



AMERICAN KENNEL CLUB
CANINE HEALTH FOUNDATION

American Kennel Club and Canine Health Foundation
Breeders' Symposium

Hosted by
The University of Pennsylvania
School of Veterinary Medicine
January 29, 2005

ABC's of Breeding

Claudia Orlandi, PhD
Essex Junction, Vermont

The *ABC's of Breeding Home Study Program* is based on Dr. Orlandi's belief that **anyone** can and should understand the basic and important rules of canine genetics in his quest to breed better, healthier dogs. The *ABC's of Breeding's* unique, step-by-step approach to better breeding includes easy-to-answer workbook exercises along with an innovative set of flash cards, which makes learning new material fun and easy. Attendees who complete the *ABC's of Breeding* workbook exercises and send them in to AKC will receive a certificate of completion.

The *ABC's* takes a practical approach to teaching the art and science of dog breeding and focuses on six key tools and concepts. This include 1) genetics, 2) breeding systems, 3) the pedigree, 4) the selection process and the concepts of 5) genetic defects and 6) kennel blindness. Understanding each of these components can help breeders put together the pieces for a more successful breeding program.

Along with reviewing the basics of heredity, some of the common misconceptions that have been passed down from dog breeder to dog breeder are also discussed. A few of these include: What is the definition of linebreeding? Why can linebreeding beyond the fourth generation have relatively little genetic impact on a litter? Should you breed an inferior dog with an excellent pedigree? Is the pedigree more important than the dog itself?

Throughout the *ABC's of Breeding* program the focus is on "need-to-know," practical information, with an emphasis on making it all easy to understand and fun to learn.

Biographical Profile

Dr. Claudia Orlandi's involvement with showing dogs began as a Junior Handler. She and her husband currently have a kennel of 40 to 50 Basset Hounds under the Topsfield prefix on 200 acres in northern Vermont. They have bred over 60 champions, including record holding Bassets in several areas. A teacher by profession, Claudia has been actively involved in education within the Basset Hound Club of America and as a lecturer. She has served on the BHCA Health & Research Committee, the Judges' Education committee and is currently Chairman of Member Education for which she is designing an innovative concept called "Basset Hound University". She authors a column called "Breeder's Toolbox" in the BHCA newsletter and has designed "The Pedi-Score Tool Kit: A Recording System for Basset Hound Breeders." She has also written "Discover the Basset Hound: A Guide To This Fascinating Breed and presented the following workshops: "Tips on using the Pedi-Score Tool Kit to Evaluate a Litter," "Evaluating Forequarters in the Basset Hound" and "Evaluating Hindquarters and Balance in the Basset Hound." She has recently developed "The ABC's of Breeding: What Every Dog Breeder Should Know," which is a home study program for dog breeders. She judges Basset Hounds, Dachshunds and Junior Showmanship.

*American Kennel Club and Canine Health Foundation Breeders' Symposium
Hosted by the University of Pennsylvania School of Veterinary Medicine
January 29, 2005*

Assisted Reproduction: Insight Into Current and Future Techniques for the Next Generation of Puppies

Dr. Anne Traas
University of Pennsylvania

Pre-breeding Exam Male

- Health Record Review
- Breeding History
- Physical Exam
- Semen evaluation
- Brucellosis Test

History Questions, Male

- What is the reason for the exam
 - Routine, Infertility, Pre-breeding
- Signalment
 - Age: Young, Mature, Old
 - Breed
- Family and kennel history
 - Reproductive history of males and females
 - Genetic problems in this line
- Brucellosis test(s) performed
- Diet and Supplements received
- History of training, stress, or high exercise levels
- Previous Breeding History
 - Last breeding when and how timed
 - How many litters and how long ago
- Mating behavior observations
 - Interested in estrous female
 - Mounts and ties normally
- Any other health or behavior issues
 - Arthritis, systemic illness, injuries, etc.
- Any previous semen evaluations
- Is there any frozen semen available on this male

Pre-breeding Exam Female

- Health record review
- Breeding and cycle history review
- Physical exam
- Brucellosis test
- Vaginal cultures are not needed because the information they give tells us nothing in a bitch that is healthy. We expect to grow bacteria because the vagina is not sterile.

