

Embark for Veterinary Practice

A Case Study with Telford Veterinary Hospital



Dear Colleagues,

I am excited to share with you my experience in the rapidly evolving field of clinical genetics. I have personally seen the potential genetic screening has to complement existing best practices and strengthen the doctor-client-patient bond. Every veterinarian genetically screens patients when we refine differentials based on breed. We can gain even greater insight by utilizing evidence-based technology that can inform on breed ancestry, traits, and health conditions.

As a Senior Veterinary Geneticist with Embark, who has grown with the company since 2019, my purpose is to make genetic discoveries that are actionable and clinically relevant. My background conducting clinical trials and engaging in molecular genetics research uniquely prepared me for my current position.

I have been a clinical veterinarian for ten years and I continue to practice emergency medicine today. I understand the difficulties we all encounter providing personalized care to our patients. I am here to tell you a few stories that demonstrate how Embark can add immediate value to your client and patient interactions.

The study below will introduce you to Embark and to a very special hospital who conducted our first pilot. We will clearly present how Embark testing can fit into your current workflow and become a source of continuing revenue.

You will meet Molly, a Keeshond with von Willebrand Disease, and Smokey, a mixed breed dog “At Risk” for Hyperuricosuria (HUU). You’ll come to understand how we interpret genetic screening results and the follow-up diagnostics and therapeutics that can be considered in each case.

I look forward to Embarking with you!



Regards,

Kari Cueva, DVM

Embark Senior Manager, Veterinary Genetics
ER Clinician
Reproduction & Genetics Intern (UC Davis)
Genetics Research Fellow (NIH, Cornell)

About Embark Veterinary

Embark Veterinary, the leading canine genetics testing company, offers comprehensive, affordable genetic health screening and genetic breed ancestry. Embark empowers veterinarians, dog owners, and breeders to tailor care to each individual dog, mixed breed or purebred. Users value the ease of sample submission, engagement throughout the testing process, and the quality and breadth of the results they receive. Embark's state-of-the-art, research-grade genotyping platform provides unprecedented potential for novel genetic discovery, and Embark has amassed the largest canine data set in the world.

About Telford Veterinary Hospital

Telford Veterinary Hospital (Telford Vet), established in 1999, is a small animal practice located in Souderton, Pennsylvania. It is a Fear-Free Certified® practice that operates with two veterinarians, nine veterinary technicians, and four client service representatives. Key participants in the study included both practice owners, Dr. Sharon Minninger and Jonathan Detweiler.

