

Revival Animal Health

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Vaccinology

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1. How the Immune System Responds to Vaccines

Vaccines have probably saved more lives than any other medical advancement. Regardless, there has been a recent push back in human and animal vaccine acceptance – called "vaccine hesitancy".

Vaccines are one of the strongest medications our cats (or us) can receive. They should be selected carefully with appropriate timing to receive the greatest benefit and minimize risks. Understanding how vaccines work is essential in this process.

It is important to know what vaccines can do and what they cannot do – in other words, how the immune system works and responds to vaccines. You also need to know how vaccines work, which vaccines are appropriate for your pet's lifestyle, how to select the right vaccines, and how vaccines should be handled and administered. Vaccines are an important but not solitary key to preventing infectious diseases. We need to practice good hygiene in queen and cattery management as well.

There are 5 general kinds of vaccines: modified live (attenuated), inactivated (killed), recombinant immunizing agents, subunit vaccines and toxoid. The modified live means the disease-causing organism is altered and weakened so it can be administered to a patient, creating an immune response but not causing disease. A killed vaccine contains only bacteria or viruses that are dead, allowing the immune system to see and create immunity but not cause disease. Recombinant agents are



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made of a live attenuated (weakened) viral or bacterial strain used as a vector to carry the gene or genes encoding the desired vaccine antigens. Toxoids protect against the toxin produced by the offending bacteria. Another way to classify vaccines are whether they are to protect against viral diseases, or bacterial diseases, called bacterins. A vector vaccine is a particular modification of a MLV vaccine, in which the immunodominant protein of a virus is expressed by a vector virus, e.g., canarypox virus. When the vector virus replicates, the foreign protein is expressed along with the vector virus proteins and is therefore presented as a *de novo* synthesized protein to the immune cells. For an efficient immune response to occur, the vector virus has to infect the cat, but the vector virus replication is blocked at a specific stage in the viral replication cycle. Therefore, no infectious virus particles are formed and no vector virus is shed by the vaccinated cat.

2. Maternally Derived Antibodies (MDA)

The immune system in kittens is born "naive", meaning when a kitten is born, they have virtually no immunity to the viruses and bacteria that will soon populate their world and bodies. Initially, their only immunity comes from their mother's colostrum that they must receive by nursing in their 1st 24 hours or less. Failure to receive colostrum in an adequate quantity will lead to "failure of passive immunity". This sets up kittens for likely illness when exposed to the viruses and bacteria in their environment and in cats they will associate with. The only way around this in very young kittens is to administer colostrum, plasma or serum from a donor cat. Should you have a dam with excessive colostrum, it can be collected manually, and stored in the freezer for up to 1 year. Plasma or serum can be collected from a healthy, hyperimmunized cat, and purchased from Animal Blood Resources in Michigan. Colostrum can be administered by a feeding tube after thawing within 24 hours of birth. Plasma or serum can be administered via feeding tube after thawing within 24 hours of birth. Plasma is 3.5 cc per kitten.

Kittens that have received adequate amounts of colostrum when under 24 hours old will have immunity to what their mothers are immune to – this is called "passive" immunity. As kittens mature, the maternal antibodies slowly degrade. As the antibodies drop, the kitten's immune system can begin to mount its own response – this is called "active" immunity.

<u>3. Titers</u> The challenge to using vaccines is to time the administration so the immune system can produce its own antibodies, but before there is an exposure to a serious disease. Dr. Ron Schulz and Dr. Laurie Larsen have developed a graph and testing system known as a nomogram/nomograph. Kittens immunity drops 50% every 2 weeks from birth to maturity. The higher the maternal antibodies, the longer they last, blocking the kitten's response to vaccines. The lower the maternal antibodies, the earlier the kittens need to be vaccinated. The challenge is that it is

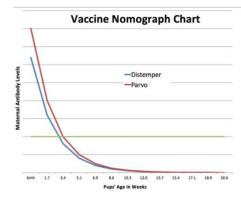


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not practical to blood test each and every kitten in a litter to determine when the

ideal time to administer a vaccine to the kitten. There is no good test for any disease other than feline panleukopenia, making testing in kittens impractical.