History Questions, Female

- What is the reason for the exam
 - Routine, Infertility, Pre-breeding
- Age: Young, Mature, Old
- Breed
- Family and Kennel History
 - Reproductive history of males and females
 - Genetic problems in this line
- Diet
 - Current and previous
 - Supplements and vitamins (Joint meds, etc.)
 - Treats or rewards (liver, commercial, homemade)
 - Medications (HW, Flea and Tick, thyroid, NSAIDs, etc)
- Medical History
 - Previous illness
 - Systemic signs of current illness
 - Vomiting, diarrhea, coughing, sneezing, skin, drinking too much (PD), urinating too much (PU), activity level, body condition score, other
- Cycle history
 - First cycle
 - Can be erratic and may be too young to breed
 - Have cycles been normal
 - How often does she cycle and how long
 - Has she ever had a vaginal smear or series of smears
 - Has she ever has a progesterone or luteinizing hormone (LH) test
- Breeding history
 - Has she been bred before
 - Will she allow a male to mount and tie
 - How was her cycle timed when she was bred
 - Was she bred here or shipped to the male
 - Was she bred to a proven male
 - When was his last litter born
 - How was she bred
 - Natural – was a tie observed
 - AI or chilled – was the semen quality evaluated
 - Surgical or TCI – post thaw semen evaluation
- Pregnancy history
 - Has a pregnancy test been performed
 - How and when was the test done
 - Ultrasound, palpation, relaxin, x-ray

- Has she had a litter
 - How many litters
 - When was the last litter
 - History of dystocia or c-section
 - Size and health of litter
 - Maternal behavior
- History of abortion or fetal resorption (early pregnancy loss)
- Brucellosis testing
- Reproduction Treatments
 - Pyometra
 - Vaginitis
 - Thyroid
 - Mismatching treatments
 - Treatments to prevent or delay estrous cycles
 - Has she been treated with anything for infertility
 - Estrus induction, fertility drugs, homeopathic meds, supplements etc

Physical Exam

- Thorough Exam
 - Routine Physical
 - Systemic Medical Conditions may affect fertility
 - Conditions such as lameness or obesity may affect the ability to breed or give birth
 - Reproductive Organs
 - Examined for overall condition as well as presence of discharge (male or female)

Semen Evaluation

- Mating Behavior
- Sample Color, Cloudiness, Consistency
- Motility
- Morphology
- Number of Sperm
- Total Number of Normal Progressively Motile Sperm (NPMS) per collection

Ways to Use Semen

- Natural Service - Hand or Run Bred
 - Pros
 - Low cost
 - Often is the easiest for many breeders
 - Fresh semen can live in the reproductive tract for 4-9 days.
 - Mating can be done several times.
 - No damage to semen from handling

- Cons
 - Male must be alive, healthy and fertile
 - Number of females serviced is limited.
 - Male and female must be brought together
 - Semen can not be evaluated at time of insemination
 - Male can service only one female per ejaculation.
 - Temperaments of animals must be compatible
- Fresh - Manually collected and used immediately
 - Pros
 - Semen is evaluated
 - Accurate breeding dates recorded
 - Semen can be placed in uterus if male is sub-fertile
 - Semen may be split between females
 - Cons
 - Male and female must be in close proximity
 - Male must be alive healthy and fertile
 - Limited services per week
 - Rarely, males will not allow collection
 - Must be used immediately
- Chilled - Manually collected, extenders are added and it is cooled for use within 48 hours
 - Pros
 - Male and female do not have to be in close proximity
 - May be shipped overnight
 - May be inseminated in uterus or vagina
 - Semen is evaluated before use both when collected and before insemination.
 - Cons
 - Not all sperm survive chilling
 - A few dogs' semen does not chill well
 - Shipment timing can be difficult because of mail or flight scheduling weather, etc.
 - Male must be alive, healthy and fertile
 - Number of services limited
 - Semen may arrive in poor condition due to delay in shipment, temperature variation, or individual low tolerance to chilling process.
- Frozen - Manually collected, frozen and stored until needed
 - Pros
 - Can be stored for long periods of time
 - Multiple breeding units per collection

- Semen is evaluated
- Can be shipped
- Semen may be used after male is dead or unable to breed
- Many more bitches can be serviced
- Cons
 - Best results when placed in the uterus
 - Semen is partially damaged in freezing process
 - Bitch timing must be exact
 - Special advanced equipment required
 - Not all males have semen that is good enough to freeze