Purpose of Pilot Study

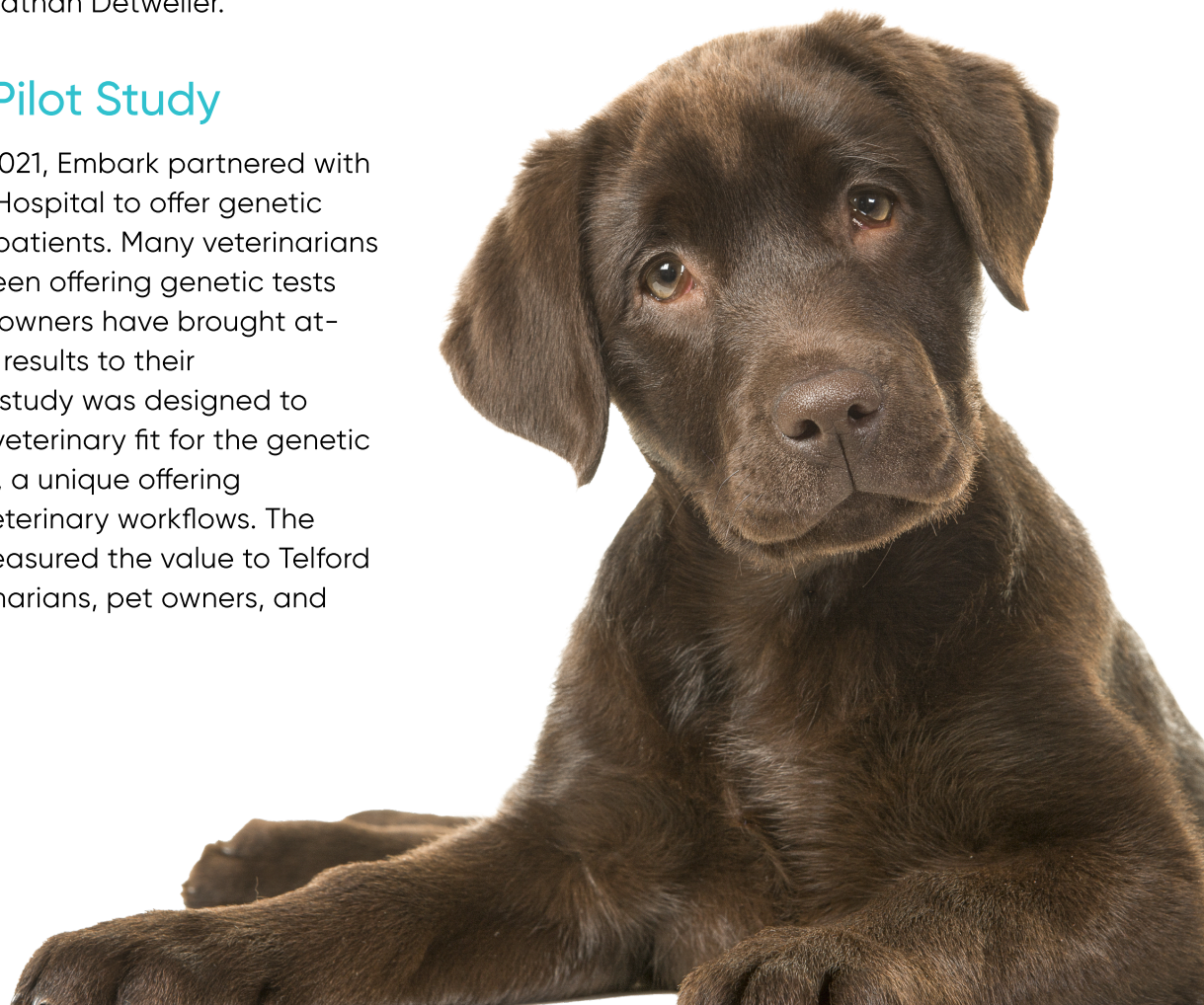
In the summer of 2021, Embark partnered with Telford Veterinary Hospital to offer genetic screening to their patients. Many veterinarians worldwide have been offering genetic tests for years, and pet owners have brought at-home genetic test results to their veterinarians. This study was designed to gauge client and veterinary fit for the genetic screening product, a unique offering developed to fit veterinary workflows. The pilot study also measured the value to Telford Vet and the veterinarians, pet owners, and the dogs tested.

Study Design

The main goals of the pilot study were to gain insight regarding practical in-hospital experience with Embark genetic screening and to measure client responsiveness to the medical recommendations generated by Telford Vet as a result of the test results. Embark packaged and sent 25 swabs with the goal of collecting 20 samples from young dogs as part of Telford Vet's Puppy Wellness offerings. Clients were offered a chance to participate in the pilot study, at no additional cost, during their regularly scheduled wellness appointment. Telford Vet was encouraged to select candidate clients/dogs from existing clients by discussing the benefits of genetic screening.

Each dog's genetic test results and a customized Vet Report were released to the hospital to share directly with the clients. Embark's Veterinary Geneticists were available for consultation and provided additional client-facing supporting documentation to Telford Vet when requested.

Figure 1 illustrates the Telford vet-Embark client interactions during puppy visits. Telford Vet chose to discuss both breed and health genetic results at one visit.



