxin Act, as amended.
   a. Title 9 (Animals and Animal Products), Code of Federal Regulations (CFR), parts 101 to 117.
   b. Veterinary Services Memorandum No. 800.50, Basic License Requirements for Applicants (12/6/84)
   c. Standard Requirements established for licensure of each veterinary biologic after an appropriate time.
3. By comparison, all pharmaceuticals are licensed and regulated by the Center for Veterinary Medicine (CVM) within the Food and Drug Administration (FDA). Pesticides are controlled the EPA.

II. VACCINES

A. Panleukopenia vaccines

1. **Vaccines available**
   a. Modified live-virus (MLV) injectable vaccines, virus grown in cell cultures.
   b. Inactivated cell-culture vaccines. Virus grown in cell cultures and inactivated by a variety of means. Usually in combination with other vaccines. May be used as liquid diluent for other lyophilized vaccine components.
   c. MLV intranasal vaccine (*Rhinolin-CP, Bio-Ceutic*)
   d. Inactivated tissue-origin FP vaccines are no longer produced.
   e. Recombinant FP vaccines under investigation.

2. **Vaccination** - a must for all cats
   a. 8-10 weeks of age, repeat at 3-4 week intervals
   b. Last vaccination must be at least 12 weeks of age, 14 would be better.
   c. Annual revaccinations for FP are not necessary.
   d. Optional program = similar to rabies 3-year program
      - vaccinate kittens
      - revaccinate (booster) one year later
      - then revaccinate every 3 years for life
   e. Should use MLV vaccines in contaminated areas such as shelters = faster protection.

3. **Maternal immunity**
   a. Maternal immunity against FPV provides solid protection and interferes with immunization.
   b. It is the most common cause of "vaccine failure" in the cat.
   c. Maternally derived antibodies are acquired via colostrum in first 24 hours postpartum.
   d. Passive antibody half-life in the cat is 8-10 days.
   e. Duration of maternal immunity in kittens depends on dams VN antibody titer at queening.
      - Usually can be overcome with FP vaccine by 12 weeks of age.

B. Respiratory Disease Vaccines

1. **Vaccines Available**

   a. **FHV-1** = feline viral rhinotracheitis, herpesvirus, "rhino"
      - MLV cell culture origin vaccines
      - Inactivated cell culture origin vaccines
      - Intranasal MLV cell culture origin vaccines
        - *Felomune (Pfizer)* - FHV & FCV
        - *Rhinolin-CP (Bio-Ceutic)* - FHV, FCV, & FPV

   b. **FCV** = feline calicivirus
      - MLV cell culture origin vaccines
      - Inactivated cell culture origin vaccines
      - Intranasal MLV cell culture origin vaccines

c. **Chlamydia (Pneumonitis)**
- Modified live vaccine from *Chlamydia psittaci* culture
- Inactivated vaccine

2. **Vaccination Protocols** - The vaccine protocol used for respiratory diseases depends upon the population being vaccinated, and the existing respiratory problems within that population.
   a. **Protocol #1** - routine vaccination, low risk populations
      - FHV-1/FCV/FPV (MLV or inactivated)
        - 8 & 12 weeks of age, repeat at one year, then every 3 years
   b. **Protocol #2** - high risk populations (catteries, shelters)
      - FHV-1/FCV/FPV (MLV)(+/- chlamydia)
        - 4, 8, 12 weeks of age, repeat in one year, then every 1-3 years
   c. **Protocol #3** - high risk breeding catteries with respiratory disease problems
      - FHV-1/FCV intranasal
        - 2 weeks of age
      - FHV-1/FCV/FPV MLV injectable vaccine (+/- chlamydia)
        - 6, 10, 14 weeks, repeat in one year, then every 1-3 years

C. Rabies Vaccines

1. Vaccine recommendations must be consistent with state requirements.
2. Use only inactivated vaccines approved for use in cats.
3. Use only 3-year vaccines approved for use in cats. One- and 3-year rabies vaccine may have equal protective capabilities, but 3-year vaccines have been tested and shown effective for 3 years.
4. Vaccination schedule
   a. 1st rabies vaccine should be given at 12+ weeks when maternal antibodies are gone, and immune system is adequately developed.
   b. Repeat in 1 year, then every 1-3 years depending on state requirements.