The Secret to Success: **TIMING !**

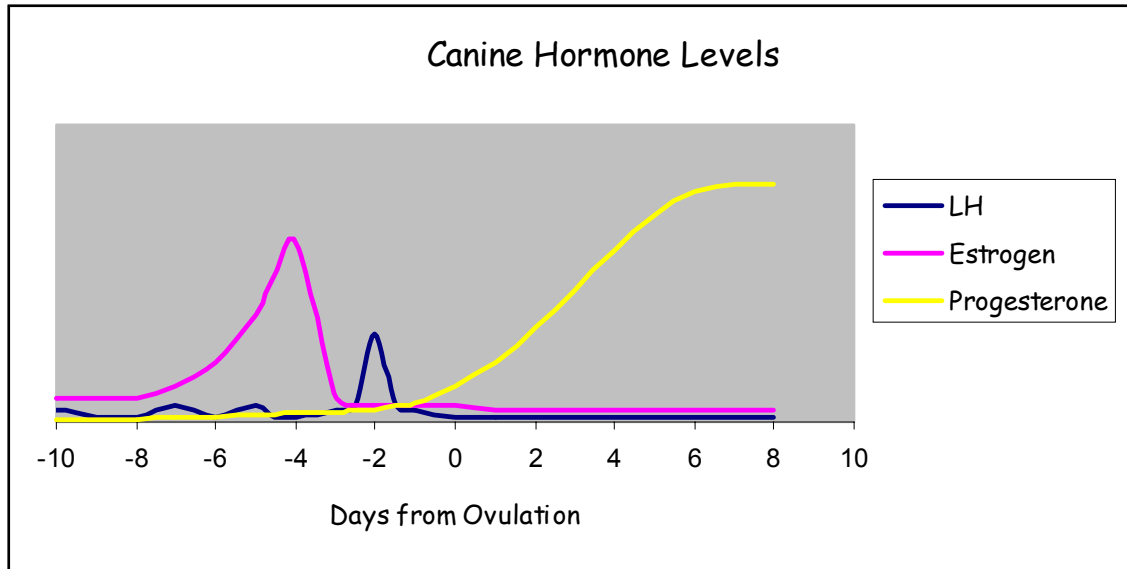
Put excellent quality semen into a fertile female at the right time for the best results.

Timing a Bitch's Season

- The Old Way – These techniques will get some bitches pregnant, they have worked for years. However when you want more than “some” of your bitches pregnant with the highest possible litter size then the new techniques are the best way to go. It is all a matter of how important **this** breeding is to the breeder.
 - Breed on Day 13
 - When do you count day 1?
 - Many bitches will be at the wrong point in the cycle.
 - This works a few times because fresh semen lives in the reproductive tract for a long period of time.
 - Breed when the male says she is ready
 - Some males will breed anything that moves
 - Some females “smell” or “act” ready at the wrong point in their cycle
 - Breed every other day as long as the bitch will stand
 - The most effective of the non-timed methods
 - Works because canine semen lives a long time in the female tract
 - Some bitches will not stand at all, some will stand at the wrong time, if semen less than ideal quality this may not work.

Hormones

- Luteinizing Hormone (LH) – peak stimulates ovulation 2 days later
- Estrogen – causes maturation and cornification of vaginal lining cells, responsible for breeding behavior
- Progesterone – produced in pregnant AND non-pregnant bitches; maintains pregnancy, induces maternal behavior
- Relaxin – produced by the placenta, relaxes pelvic canal and cervix in late pregnancy. Can be measured to determine pregnancy.

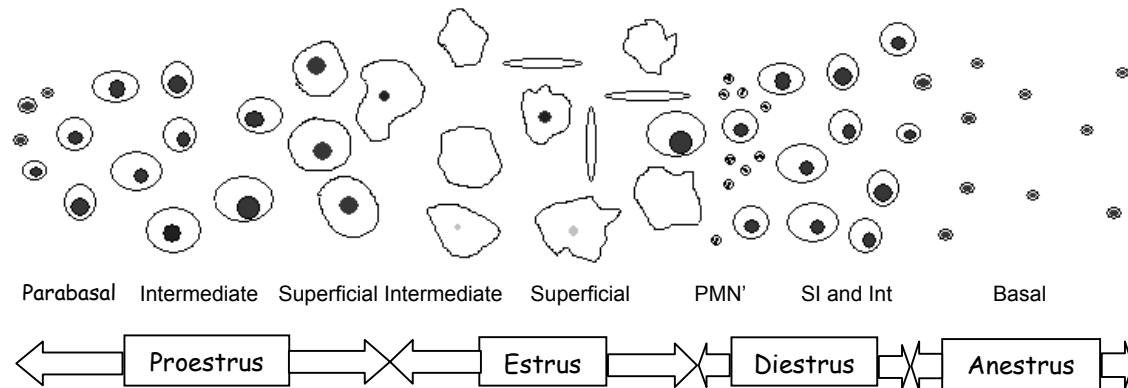


Current techniques for timing

- Luteinizing Hormone (LH) levels
 - Must be run every 12 hours to be sure to catch the surge
 - Very accurate predictor of ovulation
 - Best used in conjunction with progesterone levels
 - Can miss the LH surge if run too late in season. If the progesterone has already risen above the range we would expect for the LH surge then running LH level tests would be a waste of time and money.
 - Can become expensive
- Progesterone levels
 - Very accurate when run in a series
 - Single numbers are not as helpful as trends
 - Must be interpreted by someone experienced in canine reproduction and familiar with the lab running the tests.
- Vaginal Smears
 - Best used to gain a basic idea of where a bitch is in her cycle.
 - Should not be used alone as a timing tool if the breeding is important.
 - Are very useful when compared to progesterone levels to evaluate the stage and quality of the cycle.