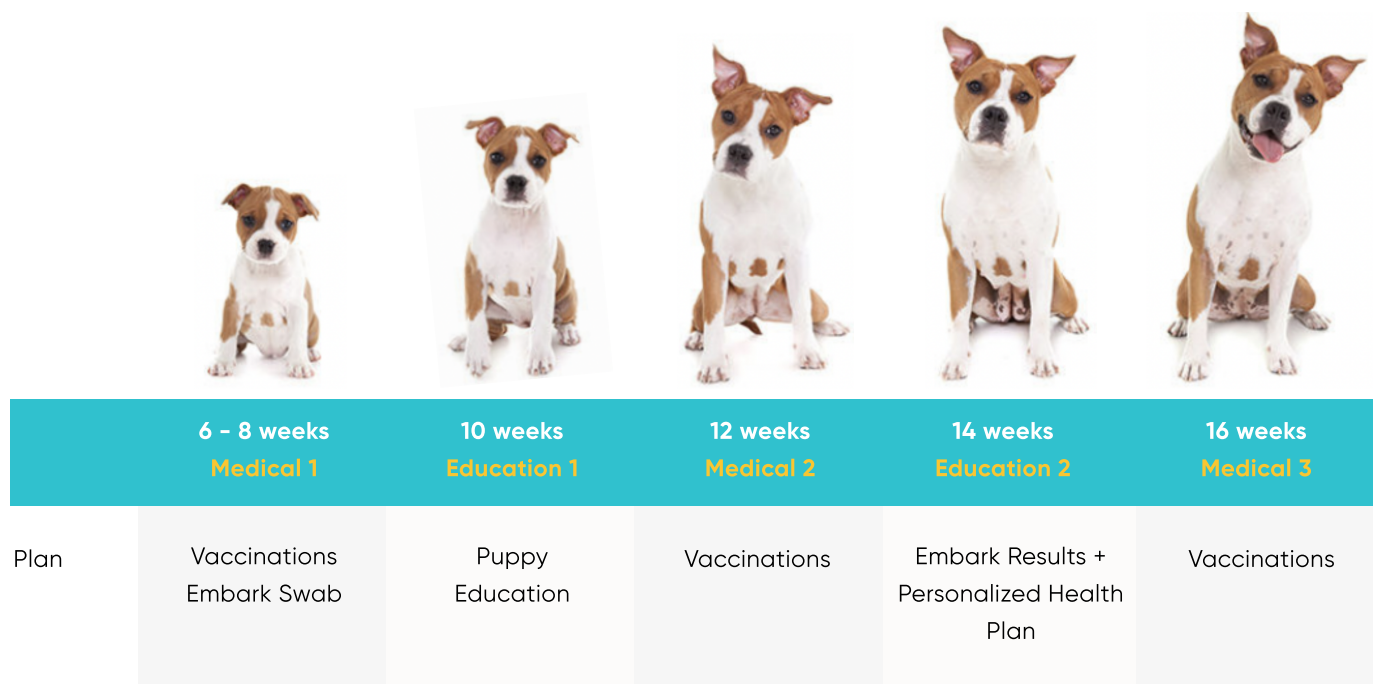


Figure 1. Timeline of Telford Vet-client interactions



14/20 Actionable Result Reports

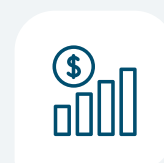
Of the 20 dogs tested in the Telford pilot, only 6 had no actionable results in their report. 4 were 'All Clear' and two had results that were deemed non-actionable.



At Risk ▲ -4* Noteworthy ● -21

Embark segments results as At Risk, Noteworthy, or All Clear. Each result report comes with breed-specific interpretive comments.

*each dog could have multiple genetic insights, so this number won't add to 20 dogs



\$27,119-\$32,679* incremental LTV

Result in the pilot supported adjusting medical care plans, offering improved medical insights that could also generate incremental revenue

*Pilot data on file; revenue numbers represent a range of recommendations; 2 specific case studies are discussed in this study

Results Summary

Genetic screening fits veterinary medical and business workflows

During the pilot, Telford Vet recorded subjective observations on their client's responsiveness as well as objective data related to follow up care choices and the economic value of the screening from health plan recommendations. The breed reveal and health reveal were key elements of the workflow that they delivered in in-person follow up visits with clients. While 20 dogs were tested, much of the discussion below will focus on two case examples that highlight the value realized.

Key Findings

- 1 Of 20 dogs tested, 14 had actionable results, which allowed Telford's staff to discuss modifications to the dog's health
- 2 As outlined in the two case studies below, genetic screening identified potential health risks that prompted follow-up screenings, procedures, and individualized care to improve pet health and extend pets' lives.
- 3 Follow-up recommendations as a result of genetic screening can generate additional revenue for veterinary practices and increase client lifetime value.
- 4 The clients ultimately: bonded tighter to the practice (built trust), had a better understanding of genetic health, and provided additional "happy visits" (positive exposure) for pets during their formative years.