D. FeLV Vaccines

1. <u>Inactivated FeLV "subunit" vaccine</u>
   a. *Leukocell & Leukocell 2* ("Norden Laboratories", "SmithKline Beecham", Pfizer)
      - first commercial FeLV vaccine
      - *Leukocell* licensed 11/13/84
      - *Leukocell 2* licensed 8/2/88 - greater antigenic mass
   b. inactivated "subunit" vaccine = "soluble tumor antigen vaccine"
   c. gp70 antigen is main component
   d. Contains dual adjuvants, aluminum hydroxide and a partially purified saponin
   e. Produced in FL-74 cells infected with 3 FeLV subtypes A, B, & C.

2. <u>Inactivated whole-virus FeLV vaccines without adjuvant</u>
   a. *VacSYN/FeLV; Panacine-5* (Synbiotics Corporation, mfg. by Bio-Trends
      - from FL-74 cells infected with FeLV strain UCD-1
      - subtypes A, B, & C

b. *RM Leucat; RM Feline 3 + Leucat; RM Feline 4 + Leucat* (Rhone Merieux) - (Similar to Fevaxyn-FeLV)
   - Subgroups A, B, and C
   - Chemical inactivation with ethylenimine
   - No adjuvant
   - Purified
     - remove excess protein including BSA
     - remove free subunits of FeLV (gp70, p15E, p27)
     - concentrated 2X
     - removed salt by dialysis

3. <u>Inactivated whole-virus FeLV vaccines with adjuvant</u>
   a. *Fel-O-Vax Lv-K; Fel-O-Vax Lv-K III; Fel-O-Vax LV-K IV* (Fort Dodge)
      - Molecularly cloned whole-virus vaccine
      - Chemically inactivated vaccine
      - Contains dual adjuvants
      - Subtypes A, B, & C

   b. *Fevaxyn FeLV; Eclipse 4 + FeLV; Eclipse 4 + FeLV/R* (Solvay)
      - whole-virus vaccine
      - subtypes A & B
      - chemically inactivated
      - selective concentration of viral components
      - aqueous adjuvant

4. <u>Recombinant FeLV subunit vaccine</u> *GenetiVac FeLV* (Pitman-Moore, Coopers Animal Health)
   a. Licensed 10/25/90
   b. Genetically engineered subunit vaccine
   c. Immunogen = purified recombinant protein containing entire amino acid sequence of FeLV subtype A gp70 envelope glycoprotein
   d. gp70 genome cloned a plasmid, then plasmid inserted into E. coli
   e. Purified to remove E. coli proteins
   f. Dual adjuvants
      - purified saponin, QS-21
      - aluminum hydroxide

5. **Safety of FeLV vaccines**
   a. All FeLV vaccines are inactivated
      - Safe from producing FeLV
      - Safe from producing FeLV-related disease
      - No indication of exacerbation of FeLV infection in an already FeLV-positive cat.
   b. Generally no unusual immediate adverse reactions from simultaneous vaccination with FeLV and other vaccines, yet some practitioners feel they see more reactions and therefore give the FeLV at a separate time.
   c. No apparent interference with other antigens in multivalent vaccines
   d. Allergic-type reactions do occur to varying degrees
      - to FeLV antigen?
      - to bovine serum albumin (BSA) in vaccine?