Vaginal Cytology

Canine Vaginal Cytology Progression



The meaning of progesterone levels

Progesterone values are in ng/dl and the values here are only valid when run using a technique called RIA, other methods, such as in clinic machines, may give very different numbers.

- < 0.5 = anestrus or early proestrus
- 0.5-1.9 = proestrus or early estrus
- 2 - 2.9 = day of the LH peak
- 3 - 3.9 = day before ovulation
- 4 - 10 = ovulation day
- > 10 = has already ovulated
 - Remember not every female “reads the book”, rarely we need to adjust our thinking for a female that is having an unusual cycle
 - Bitches should be bred 4 and 6 days after the LH peak with fresh semen for the best results. This is because it takes 2 days for the egg to mature after ovulation before it will be ready to be fertilized.
 - Progesterone should be measured to be sure she has ovulated on the day of breeding.

Timing a Bitch's Season

- First exam - Day 6-7 of her cycle
 - Physical Exam, Vaginal Cytology
 - Progesterone testing if indicated
- Recheck based on previous results
 - If vaginal smear indicates early proestrus it may be 4-7 days before recheck
 - If progesterone test is run a recheck exam will be based on the results both that and the vaginal smear.

Assisted Techniques

- Artificial Insemination (AI)
 - Semen can be fresh, chilled, or frozen
 - Best success with fresh semen
 - Semen is deposited in the vagina
- Surgical Insemination
 - Bitch is anesthetized and an incision is made in her flank or lower abdomen
 - Uterus exteriorized, semen is injected into each horn, uterus is replaced
 - Incision is sutured and bitch is allowed to wake up.
- Trans-cervical Insemination (TCI)
 - Fresh, chilled or frozen semen may be used
 - An endoscope is passed into the vagina to the cervical opening
 - A catheter is threaded through the cervix and semen is deposited in the uterine body
- Putting semen directly in the uterus may help some stud dogs with poor quality semen produce offspring
 - TCI or Surgical; fresh semen only
 - Consider that poor fertility can be hereditary

The Age of DNA

- Genetic testing is now available
 - Paternity testing
 - Enables confirmation of sire
 - Allows for multiple sires for one litter
 - Genetic Disease Testing
 - Allows control of genetic diseases by testing potential parents for carrier status

Cutting Edge

- Post Mortem Semen Harvest
 - Semen can be harvested from stud dogs that have recently died unexpectedly then frozen for future use.
- Sex Sorted Semen
 - Commercially available for Humans, Cattle, Horses. Not yet available for dogs. The availability will largely be based on demand for the service. It is very costly to set up the sorter and obtain the license to run it.
 - Sorted Female Sperm is 91% female
 - Sorted Male Sperm is 76% male

On The Horizon

None of these techniques are available commercially right now but they may be coming very soon in the future.

- Oocyte Harvest
- Ovarian Cyropreservation – Eggcicles
- In Vitro Fertilization- test tube puppies
- Embryo Transfer – surrogate bitches
- Cloning- Copy Dogs

Biographical Profile

Dr. Traas is currently the Medical Genetics Resident at the Matthew J. Ryan Veterinary Hospital at the University of Pennsylvania where she sees cases in genetics, pediatrics, and reproduction.

Most of her undergraduate work was completed at the University of Wisconsin – River Falls but she received her BS in 1999 from the University of Minnesota. She also received her DVM from the University of Minnesota in 2001.

The three years preceding her residency were spent at Symbioun Inc., a private practice in Kansas, where over 90% of her cases were reproduction related. Over the last three years she has assisted in the breeding of over 3,500 dogs with an average success rate between 93% and 95%.

She currently lives in Philadelphia with her husband Jeremy, her Border Collies, and Ragdoll cats.

Genetics and Cancer: Understanding the Link

Beth Overley, VMD, DACVIM
University of Pennsylvania

The prevalence of cancer is increasing in the pet population. Forty-five percent of all dogs that live to be 10 years old will die of cancer, and a recent health survey identified cancer as one of the leading causes of canine death. Dogs are living longer due to improved health care, better nutrition, and an increased awareness of the importance of the human-animal bond. However, it is unclear whether increased longevity is the only reason for the increased prevalence of cancer in the pet population. The causes of cancer are multi-factorial, and environmental exposure and genetic predisposition each play a role.

The hallmark of cancer is genetic instability. Tumor suppressor genes, such as *p53*, serve to prevent the growth and replication of abnormal cells. Proto-oncogenes, such as *c-myc*, stimulate cellular growth and proliferation. These genes regulate cell growth and provide a fine balance to keep cancer in check. Accumulated genetic mutations in these genes disrupt the balance and lead to cancer. Causes of such genetic mutations include both inherited and non-inherited (environmental, epigenetic, carcinogenic, or unknown) causes. Heritable syndromes are well-known in humans but still not well characterized in veterinary medicine. However, breed-related predispositions to various cancers have been recognized, and it is likely that genetic predisposition plays a role.