The Breed Reveal

A key subjective observation was the increase in the client/veterinary bond, noted by the increased engagement in the clients as Telford Vet's custom breed reveal game was rolled out in visits. Workflow was a factor in both this increased value and in the aforementioned compliance with recommendations. Telford Vet designed a custom breed reveal game (Figure 2). Clients were asked to guess the percentage of each breed in their dog's breed mix, based on the game show *The Price is Right*™. Each client punched open a holder in the game board, withdrew a pre-placed breed ID card, and placed that card next to the percentage they believed was most likely in their dog. In observed breed reveal experiences, clients were deeply engaged, took pictures to share with their family and friends, and ultimately were excited to know more about their pet.

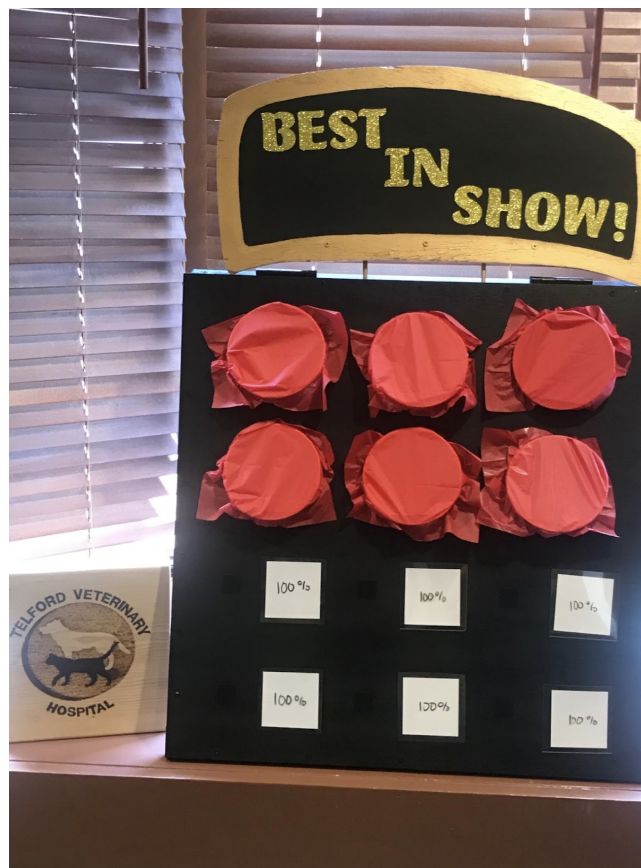


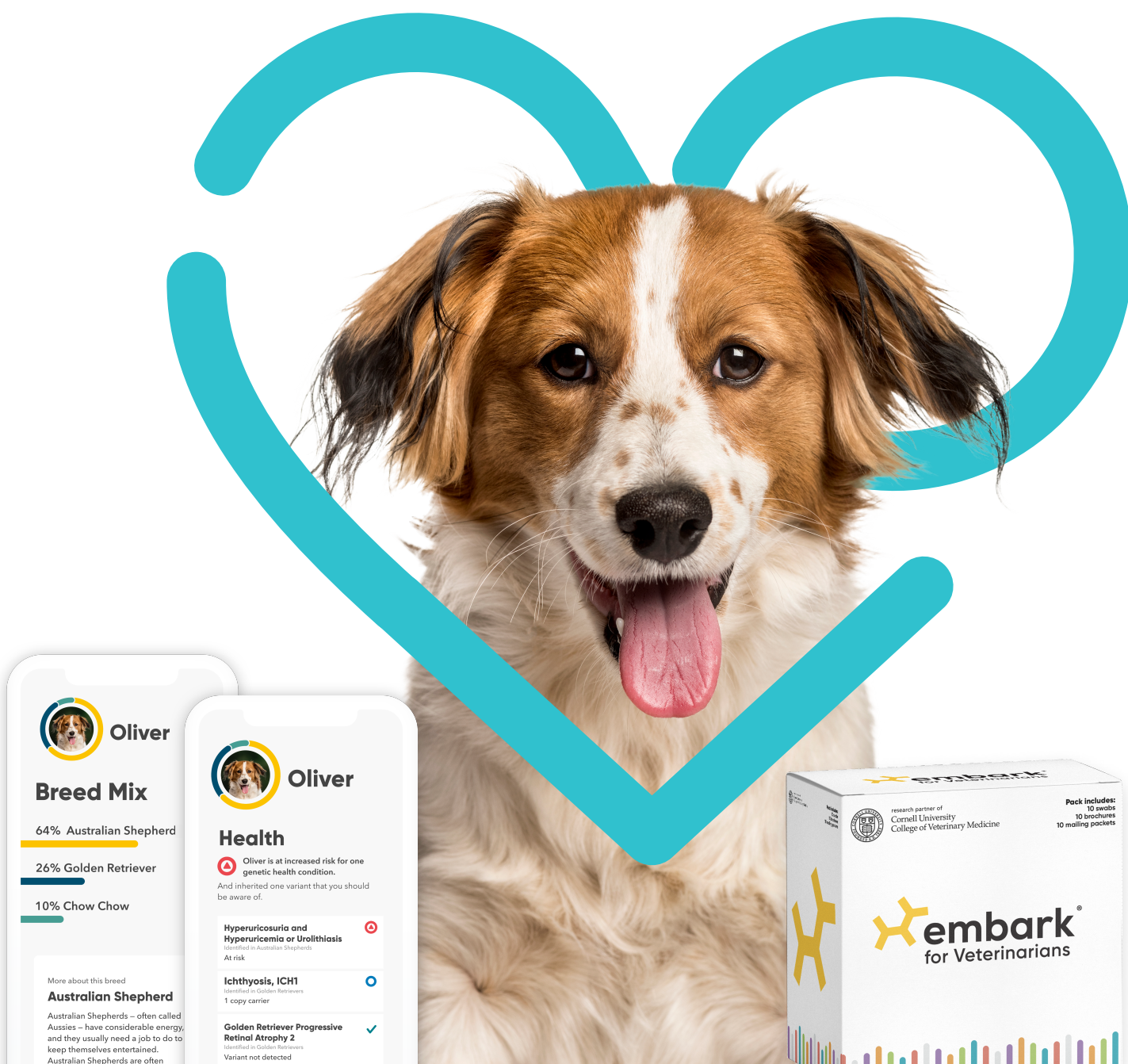
Figure 2. Custom made breed reveal game

The Health Reveal

Dr. Minninger trained her supporting staff to deliver the summary of health risks or clinical tools that genetic screening discovered, under her supervision. Before each appointment, she reviewed the Embark results with her Veterinary Technician team.

Telford Vet printed an Embark Veterinary Report for each of the patients, sharing a summary of findings verbally with the client first. Embark categorizes results as “All Clear”, “Noteworthy” or “At Risk,” making it easy for Telford Vet to focus on the findings that might require more discussion. (The case studies discussed in the next section provide two specific examples.)

Dr. Minninger’s staff, under her direction, made health-related recommendations based on Embark results and clients were generally in agreement. In cases where the client deferred the care recommendations, Telford Vet suggested blood work at the next scheduled visit, which was ultimately not declined but rather delayed only a short amount of time. Telford Vet believes that the breed reveal game helped their already engaged clients realize a strong bond to the practice and their dog, so health-related recommendations were more readily received.