Just as in human medicine, most of our kittens will receive a series of vaccines. By administering the vaccines repeatedly, we are playing the odds that somewhere in between the 1st and last vaccination, the maternal antibodies will disappear,



allowing the kitten's immune system to "see" the vaccine and develop active immunity.

4. Vaccine Failures

Most kittens will mount an adequate immune response to a series of 2 vaccines, administered 2 to 4 weeks apart. The 1st vaccination a kitten or adult cat receives will allow the kittens' immune system to see a foreign protein and start the formation of antibodies. The 2nd and additional vaccines, or boosters, will create a stronger immune response, called an anamnestic response. In patients with a healthy immune system, they will have memory of these vaccines, sometimes lasting a lifetime.

It is important to understand that administering the booster in less than 14 days from the 1st vaccination can do more harm than good. The immune system needs at least 2 weeks to respond to an additional vaccine. Administering a booster in less time can suppress the immune system. Keep good records and work with veterinary professionals who follow these guidelines.

Some breeds and some individuals within a breed (up to 10%) may not respond adequately to a vaccine. Knowing this failure to respond to vaccines will allow the owners to request additional vaccines be administered to these patients. Often, changing the manufacturer of the vaccine and repeating the titer will allow for these low or no-responders to safely interact with other cats. Should you have a cat or line of cats who do not adequately respond to vaccines, you need to be extra vigilant to protect these cats.

Although titers can be run to assess vaccine responses to the rabies vaccines, most states and municipalities will not accept a protective titer as an alternative to rabies vaccines. While it is possible that many cats have protection for longer than 3 years, the 3 year interval is still required to have a cat considered a vaccinated cat. Only in rare circumstances would it be recommended that you use a titer as an alternative



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to triannual rabies boosters. Don't take a chance. Rabies vaccines for our cats is as much for the protection of human health as it is for canine health.

5. Why We Administer Multiple Vaccines

Kittens need a series of vaccines when young to mount an adequate protective vaccine response. Since it is impractical to do titers on each kittens, we need to repeatedly expose the kittens to the antigens, the proteins, that allow the immune system to develop antibodies. By starting to vaccinate between 6 and 8 weeks of age, and repeatedly administering vaccines till the kittens are 18 to 20 weeks old, we can give our kittens protection. Somewhere in the 6 week to 20 week age range, almost every kitten will have their maternal antibodies bottom out and be exposed to the vaccine antigens, producing their own active immunity. If you start vaccinating too late or stop too early, you are putting your kittens at risk of being exposed to a disease they are not prepared to fight off.

Over time, even kittens with competent immune systems will have their antibody levels wane. For this reason, we need to booster our adult cats. In general, we booster young adults approximately 1 year after they complete their vaccine series for appropriate lifestyle and core based diseases. After the 15 month age, we booster for some diseases annually and some diseases tri-annually.

6. <u>Core Vaccines</u>

Core vaccines are vaccines to protect cats against diseases that are prevalent and common enough that veterinary experts have determined all cats should be protected from. These include <u>rabies</u>, <u>feline panleukopenia</u>, rhinotracheitis, and <u>calicivirus</u>. Some believe that all kittens should be vaccinated against feline leukemia. There is a new FIP vaccine which does not yet have enough history to determine how widely used it should be.

7. Non-Core or Lifestyle Vaccines

Lifestyle vaccines are vaccines recommended based on each individual cat's lifestyle, endemic conditions and exposure. Using the AAHA questionnaire and/or a conversation with your veterinary professional can assist you in determining which vaccines are indicated for your individual cats. These diseases include chlamydia and Bordetella.