This talk explores the link between genetics and cancer development, reviews the known causes of veterinary cancers, reviews breed predispositions, discusses some of the current research in the field.

Biographical Profile

Beth Overley is a clinical lecturer at the MJR Veterinary Hospital of the University of Pennsylvania. She completed her veterinary training, internship, and residency at the University of Pennsylvania and passed her oncology specialty boards in June 2004. Her research includes characterization of canine lymphoma through comparison of histopathology, cytology, and flow cytometry for patients treated on a single chemotherapeutic protocol; assessment of immunological recovery of cancer patients treated with a short chemotherapeutic protocol; assessment of the role of angiogenic factors in canine lymphoma; evaluation of treatment response of canine lymphoma and hemangiosarcoma to a novel chemotherapeutic agent and prediction of treatment response using genetic profiling; and assessment of carboplatin chemotherapy as an adjuvant treatment for canine oral melanoma.

Feeding Dogs for Health & Longevity

Kathryn E. Michel, DVM, MS, DACVIM
University of Pennsylvania

The field of nutrition is an exciting place to be these days. For decades the focus has been on understanding what nutrients were essential in the diet. The impact of that research has been profound. People and companion animals live much longer healthier lives than they did a century ago now that dietary deficiencies can be avoided. However, the focus is shifting to the more subtle ways that diet can influence health and longevity. We now recognize that not only enough of the right nutrients is important. Too much, even just a little bit too much, can have deleterious consequences over a lifetime. What's more, we are increasingly recognizing that foods contain many other physiologically active substances in addition to essential nutrients.

New information is arriving every day and it is hard to keep up and differentiate the sound byte from the scientifically sound. Unfortunately the field of nutrition is one that seems to be fraught with evangelical-like self-proclaimed experts who are ever ready to tell you they have found the ultimate diet and then sell it to you. Personally, I try to keep an open mind, keep current with the scientific literature (and review it critically) and do my bit to contribute to our understanding of nutrition through research. With all of this in mind, my talk will focus on a few fundamentals that we should never lose sight of even as we look forward to a growing understanding of the role of nutrition in the prevention and treatment of disease.

Things to Consider When Evaluating a Pet Food

1. Is the nutritional adequacy statement based on feeding trials?
2. Is there a phone number on the label for consumer inquiries?

If the answer is no to either of the above questions I would be disinclined to use the food. If the answer were yes to both questions then I would call the phone number and make the following inquiries:

3. Does the company run AFFCO feeding trials on each of their products or product families?
4. Does the company have their own manufacturing plants or do they contract with an outside feed mill or manufacturing plant?
5. Does the company have an R&D department?
6. Where does the company get their raw ingredients? Are they from established sources or do the sources vary? What kind of standards does the company have for raw ingredients? Do they do any testing in-house before using an ingredient for manufacturing?
7. What kind of testing does the company do at the end of each run? Do they hold the product for shipment until this testing is completed?

8. Does the company do stability testing of their products? Do they know the shelf life of their product? Do they put expiration dates on their product?

Finally, I look at any promotional material that is available for the product (including the packaging) and evaluate how the product is marketed. Are they basing their marketing claims on a sound scientific rationale? Is the marketing based on a gimmick (e.g. people foods as pet foods)?

Biographical Profile

Dr. Kathy Michel received her veterinary degree from Tufts University in 1983. In 1997, she received certification from the American College of Veterinary Nutrition. Dr. Michel's clinical interests include nutritional assessment and nutritional support of critically ill patients, and her research has focused on nutritional requirements of critically ill patients and nutrient modulation of gastrointestinal and endocrine diseases.

Vaccinations: Less is More?!

Margret Casal, Dr. med.vet., DECAR
University of Pennsylvania

Vaccinations have greatly contributed to the well being of our canine companions. The number of patients that we see with infectious diseases has decreased significantly over the past 20 years, ever since the first canine vaccines were available. Many of the infectious diseases in dogs are ubiquitous and are often fatal in the unvaccinated animal. Prior to the availability of vaccines, distemper was the leading cause of death in dogs. Thus, the importance of vaccinations cannot be overstated. However, differences in risk of exposure to infectious diseases, age and health of the patient, and potential side effects of certain vaccines, make it next to impossible to recommend one single vaccination protocol for all dogs. Therefore, we recommend for optimal protection that each dog be examined on a yearly basis even if vaccines are not to be given in that particular year. Health and life style changes can be assessed and the dog's vaccination protocol can be adjusted as needed.

This handout gives an overview of the general vaccination protocol we follow at the University of Pennsylvania. Some of the important issues regarding certain available vaccines are outlined below.