Case Study:

Molly



4 months old



18-lb



Female



Keeshond



Case Study: Molly

Molly, a 4-month-old, 18-lb, intact female Keeshond presented to Telford Vet for a physical examination and preventative care discussion. Molly's owner elected to enroll Molly in the Embark/Telford partnered pilot program. A standard saliva swab was submitted for Embark's Breed + Health DNA testing. Molly had no relevant medical history. Testing was intended to gauge Embark's ability to identify breed ancestry, relatedness, and genetic health risk.

Telford Vet was provided with Molly's comprehensive genetic screening results. Embark confirmed that Molly had 100% Keeshond ancestry. She was reported as being heterozygous (one copy of the variant) for von Willebrand Disease Type 1, which is not widely reported in the Keeshond breed. She also tested as having one copy of a dominant variant that may cause low ALT activity.

Von Willebrand Disease Type I, or vWD I, is caused by a variant in the VWF gene. There are three types of von Willebrand Disease reported in dogs, with variable severity and expressivity. Type I is the least severe of the three types, with affected dogs having a normal von Willebrand Factor (vWF) structure, but a low concentration. vWF levels fluctuate over time and in response to certain disease processes. Affected dogs can have a range of clinical signs, from asymptomatic to moderate clinical severity. Clinical signs can include bruising, prolonged clotting times, and bleeding spontaneously. This variant is found across a variety of breeds, including the Doberman Pinscher, German Shepherd, Dachshund, Akita, and Poodle.