- to other proteins?
- to adjuvant(s)

e. Fibrosarcomas in 1/1,000 to 1/10,000 cats receiving FeLV vaccines

6. **Efficacy of FeLV Vaccines**
   a. Factors affecting efficacy of FeLV vaccines
      - Antigenic mass of vaccine
      - Adjuvant
      - Challenge system used
        - immunosuppressed?
        - route of challenge?
        - challenge virus strain?
      - Criteria for efficacy
        - prevent persistent viremia?
        - prevent viremia?
        - prevent latency?
        - stimulate VN antibody titer?
        - prevent tumor formation?
        - survival?
      - Experimental design of study
      - How results reported
        - % of vaccinates? = not accurate
        - preventable fraction = PF? - must use PF since controls not all come down with disease
      - Age of cats
   b. Reported studies on efficacy
      - From FeLV/FIV Colloquium, 1991 *JAVMA, 199(11), Nov. 15, 1991*

7. **FeLV Vaccine Guidelines**

   a. From FeLV/FIV Colloquium, 1991 *JAVMA, 199(11), Nov. 15, 1991*

   b. Routinely used in most veterinary clinics
      - multivalent vaccines with FP/FHV/FCV and possibly rabies
      - individual FeLV vaccine given at same time as other multivalent vaccines, or at a separate clinic visit

E. FIP Vaccine

1. *Primucell FIP* (Pfizer) - only vaccine available
   a. MLV temperature sensitive mutant
   b. intranasal vaccine
   c. 2 doses 3-4 weeks apart, starting at 16 weeks of age
   d. stimulates local IgA and VN antibody titers in serum
   e. VN antibodies are also enhancing antibodies
   f. efficacy depends on dose of FIPV exposure
      - low dose exposure - partial protection
      - high dose exposure - no protection, and enhanced disease
      - normal exposure dose in nature is unknown at this time, but it appears to be a low dose exposure, otherwise we would be seeing large numbers of cases of enhanced disease.
2. Use of vaccine
   a. limited use in special situations
   b. not used as a routine vaccine

F. *Microsporum canis* **vaccine**

1. *Fel-O-Vax MC-K* (Fort Dodge)
2. Inactivated, whole dermatophyte vaccine, given in 3 1-ml doses
3. Homogenized for uniformity
4. Adjuvanted with "MetaStim"
5. Indications - "For use in adult cats at least four months of age as an aid in the prevention and treatment of clinical signs of disease caused by *Microsporum canis*."
6. Vaccine will not eliminate *M. canis* from infected cats.

III. Table of Licensed Feline Vaccines

The following 2-page table of licensed feline vaccines is from "Compendium of Veterinary Products", 3rd Edition, 1995-1996