VACCINATION SCHEDULE

The purpose of vaccinations is to stimulate humoral and/or cellular immune responses and to generate an appropriate immune memory so that subsequent exposure of the animal to the infectious agent will not result in a disease state. In young animals, the presence of maternally derived, passive immunity may interfere with this process, as may other factors such as poor nutritional status, concurrent disease, and anesthesia. Because maternally derived antibodies may block an immune response to vaccines in very young puppies, a series of vaccines are given at appropriate intervals, which should then result in active immunity against the vaccine antigens and the corresponding naturally found antigens. Owners need to understand the purpose of vaccination, the vaccination schedule, and onset of protection, as it differs greatly from those used in humans. Owners also need to know about possible adverse reactions to the vaccines, such as fever, lethargy, anaphylaxis, other immune-mediated diseases, and local inflammation and lack of protection against a given infectious agent.

At what **age** should one begin vaccinating puppies? As there is no transfer of maternal antibodies through the placenta to the fetus, puppies are born with almost no antibodies. Thus, protection is provided by ingestion of colostral antibodies during the first day of life. As maternally derived antibody titers decline in puppies, the neonates' immune system develops further. In theory, colostrum-deprived animals could receive their first vaccinations at 2-3 weeks of age and colostrum recipients at 6-9 weeks of age. Vaccinations may accelerate depletion of maternally derived antibodies in neonate. Thus during an outbreak, it may be useful to begin vaccinating as early and as often as

possible. Vaccines are routinely **administered** subcutaneously. However, the advantage of intranasal vaccines is that they provide local immunity and appear to break through maternal immunity quicker. However, the owner should be made aware of the possibility of mild to (rarely) severe signs of the corresponding disease after intranasal vaccination. The **interval** between the first series of booster vaccinations should be between 3 and 4 weeks because vaccines can interfere with each other; upon infection with the vaccine virus, cells increase interferon production. Therefore, if the second vaccine is given within a week to ten days, it will fail. Delays longer than 8 weeks should be avoided. The exception is the rabies vaccine that is only given once at 13 weeks of age and then followed by a booster at one year of age. After all **boosters** are given at one year of age, all modified live vaccines (DA₂PP) can be given every three years instead of yearly. The killed vaccines (i.e. leptospirosis, Bordetella, Lyme) need to be repeated yearly, as studies have demonstrated a short (less than one year) duration of immunity. On a final note: never mix vaccines, only use licensed multivalent vaccines, and never inject a vaccine that is intended for intranasal use.

GENERAL GUIDELINES AND STRATEGIES REGARDING THE USES OF VACCINES IN DOGS

Only **healthy** animals should be vaccinated. For example, if an animal is presented with a body temperature that is elevated and remains above 103°F on repeated measurements, its cellular immune system shuts down. Thus, the vaccine may not be efficacious or worse, may cause disease. Animals with immunodeficiencies or receiving chemotherapy will also not respond appropriately to vaccination. For these animals it may be beneficial to use killed vaccines to which many are still able to respond (i.e. mount an immune response), yet the risk of causing infection as with modified live vaccines is virtually absent.

Vaccination sites: It should **always** be recorded where the vaccines were given, in case reactions are seen later. In dogs, rabies should always be given in the right upper hind limb. The other vaccines may be given on the right or left side of the abdomen. We do not recommend giving vaccines between the shoulder blades (or under the skin of the tail) because of the poor drainage of this site.

Pregnancy: It is best to vaccinate before pregnancy. If this is not possible or the opportunity missed, it has been recommended that killed vaccines should and can be used safely two weeks before the expected due date. Two weeks allows sufficient time for the production of antibodies, which can then be passed on to the offspring via colostrum intake. However, because of the nature of killed vaccines, adverse, allergic type reactions are more likely. Never give a rabies vaccination during pregnancy because it may cause abortion.

Vaccine reactions: The owner should carefully observe any animal for the first half-hour after vaccination for signs of acute allergic reactions. In our clinic this is about the time it takes to write up the discharges and have the business office write up the bill. In case of allergic reactions, contact the clinician or the emergency service immediately. If an

animal has had a reaction before, depending on the severity, it may be given Benadryl® one half hour before vaccination, may be kept in the clinic for 24 hours for observation, or not vaccinated at all. In cases where the veterinarian and the owner have opted not to vaccinate the animal, titers to the corresponding diseases may be measured, but keep in mind that serum titers do not reflect the actual state of local immunity. There are no accurate numbers describing the frequency of vaccine reactions (see below). However, there are some estimates, which are presented here. Anaphylaxis is thought to occur at a rate of 1 per 15,000 vaccinations and there is one scientific article describing IMHA in a dog after vaccination. We all feel horrible if the animal we vaccinated develops a vaccine reaction. However, morbidity and mortality rates in unvaccinated animals far exceed the number of adverse reactions in vaccinated patients. For example, there is a 90% morbidity rate in unvaccinated dogs with parvoviral infections and many of these dogs die. There are essentially no reports of adverse reactions after using this vaccine.