Most Dobermans are screened for vWD type I prior to spay or neuter surgery. This is not yet standard practice in the Keeshond. There are no published reports of Keeshonds with type vWD I. Embark funded additional diagnostics through Cornell University's Animal Health Diagnostic Center.

Two samples were submitted two weeks apart for vWF Antigen Assay (vWF:Ag) testing. The first sample vWF:Ag was 20% (abnormal) and the second sample vWF:Ag was 40% (abnormal). Clotting times were normal: PT 11.1 (6.3-13.3) and PTT 13.7 (10.6-16.8).

Dr. Minninger consulted with a specialist at Cornell University College of Veterinary Medicine, who advised her to send Molly to a specialty hospital for an ovariectomy. Blood products were on hand in case of a prolonged bleeding event. Dr. Minninger recommended annual medical care including complete blood panels and urinalysis. This will allow for both personalized monitoring of her ALT activity and early detection of a disease that could complicate her low vWF level. She will also be fully vaccinated in accordance with her lifestyle and geographic location. She will receive year-round preventatives for intestinal parasites, heartworm, and ectoparasites.

Outcomes

- Dr. Minninger and Molly's owner believe that the Embark test was potentially life saving for Molly.
- Molly's owner has taken steps to ensure she knows where the closest 24-hour facilities with blood products are in case of emergency.
- Molly's owner feels more bonded with Dr. Minninger and Telford Vet.
- Family members of Molly's owner have made appointments at Telford Vet to have Embark genetic health screening testing done on their dogs.



Case Study:

Smokey



1 year old



61-lb



Female



Mixed Pit Bull

Case Study: Smokey

Smokey, an approximately one-year-old, 61-lb, spayed female, presumed Pit Bull mixed-breed dog presented to Telford Vet in May 2021 for a routine wellness examination and preventative care. Smokey's owner elected to participate in the Embark/Telford partnered pilot program, and a standard saliva swab was submitted for Embark's Breed + Health DNA testing. Smokey's owner had no concerns. Testing was intended to assess potential genetic health risk and breed ancestry, not as part of a diagnostic work-up.

Smokey's genetic breed ancestry was primarily American Pitt Bull Terrier with Cane Corso and American Staffordshire Terrier contributing slightly less ancestry. Smokey tested as having two copies of a recessive genetic health risk (HUU) and one clinical tool (ALT activity).

Hyperuricosuria and Hyperuricemia or Urolithiasis (HUU) is caused by an autosomal recessive variant in the SLC2A9 gene. As Smokey inherited two copies of this variant, she was genetically at risk for developing urate kidney and bladder stones. Breeds frequently impacted by this variant include Dalmatians, Black Russian Terriers, and Bulldogs. (This variant is also known to occur in American Pitt Bull and American Staffordshire Terriers, but is not as emphasized in the veterinary teachings.)

In most dogs, uric acid is converted to allantoin, an inert substance that is then excreted in the urine. Dogs with HUU have defects in the pathway that converts uric acid to allantoin. As a result, uric acid builds up, crystallizes, and forms urate stones in the kidneys and bladder. Uric acid is an intermediate of purine metabolism. While hyperuricemia in other species (including humans) can lead to painful conditions such as gout, dogs do not develop systemic signs of hyperuricemia. However, dogs that form urate stones are more likely to develop urinary tract infections (UTIs) and are at risk of developing a urinary obstruction.

Most dogs are adults before they show any signs of urinary issues (4 to 6 years of age, on average). A complicating factor of diagnosing urate uroliths is that they are radiolucent and may be missed on plain-film radiographic imaging.

If caught early, HUU is responsive to dietary management. Surgical intervention is often required when stones or an obstruction form.