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Vaccine/agent		Kitten PV1	Kitten PV2	Kitten PV3	Final PV/ First booster	Adult cat vaccinated <3 yrs ago	Adult cat vaccinated >3 yrs ago	Unvaccinated cat/ No vaccination history	Notes	
FPV		6 weeks*	3-4 weeks later	3-4 wks later until 16 wks	At 10-16 months	One immunisation, boost every 3 years or more.	One immunisation, boost 1 year later, then every 3 years	One immunisation, boost 1 year later, then every 3 years	- 1,2	
	•	8-9 weeks	12 weeks	16-20 wks	of age	Boost queens every 3 years or yearly if low MDA			1, 2	
FHV		6 weeks*	3-4 weeks later	3-4 wks later until 12 wks	At 10-16 months	One immunisation, boost annually	Two immunisations 2-4 weeks apart, boost annually	Two immunisations 2-4 wks apart, boost 1 year later	Rescue: 3, 4	
	0	8-9 weeks	12 weeks		of age	Boost queens annually and before breeding if low MDA			Breeding: 4, 5,	
FCV	•	6 weeks*	3-4 weeks later	3-4 wks later until 16 wks	At 10-16 months	One immunisation, boost annually	Two immunisations 2-4 weeks apart, boost annually	Two immunisations 2-4 wks apart, boost 1 year later	Rescue: 3, 4	
	•	8-9 weeks	12 weeks	16 weeks	of age	Boost queens annually and before breeding if low MDA			Breeding: 4, 5,	
Rabies	0 0	12-16 weeks (single vaccination)			1 year later	DOI of certain vaccines is 3 yrs, but legislation may require annual boosters	One immunisation One immunisation		Rescue: 7, 8 Breeding: 9	
FeLV	0	8-9 weeks	eeks 12 weeks -		1 year later	Boost every 2-3 years after 3 years of age	Two immunisations 2-4 weeks apart, boost one year later	Two immunisations 2-4 weeks apart, boost 1 year later	Rescue: 11 Breeding: 10, 1	
Bordetella bronchiseptica	•	≥ 1 month of age (single vaccination)			1 year later	One immunisation in high density population only. Boost queens annually.	One immunisation in high density population only, boost annually annually annually		12	
Chlamydia felis	••	8-9 weeks	-9 weeks 12 weeks -		1 year later	One immunisation, boost annually	Two immunisations 2-4 weeks apart, boost 1 year later	Two immunisations 2-4 weeks apart, boost 1 year later	13	
FCoV/FIP	0	Not before 16 weeks	3 weeks later		1 year later	One immunisation, boost annually	Two immunisations, boost annually	Two immunisations, boost annually	14	

* in case of an outbreak, start at 4 weeks of age and vaccinate every 2 weeks

Lifestyle assessments include your cat's exposure to other cats at boarding, cat shows and other events, groomers, family members, and so on. Be sure to bring up lifestyle when you visit your veterinary clinic. Breeding catteries have an increased risk of exposure based on numbers of cats, cats moving in and out of the cattery, pregnancy causing immunosuppression and the age of younger kittens.

Vaccine/agent		Kitten PV1 Kitten PV2		Kitten PV3	Final PV/ First booster	Adult cat vaccinated <3 yrs ago	Adult cat vaccinated >3 yrs ago	Unvaccinated cat/ No vaccination history	Notes
FPV	•	8-9 weeks	12 weeks	16 weeks*	At 10-16 months of age	One immunisation, boost every 3 years or more	One immunisation, boost every 3 years or more	One immunisation, boost 1 yr later, then every 3 yrs or more	1
FHV	•	8-9 weeks	12 weeks		At 10-16 months of age	One immunisation, boost annually (or up to every 3 yrs in low-risk situations)	Two immunisations 2-4 wks apart, boost annually or up to every 3 yrs in low-risk situations	Two immunisations 2-4 wks apart, boost 1 yr later	2
cv	•	8-9 weeks	12 weeks	16 weeks	At 10-16 months of age	One immunisation, boost annually (or up to every 3 yrs in low-risk situations)	Two immunisations 2-4 wks apart, boost annually or up to every 3 yrs in low-risk situations	Two immunisations 2-4 wks apart, boost 1 yr later	2
Rabies	•	12-16 we	eks (single vad	ccination)	1 year later	DOI of certain vaccines is 3 yrs, but legislation may require annual boosters	One immunisation	One immunisation	Outdoor cats: 3 Indoor cats: 4
eLV	-	8-9 weeks	12 weeks	-	1 year later	Boost every 2-3 years after 3 years of age	Two immunisations 2-4 wks apart, boost 1 yr later	Two immunisations 2-4 wks apart, boost 1 yr later	Outdoor cats: 5 Indoor cats : 6
Bordetella bronchiseptica	-	≥1 month o	of age (single v	vaccination)	1 year later	One immunisation in high density population only, boost annually	One immunisation in high density population only, boost annually	One immunisation in high density population only, boost annually	7
Chlamydia felis	•	8-9 weeks	12 weeks	-	1 year later	One immunisation, boost annually	Two immunisations 2-4 wks apart, boost 1 yr later	Two immunisations 2-4 wks apart, boost 1 yr later	8
FCoV/FIP		Not before 16 weeks	3 weeks later		1 year later	One immunisation, boost annually	Two immunisations, boost annually	Two immunisations, boost annually	9