Please find below the vaccination schedule recommended for dogs. It is ultimately up to you and your veterinarian to weigh the risks versus the benefits and thus which vaccines should be given and how often your dog will be receiving them..

CANINE VACCINATIONS

Canine Vaccination Protocol at the Veterinary Hospital of the University of Pennsylvania

Vaccines	Neonates	Puppy Series			Last Puppy booster	First Adult Booster	Adult Boosters	
	* 2-6 weeks	6-8 weeks	10-12 weeks	13-16 weeks	16 weeks	15 months	Every year	Every 3 years
Distemper/ Measles	X							
Killed Parvovirus	X							
Distemper		X	X	X	X#	X		X
Canine Adenovirus Type 2		X	X	X	X#	X		X
Canine Parainfluenza		X	X	X	X	X		X
Canine Parvovirus				X		X		X
Rabies Virus				X		X		X
Leptospira (optional)			X	X	X#	X	X	
Bordetella (optional)		X	X	X		X	X [†]	

*: See text

#: Optional; usually present in combination vaccines together with canine Parvovirus

† Booster every 6 months if kenneled.

Puppies: A dog presented before 6 weeks of age that may be lacking colostrum or in case of high infectious disease risk (*) may be given measles virus vaccine to overcome maternal protection against distemper and killed canine Parvovirus vaccine (killed CPV). Do not use live CPV < 5 weeks of age because of the potential damage to still dividing and developing myocytes. After 6 weeks the regular protocol above should be followed. The last “puppy booster” should be given at 16 weeks and the first adult booster one year later. Potentiated modified live CPV vaccines (fewer cell passages to produce a more immunogenic Parvovirus) provide much better immunogenicity.

Canine Rabies Vaccine: Rabies vaccines have been around for quite a long time. They are killed vaccines, which are very effective and provide long-lasting immunity. Rabies is probably the single most important canine vaccination, as there is the potential for an unprotected rabid dog biting and thus infecting a human. Although rabies vaccines given intramuscularly may lead to quicker protection, the disadvantages of this route are that the intramuscular injection is more painful, there is a higher risk of type I immunologic reactions, and it is more difficult to see a local reaction in a muscle than when the vaccine is given subcutaneously. Never use modified live rabies vaccines as they produce numerous severe side effects.

Canine Distemper Vaccine: Currently, distemper vaccines are modified-live vaccines, which are very effective. It was previously thought that combining distemper and Parvo in the same vaccine would lead to a decrease or a delay in the response to the distemper component. However, my own studies and those from Cornell have been unable to substantiate such claims. If a patient is immune deficient or pregnant, the MLV vaccines should not be used because they may cause disease in the patient or the fetuses, respectively. Therefore, killed vaccine can be purchased from Intervet or other companies. Alternatively, measles vaccines (also a Morbilli virus) may be used, which do not cause disease but are cross-protective. DNA vaccines are being developed but are not commercially available at this time.

Canine Parvovirus Vaccine: Modified live and killed vaccines are available for dogs. Killed vaccines are preferred in puppies under 5 weeks of age and immune deficient dogs as the MLV may cause disease. Today's MLV Parvovirus vaccines are less attenuated (new-generation, high-titer, low-passage) than previous ones and are claimed to be able to "break through" maternally derived immunity. However, the Baker Institute at Cornell examined 5 different commercially available Parvovirus vaccines and found that the vaccines failed to elicit immune responses until the maternally derived antibodies had declined to levels at which the pups were susceptible to infection. In a recent study 60 mixed-breed pups were vaccinated with these newer versions of the CPV vaccines at 6, 9, and 12 weeks. The results showed that all pups had seroconverted by 15 weeks of age, suggesting a faster response and higher serum neutralization titers. However, the study was sponsored by one of the drug companies that produces one of these vaccines. MLV vaccines are shed for at least one week post vaccination and may spread to other animals. This may actually be an added benefit in kennel situations in which susceptible littermates may be vaccinated by the shed vaccine virus. Alternatively, if there are immune deficient animals present, they may contract the disease from the vaccine virus. There are myths about the MLV Parvovirus vaccine suppressing the immune system. However, all of the scientific studies done to date have not been able to substantiate such claims. Another myth is that it is more difficult to vaccinate Rottweilers and Dobermans against CPV infections. While these dog breeds may develop more serious disease after natural infection, they mount immune responses to an efficacious vaccine just like any other dog. Lastly, Parvovirus outbreaks are not prevented with more frequent vaccination. Vaccinating every two weeks during puppyhood can actually be detrimental. The only way to prevent outbreaks is with proper hygiene, even if this means footbaths and limited contact. CPV is spread almost entirely by contact, unlike CDV. New vaccines that are being developed include DNA vaccines and recombinant vaccines on plant virus vectors.