Dr. Minninger discussed the breed and health risk as well as the clinical tool results with Smokey's owner, and together, they established a Genetic Plus Medical Care Plan. This included a baseline urinalysis and baseline bloodwork, and Smokey's diet was changed to Royal Canin Urinary UC Low Purine. Dr. Minninger also discussed key clinical signs of a UTI and/or urinary obstruction with Smokey's owner. Ongoing, bloodwork will be performed annually until she is 5 years old to monitor her ALT activity as well as her total protein since she will be on a restricted diet. Starting at 6 years of age, biannual complete blood work will be recommended. Urinalysis will be recommended every 6 months for life to monitor for changes and urate crystal development. An abdominal ultrasound will be recommended at the identification of any urine crystals or persistent hematuria.

Outcomes

- Smokey's owner is more at ease knowing the genetic health risk and clinical signs of concern.
- Early dietary intervention will hopefully keep Smokey from facing painful bladder stones, a related UTI, or a surgical emergency.
- Dr. Minninger and Smokey's owner are now more bonded as a result of having this conversation early in their relationship.
- Telford Vet has previously unforeseen recurring revenue from therapeutic diet sales and routine laboratory monitoring.

The Economic Value

Telford Vet, in response to the quality of interactions and follow-up plans derived from Embark’s genetic screening results in the pilot, introduced a Lifetime Proactive Genetic Plus Medical Care Plan as a premium offering on top of their existing Lifetime Basic Medical Care Plan. In the case of Molly, genetic results

supported recommendations to the medical plan (comprehensive annual blood work and urinalysis) that will generate approximately \$7,800 in incremental revenue for Telford Vet over Molly’s expected lifetime. More importantly, Molly’s family received peace of mind with the knowledge that they can help reduce the risk of complications and ensure access to the right specialists.

Table 1. Case 2 – Molly Projected Annualized Medical Care Plans

Basic Medical Care Plan		Proactive Genetic Plus Medical Care Plan	
Comprehensive Wellness Exam	\$55	von Willebrand Factor Testing	\$289
Fecal Parasite Test	\$63	PT/PTT Blood Clotting Testing	\$217
4DX – Heartworm and Tick Screen with Lyme Titer	\$111	CBC/CHEM 10 Blood Chemistry/ Hematology Testing	\$125
Rabies Vaccine	\$32	Specialty Spay at Surgical Facility with Blood Transfusion	\$1400
DHLPP Vaccine	\$32		
Lyme Vaccine	\$32		
Bordetella Vaccine	\$32		
Canine Influenza Vaccine	\$32		
Heartwork Preventive – Heartgard Plus	\$85		
Flea and Tick Preventive – Bravecto	\$240		
Year 0 Basic Care Life to Date total \$714		Year 0 Combined Basic & Proactive Life to Date total \$2.745	

For Smokey, the plan provided an opportunity for medically relevant incremental testing and follow up therapeutics based on genetic results (comprehensive annual blood work and urinalysis, therapeutic diet). This proactive health plan will yield an additional \$18,000 over Smokey's

lifetime compared to the basic plan. This plan increases revenue and, more importantly, provides proactive dietary intervention and diagnostic screening to prevent or catch any developing issues early.

Table 1. Case 1 - Smokey Projected Annualized Medical Care Plans

Basic Medical Care Plan		Proactive Genetic Plus Medical Care Plan	
Comprehensive Wellness Exam	\$55	CBC/CHEM 10 Blood Chemistry/ Hematology Testing	\$125
Fecal Parasite Test	\$63	Urinalysis	\$85
4DX - Heartworm and Tick Screen with Lyme Titer	\$111	6 Month Urinalysis	\$85
Rabies Vaccine	\$32	Therapeutic Diet - Royal Canin UC	\$1260
DHLPP Vaccine	\$32		
Heartwork Preventive - Heartgard Plus	\$105		
Flea and Tick Preventive - Bravecto	\$240		
Year 0 Basic Care Life to Date total \$638		Year 0 Combined Basic & Proactive Life to Date total \$2.193	

Telford Vet plans to continue to regularly offer genetic screening based on the value offered to them in the pilot.



Conclusion

This pilot study between Telford Vet and Embark demonstrates that clinic-driven genetic screening can positively impact the standard of care. It can be integrated easily into the standard veterinary workflow to drive value to veterinary hospitals, veterinarians, clients, and pets.

Additional Service and Care Offerings

From a client relationship perspective, it offered them the ability to offer a higher level of service and to support increased care options based on the genetic screen findings. Recently, Telford Vet purchased additional tests from Embark and offered genetic screening to their clients at a special promotional rate. Of the first 25 tests they purchased, they resold 17 tests on the first day and plan to continue to offer the service.