* Particularly important for kittens born to queens with high antibody titres

8. Contraindications for Vaccines

There are times that either temporarily or permanently, vaccines may not be a good idea for your cat. Temporary pauses would include pregnancy or short-term medications or illnesses. Permanent pauses would include patients suffering from immune mediated diseases. Be sure to give a complete medical history prior to anyone administering vaccines to your cat. Remember, vaccines are one of the strongest medications you can give to your cat. Avoid low cost vaccine clinics, going



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to a veterinary clinic that does not know or have your cat's entire medical history, or "do it yourself" vaccines if your cat has any medical condition that could put them at risk to an adverse vaccine reaction.

9. Adverse Vaccine Reactions

Adverse vaccine reactions can come in several forms.

You may want to discuss limiting the number of antigens your kitten or cat receives at any one given time. Too many vaccines at one visit can overwhelm the immune system. If you are doing your own vaccinations, this is easy. If you are having your veterinary professional vaccinate your cat, consider splitting the vaccines up across more than 1 visit. You may have to pay for an additional office visit, or your veterinary clinic may allow these split vaccines to be given by one of their technicians. Even if your cat has previously handled many antigens at one time, it could backfire at an upcoming visit.

An anaphylactic reaction is the most acute and life-threatening reaction. In this case, the cat will suddenly, within seconds to minutes, collapse. His or her gums will be pale, may vomit, and you will be terrified. This reaction requires IV fluids and drugs. In most cases, the cat will make a rapid recovery with supportive care.

A 2nd and more common reaction will occur about 45 minutes to a few hours after the vaccination. The cat will have significant facial swelling starting at the lips and moving back to the eyes and ears. There may also be vomiting. Rarely, there can be difficulty breathing. These patients will respond well to diphenhydramine (Benadryl) and/or prednisone.

A 3rd reaction can be swelling and pain at the injection site, starting a few hours to a few days after the vaccine is administered. This generally requires little to no treatment.

Only in cats can we rarely see Vaccine Related Sarcoma, a life-threating tumor that can develop at the site of a previous injection, vaccines and others. For this reason, vaccines in cats should be placed low in the forelimb or hindlimb, never in the scruff of the neck or over the shoulders.

Because you cannot predict which cats and when a cat will react, it is best to vaccinate your cat, should you do it yourself, when there is a nearby veterinary clinic open and available to manage adverse reactions. Many vaccine manufacturers will cover the cost of supportive care if the vaccine was administered at a veterinary clinic.



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If your cat has had an adverse reaction, you should discuss which vaccines should be given individually, with a pre-medication, or at all, with your veterinary professional. In some cases, your veterinarian may suggest you eliminate some vaccines altogether.

10. <u>Selecting a Vaccine Manufacturer</u>

Not all vaccines are created equal. Use high quality vaccines that have been shipped and stored at refrigerator temperatures, mixed immediately before use, and administered by required routes (SQ or IN) at recommended ages and frequencies. Vaccine manufacturers that we recommend include: Merck, Zoetis, Elanco, BI, and Solvay.

11. Handling and Administering Vaccines

Upon receipt of your order, check the shipping box for temperature – the ice packs may be soft but should be cool. Refrigerate the vaccines immediately upon receipt.

If expired, made up too far in advance, or not shipped and refrigerated correctly, discard vaccines. Vaccines contain living virus and bacteria – they are fragile and ineffective if not handled with care.