FELINE

K - antibodies - antitoxin - extract - killed - subunit - toxoid M - modified live Product Name	RHINOTRACHEITIS	CALICI	PANLEUKOPENIA	CHLAMYDIA	LEUKEMIA	RABIES	INFECTIOUS PERITONITIS	*MICROSPORUM CANIS*
Felomune CVR® (SmithKline Beecham)	M	M						
Felin-L™ (Anchor)			M					
Fel-O-Vax® PCT (Fort Dodge)	K	K	K					
Fevaxyn® 3 (Solvay)	K	K	K					
Eclipse® 3 KP (Solvay)	M	M	K					
Feline 3 Vaccine (Durvet)	M	M	K					
FeTec™ 3 KP (Upjohn)	M	M	K					
FVR® C-P (Mallinckrodt)	M	M	K					
Panacine® RC (Synbiotics)	M	M	K					
Panavac® RC (Synbiotics)	M	M	K					
Respomune® CP (BioCor)	M	M	K					
RXV Vac™ Feline BodyGuard 3 (RXV)	M	M	K					
Eclipse® 3 (Solvay)	M	M	M					
Felin-RC™ (Anchor)	M	M	M					
Felocell CVR® (SmithKline Beecham)	M	M	M					
FeTec™ 3 (Upjohn)	M	M	M					
FVR® C-P (MLV) (Mallinckrodt)	M	M	M					
Performer®-Feline (Performer)	M	M	M					
Protex™-3 (Intervet)	M	M	M					
Rhinolin-CP™ (Bio-Ceutic)	M	M	M					
Rhinopan® MLV (BioCor)	M	M	M					
RM® Feline 3 (Rhone Merieux)	M	M	M					
Psittacoid™ (Solvay)				M				
Fel-O-Vax® IV ([redacted] (Fort Dodge)	K	K	K	M				
Fevaxyn® 3 + C (Solvay)	K	K	K	M				
Eclipse® 4 KP (Solvay)	M	M	K	M				
RM® Feline 4 Pk (Rhone Merieux)	M	M	K	M				
Eclipse® 4 (Solvay)	M	M	M	M				
Feline 3-C Vaccine (Durvet)	M	M	M	M				
Felocell CVR-C® (SmithKline Beecham)	M	M	M	M				
FeTec™ 4 (Upjohn)	M	M	M	M				
FVR® C-P-C (Mallinckrodt)	M	M	M	M				
Performer®-Feline 4 (Performer)	M	M	M	M				
Rhinopan® 4 (BioCor)	M	M	M	M				
RM® Feline 4 (Rhone Merieux)	M	M	M	M				
Fel-O-Vax® Lv-K (Fort Dodge)					K			
Fevaxyn FeLV® (Solvay)					K			
Genetivac® FeLV (Coopers)					K			
Leukocell 2® (SmithKline Beecham)					K			
RM Leucat® (Rhone Merieux)					K			
VacSYN™/FeLV (Synbiotics)					K			
Fel-O-Vax Lv-K® III (Fort Dodge)	K	K	K		K			
RM Feline 3 + Leucat® (Rhone Merieux)	M	M	M		K			

(continued on next page)

Please refer to product listings for more complete information.

FELINE (continued)

K - antibodies - antitoxin - extract - killed - subunit - toxoid M - modified live Product Name	RHINOTRACHEITIS	CALICI	PANLEUKOPENIA	CHLAMYDIA	LEUKEMIA	RABIES	INFECTIOUS PERITONITIS	MICROSPORUM CANIS
Fel-O-Vax® Lv-K IV (Fort Dodge)	K	K	K	K	K			
Eclipse® 4 + FeLV (Solvay)	M	M	M	M	K			
Panacine®-5 (Synbiotics)	M	M	M	M	K			
RM Feline 4 + Leucat® (Rhone Merieux)	M	M	M	M	K			
Annumune® (Fort Dodge)						K		
Defensor™ (SmithKline Beecham)						K		
Dura-Rab 1™ (Vedco)						K		
Dura-Rab 1® (ImmunoVet)						K		
Dura-Rab 3™ (Vedco)						K		
Dura-Rab 3® (ImmunoVet)						K		
Endurall-K® (SmithKline Beecham)						K		
Endurall-P™ (SmithKline Beecham)						K		
Prorab™-1 (Intervet)						K		
Rabdomun® (Mallinckrodt)						K		
Rabdomun® 1 (Mallinckrodt)						K		
Rabguard-TC® (SmithKline Beecham)						K		
Rabvac™ 1 (Solvay)						K		
Rabvac™ 3 (Solvay)						K		
RM Imrab® 1 (Rhone Merieux)						K		
RM Imrab® 3 (Rhone Merieux)						K		
SentryRab™-1 (Synbiotics)						K		
Trimune® (Fort Dodge)						K		
Fel-O-Vax® PCT-R (Fort Dodge)	K	K	K			K		
Eclipse® 3 KP-R (Solvay)	M	M	K			K		
RM Feline 3 + Imrab® 3 (Rhone Merieux)	M	M	M			K		
Eclipse® 4 KP-R (Solvay)	M	M	K	M		K		
RM Feline 4 + Imrab® 3 (Rhone Merieux)	M	M	M	M		K		
Primucell FIP® (SmithKline Beecham)							M	
Fel-O-Vax® MC-K (Fort Dodge)								K
Eclipse® 4 + FeLV/R (Solvay)	M	M	M	M	K	K		