Canine Adenovirus Vaccine: Canine Adenovirus (CAV) type 1 causes infectious canine hepatitis and CAV-2 is part of the kennel cough complex. Because of previously reported side effects (Blue Eye) when using CAV-1, most vaccine manufacturers now offer CAV-2 in their vaccines as it provides cross-protection against infections with CAV-1. Parenteral and intra-nasal MLV vaccines are available and they are equally effective. Minor side effects are possible with the intranasal vaccine such as nasal and ocular discharge and allergic reactions to the parenteral vaccine have been reported.

Canine Parainfluenza Vaccine: This old tried and true vaccine comes in a parenteral and intranasal MLV form. It is an effective vaccine in the prevention of this component of the kennel cough complex. Side effects include those seen with intranasal CAV-2 vaccines.

Coronavirus Vaccines: Ten years ago when the first Coronavirus vaccines were introduced, severe neurologic side effects were seen. Since then, the vaccine has been reformulated and appears to be safe at this time. Natural coronaviral infections only causes serious, fatal disease in puppies less than 5 weeks of age. However, puppies are generally protected through colostral antibodies until 8 – 12 weeks of age. Thus, it is probably of little value vaccinating puppies against coronaviral infections. Vaccinate against canine corona viral infections only when there is a concurrent CPV infection in the kennel/breeding facility or there appears to be a greater risk of CPV infection. Some of the older vaccines are inactivated and have been shown to provide incomplete protection. The newer vaccines available today are modified live, provide adequate protection, and adverse reactions have not been reported.

Leptospira Vaccines: Because all Leptospira vaccines are bacterins, their use may result in allergic reactions. Recently, a new Leptospira vaccine has become available that contains four different serovars: grippityphosa, canicola, icterohemorrhagica, and pomona. The vaccine is now purified, which may reduce allergic reactions and although titers drop significantly after 6 months, challenge with pathogenic forms of L. icterohemorrhagica and canicola one year after vaccination did not cause disease. Generally, we recommend this vaccine, given yearly, especially for dogs that come in contact with wild life or city rodents. However, there are recent reports from practitioners that have seen allergic reactions in small breed dogs. Thus, if these, smaller dogs are at less risk of coming in contact with leptospirosis carriers (wild life and rats), we recommend not vaccinating them against leptospirosis until further notice. Vaccines against leptospirosis do not prevent carrier-state.

Lyme Disease (Borreliosis) Vaccines: We do not recommend or carry this vaccine. Tick prevention should be implemented in place of vaccination. Post-vaccinal Lyme-like syndrome has been described and it is possible that the same dog breeds that have had these types of reactions may also be the ones that have more serious disease after infection with the naturally occurring strain. The vaccine also interferes with interpretation of titers possibly for years after vaccination. One of the difficulties in assessing the Lyme vaccines is that it has been quite difficult to evaluate their efficacy. Most of the vaccines available are bacterins, which have been suspected of causing polyarthropathies in some dogs after their use. Newer Lyme vaccines are recombinant products presenting the OspA protein for immune stimulation. However, one study has also shown that side effects remain after use of this product.

Bordetella bronchiseptica Vaccines: This is probably not a very effective vaccine, and there are not enough studies to document either short- or long-term efficacy. However, there are some kennels that require Bordetella vaccinations before the dog can be boarded. The intranasal vaccine seems to provide marginally better protection than the injectable form. The dog should receive a booster 2-4 weeks after the initial vaccination, if given the killed injectable vaccine. A single dose of the intranasal vaccine is likely to be sufficient in a puppy older than 14 weeks of age, when the maternal antibodies have dropped to undetectable levels.

Giardia Vaccines: Infections with Giardia spp. generally do not cause serious disease. However to prevent shedding, we do recommend vaccinating dogs living in households with immunologically compromised humans, as it is an anthroponozoonotic disease. In addition, there are some younger dogs that seem to have a harder time clearing infections with Giardia. Therefore, parasitologists have recommended vaccinating these dogs to shorten the duration of diarrhea/shedding and thus, the possibility of re-infections.

Biographical Profile

Dr. Margret Casal grew up in California, but went to veterinary school in Switzerland where she received her degree in 1984. She obtained her Master's degree (1988) in evaluating the efficacy and safety of canine vaccines used at the time of a major distemper outbreak in Switzerland during the summer of 1986. Until 1991 Dr. Casal was a lecturer at the University of Zurich in Department for Small Animal Reproduction. From 1991-1993 she did her residency in Medical Genetics at the Veterinary School of the University of Pennsylvania and from 1993-1999 she performed graduate studies and obtained a PhD in 1999 (topic: In utero gene therapy of mucopolysaccharidosis type VII). Since then, Dr. Casal has been an assistant professor in the Section of Medical Genetics at the Veterinary School of the University of Pennsylvania. She is a member of the vaccine committee and am board certified at the European College of Animal Reproduction.