Vaccines should be stored in a refrigerator, on a back shelf, not on the door where there are temperature swings. Use a thermometer to monitor the temperature stored. Vaccines that are too warm or too cold in storage may have increased risk of adverse vaccine reactions or failure. Keep the vaccines refrigerated until just prior to use.

Some vaccines are in a single vial, liquid. Some require reconstitution – mixing the lyophilized (freeze dried) cake with the matching liquid portion. In these cases, the liquid may be just a diluent or it may contain vaccine antigens. Only use the diluent that comes in the same tray or package as the cake – do not mix and match. Some vaccines come in multidose vials. Use only a 1 use sterile needle, drawing up the recommended volume. Roll or shake these multidose vials before drawing the vaccine into the syringe.

Do not mix vaccines together unless the manufacturer has them paired up.

Using a new needle and syringe – usually a 1 cc syringe with a 25 g needle, push the needle into the vial with the liquid and aspirate the entire contents of the vial. If you need to reconstitute the vaccine with the diluent, push the needle into the vial with the dried cake, let the fluid enter the vial, roll to mix, then aspirate the entire 1 cc contents back into the syringe. Keep the needle sterile until use. Administer within a few minutes after reconstitution. Do not make up in advance of administration.



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Some vaccines are intended to be given as a subcutaneous (SQ) injection and some as oral or nasal administration. Take great care to administer by the route intended by the manufacturer. Do not give intranasal (IN) vaccines or intraoral (IO) by injection.

Administering vaccines in specific locations has the advantage of making tracking adverse local events more easily. In our practice, we administer FVR CP IN or in the right elbow, Feline Leukemia in the left hock and Rabies in the right hock SQ. Avoid injecting into the scruff of the neck or into the muscle (IM). As long as you track and are consistent with the administration site, you will better be able to report reactions to the manufacturer. All adverse reactions should be reported either to USDA or the manufacturer.

When handling litters for vaccines, place all kittens in 1 enclosure, then as they are vaccinated, transfer them to a 2nd enclosure. In this way, you will be certain you have vaccinated each kitten once – that you have not lost track of who is and is not vaccinated.

Most single dose vaccines have a label that can be peeled off and saved to record the manufacturer, lot and serial number. This is important for the future owner to share with their vet and to use if there is a need to contact the vaccine manufacturer (vaccine failure or adverse event).

12. Vaccine Schedule for Kittens: ALL kittens need to be vaccinated! See below

13. Vaccine Schedule for Adult Cats

After the kitten vaccine series, adolescent cats require boosters on most vaccines.

14. Rabies Vaccines

Rabies vaccines should only be administered by a licensed veterinarian or in some states, a licensed or certified veterinary technician. In many states, owner-administered rabies vaccinations are not considered legal vaccinations.

Veterinarians take rabies vaccines seriously. Not only are we protecting our cats, we are protecting the humans our cats come in contact with. For this reason, rabies vaccines should be administered by veterinary professionals.

15. Owner Versus Veterinary Team Vaccinations

Many owners prefer to administer vaccines to their own kittens. While you may save some money doing these yourself, you run the risk of not having the vaccine manufacturer support that you would have if the vaccine was purchased and



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administered by a veterinary professional. In the long run, you may save money by including your veterinary professionals in your vaccine program.

Some veterinarians will not "respect" the vaccines that are owner/breeder administered or the nomograms done to time kitten vaccines.

16. Conclusion

Discuss the frequency of infectious diseases and appropriate vaccination protocols with your veterinarian.

Along with vaccines, practicing good hygiene, appropriate deworming protocols, and great nutrition all contribute to a healthy immune system with minimal viral, bacterial and parasitic challenges.

Additional resources – although breeding catteries are different than shelters, both manage large groups of cats, some very young. There is valuable and timely information in these reference libraries.