Increased Revenue

In the pilot, Telford witnessed that pet owners who had walked through the breed reveal and health risks were willing to consider and ultimately accept diagnostic recommendations they may have otherwise not understood.

More Connected Client Relationships

At the end of each visit, Telford Vet logged into the Embark interface and digitally shared the genetic results account view to the pet owner. This action allows their clients to continue to gain valuable updates from Embark, such as the identification of new dog relatives, and gives the client the ability to share their results with friends and family as well as participate in surveys that support Embark genetic research.

Embark's Breed + Health testing is a valuable addition to existing veterinary workflows. As demonstrated with Telford Vet's experience, incorporating the testing into routine wellness visits

offers value to clients, the veterinary hospital, and ultimately to the ongoing health of the pet.

Embark is available to talk more with you about how to start adding genetic screening to your clinical routine by [Learn more by visiting embarkvet.com/vets](https://embarkvet.com/vets).



The state of genetic testing for dogs

Canine genetic screening has been available since 2007 and has seen tremendous growth in recent years. While human genetics research has long been in the spotlight, canine genetics research spending and databases have lagged behind. Testing for known mutations associated with diseases like cancer is now common for humans, but remains relatively rare for dogs.

Embark Veterinary was founded with the goal of increasing dogs' lifespan by three years by using genetic information to deliver better, more informed pet care. Such informed treatment and preventive care requires a large genetic database to drive discoveries that improve the life and longevity of dogs.

Canine genetic testing companies, including Embark, have been primarily selling directly to pet owners and breeders. However, today, more than 70% of veterinarians have used genetic testing, with over 40% having used genetic testing in the past 12 months.

Embark is building a tailored platform to provide genetic testing offerings designed to integrate into the veterinary workflow. Genetic test results will enable veterinarians to create customized care plans for their canine clients based on genetics and enhance the veterinary-client relationship. In partnership with veterinarians and veterinary organizations, Embark is also developing educational materials to help veterinary professionals build personalized care plans for their clients based on genetic test.

Embark's genotyping technology

Embark's innovative testing platform is a customized SNP microarray that was developed in partnership with Cornell University College of Veterinary Medicine. This platform enables the hundreds of genetic health and traits test results provided in Embark's products, while reducing the

cost of comprehensive genetic screening. Microarrays are microscope slides (often called "chips") that contain hundreds of thousands of tiny beads called probes. Each probe is individually designed to assess the genotype at a specific location, or locus, in the dog's genome. Because of the extremely high accuracy of SNP microarray testing, this method has become the go-to standard for DNA testing and research in both canines and humans.

Microarray probes primarily identify single nucleotide polymorphisms, also called SNPs (pronounced "snips"). These are places where a single base pair (letter) of DNA is mutated to another letter. A few probes also target "Indel" polymorphisms where one or more letters are deleted or inserted in the sequence.

The cheek swab

Embark's DNA testing is done using a soft, easy-to-use saliva swab. Every sample is uniquely barcoded and handled by robots in the laboratory to ensure samples are never misidentified or mixed up. Embark adheres to a stringent privacy policy that meets industry standards for commercial testing facilities.

Telford Veterinary Hospital

Telford Vet (est 1999) is a small animal practice in Souderton, PA, outside of Philadelphia. The practice is a Fear Free Certified(R) practice that operates with two Veterinarians, nine Veterinary Technicians and four Client Service Representatives.

Key participants in the study included both practice owners, Dr. Sharon Minninger and Jonathan Detweiler.

Dr. Minninger is Senior Staff Medical Director, a Fear Free Certified Professional and one of the owners of the Telford Veterinary Hospital. She completed her undergraduate studies at Delaware Valley College and received her Veterinary Degree from University of Tennessee in 1995. Jonathan is the Hospital Administrator

and co-owner of Telford Veterinary Hospital. He joined Dr. Minninger and the senior staff in 2006.

Telford were ideal candidates for a study as their protocols supported a multiple-visit touch point with clients and their operating philosophy

centers around the Human-Animal bond. They work hard to balance medical visits with less hands-on, educational visits so pets visiting can have 'happy visits' and don't identify the practice with only medical procedures.