Other Resources:

- 1. <u>Revival Animal Health Learning Center</u> -<u>https://www.revivalanimal.com/learning-center</u>
- 2. University of Wisconsin Shelter Medicine- https://sheltermedicine.wisc.edu
- 3. Maddie's Pet Forum- <u>https://forum.maddiesfund.org/home</u>
- 4. World Small Animal Veterinary Association- <u>https://wsava.org/wp-</u> content/uploads/2024/04/WSAVA-Vaccination-guidelines-2024.pdf
- 5. European Advisory Board on Cat Diseases- www.ABCDcatsvets.org
- 6. FIP Treatment: <u>https://www.kcvma.com/2024/09/01/fda-allows-compounded-fip-drug-in-certain-cases/</u>
- 7. Dr. Addie's Flowchart: <u>https://fipcaregroup.com/fipac-docs/FIPdiagnosisflowchart-catvirus.com.pdf</u>
- 8. Revival Vaccine Finder: <u>https://www.revivalanimal.com/vaccine-finder</u>
- 9. https://catfriendly.com/be-a-cat-friendly-caregiver/getting-cat-veterinarian/
- 10. How to Safely Ship Animal Vaccines- <u>https://www.revivalanimal.com/learning-</u> <u>center/how-to-ship-</u> <u>vaccines?srsltid=AfmBOorxCXK2rhkX8KiXS51lckxPjpa44Lw2lVkjeHsuo6u0zMwWR</u> kiS
- 11. Pathogenesis of Feline Infectious Peritonitis (FIP)https://www.youtube.com/watch?v=6RyI2LI9R9Q

Age		Vaccine Due	Fecal Due	Blood Test Due	 Parasite Control	Others
	Kitten biography Comprehensive Physical Exam	FVR-CP	Yes	Feline Leukemia/ FIV Test	Oral Dewormer Ear Mite/Flea/Tick Control	



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☐9to 11 weeks due	Kitten biography Comprehensive Physical Exam	FVR-CP If 2 nd , no more needed till 15 months old Feline Leukemia Vaccination	Yes	Feline Leukemia/ FIV Test if not done or previously +		Dewormer Ear Mite/Flea/Tick CONTROL Heartworm Preventive If At Risk	Kitten Kindergarten
□ 12 to 16 weeks due	Kitten biography #3 Comprehensive Physical Exam	months old Feline	No If 2 Have Already Been Done	No test due		Ear Mite/Flea/Tick Control Heartworm If At Risk	Microchip
☐6 MONTHS Or after	Presurgical	Complete series	No if 2 has been		Presurgical Blood Test	Ear Mite/ Flea/Tick Control Heartworm If At Risk	Spay/Neuter Microchip
□15 MONTHS due	Comprehensive Physical Exam	FVR-CP Feline Leukemia Rabies	Yes	Yes		Ear mite/Flea/Tick Control Heartworm if at risk	
□2 TO 8 YEARS due	Comprehensive Physical Exam	FVR-CP Feline Leukemia Rabies	Yes			Ear mite/Flea/Tick Control Heartworm if at risk	Dental cleaning as indicated
□> 9 YEARS	GERIATRIC Comprehensive Physical Exam	FVR-CP due Feline Leukemia not indicated after age 3 Rabies due	Yes		Geriatric; CBC/CS Urinalysis Thyroid	HEARTWORM Flea/Tick CONTROL	Dental cleaning as Indicated

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- <u>Nobivac[®] Feline 1-HCP Vaccine for Cats</u> (25 dose)
- <u>3cc MonoJect™ Syringes with 22 gauge</u> Needles
- Feline UltraNasal® FVRCP Vaccine (20 dose)
- <u>Nobivac[®] Feline 1-HCPCh+ FeLV (25</u> <u>dose)</u>
- Focus Cat Vax 3[®] (1 dose)
- <u>Feline UltraNasal[®] FVRC (20 dose)</u>
- Nobivac[®] 1-Rabies (10 dose)

- Nobivac[®] Feline-Bb
 - Solo-Jec[®] Feline 3 Single Dose
 - TruFel™ Ultra C2 (Ultra Fel-O-Vax Dual FVC) (25 dose)
 - Nobivac[®] Feline 1-HCPCh (25 dose)
 - Single Dose Feline Vaccines
 - Feline Leukemia Vaccines
 - <u>3 Way HCP</u>
 - <u>4 Way HCPCh</u>
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