PennVet
Working Dog Center

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Dogs of DHS: How Canine Programs Contribute to Homeland Security

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February 24, 2016

Chairman Johnson, Ranking Member Carper, and Members of the Committee

I am honored to be here to discuss the experience and research of the Penn Vet Working Dog Center (PVWDC) in its role as a national research and development center dedicated to harnessing the unique strengths of our canine partners for public safety and human health. As a veterinarian and scientist, I have dedicated my career to supporting the work of the dogs that keep our country safe. My opportunity to serve at Ground Zero to provide medical care for the responding dogs and subsequently monitor impact of that response on the health and behavior of those dogs has inspired me to expand my contribution to the working dogs of this country. The PVWDC was inspired by the dogs of 9/11 and was founded in 2007 to promote research and education and in 2012 we opened our facility to raise and train detection dogs. Our research mission includes the conduct of basic and applied studies, at the PVWDC and in collaboration with academic centers, industry and government agencies to generate unconstrained knowledge that will enhance the health and performance of detection dogs. Our education mission embraces and shares that new knowledge to inspire those invested in the work of detection dogs, including the dogs themselves, the handlers, the trainers, veterinarians, departments and agencies that employ detection dogs, breeders and the general public. In order to fully explore new avenues and test old theories, the PVWDC maintains a small breeding and development center. Our breeding program was founded on the progress and genetic stock of the TSA breeding program.

As a result of my experience, I have been called upon to lend expertise and consult or collaborate with colleagues from over 15 academic institutions, numerous government agencies including Special Operations Command, US Department of Defense, Customs and Border Protection, Transportation Security Authority, Department of Homeland Defense, Federal Emergency Management Agency, National Institutes of Standards & Technology, Defence Science and

Technology Laboratory (UK), National American Police Working Dog Association, United States Police Canine Association, local police departments and industry partners. I hope that this experience can help answer some of the questions that have been raised by this committee.

Respectfully,

Dr. Cynthia Otto, DVM, PhD, DACVECC, DACVSMR
Executive Director, Penn Vet Working Dog Center
Associate Professor of Critical Care,
University of Pennsylvania

WHAT SETS THE PVWDC APART?

- COLLABORATIVE RESEARCH
- GENETIC RESEARCH
- EARLY DEVELOPMENTAL EXPOSURE
- POSITIVE REINFORCEMENT TRAINING
- FOCUS ON FITNESS AND CONDITIONING
- COMMUNITY INVOLVEMENT
- EMPHASIS ON EDUCATION

PVWDC Contact and Staff and Collaborator Acknowledgements

If you or your staff have any questions about this testimony please contact me at cmotto@vet.upenn.edu or 215-898-3390 (office) or 215-898-2200 (Penn Vet Working Dog Center)

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PVWDC collaborators who made key contributions to this testimony are:
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Background

How the Department of Homeland Security utilizes canine units to execute its security operations.

The role of the canine in supporting national security is diverse. In this testimony you will hear from Customs and Border Protection and the Transportation Security Administration demonstrating and explaining how their canine teams make their mission more effective. In addition, it is important to recognize that our local and state police widely employ canine teams for drug interdiction, explosives detection, criminal apprehension and evidence search. The Federal Emergency Management Agency Urban Search and Rescue Teams support the most elite of canine search and rescue teams that participate in disaster response to locate trapped victims or human remains.

The dog's nose is over 1000 times more sensitive than a human's. The dog has about twice as many olfactory receptor genes as humans, 40 times the number of receptors packed at a density of 5 times that of humans. The brain processing center (olfactory bulb) represents a higher percentage of the overall brain (30 times greater than humans). This combined with the cognitive skills and communication of the dog with humans opens the door to unique partnerships to help maintain national security. The ability of a trained search dog to locate a missing person is far more effective than any current technology to date. Similarly, the ability of a dog to discern a trained odor from a background of confounding odors far exceeds any other tool that has been developed.

The use of dogs to support national security is an effective approach. The limitations currently are availability of sufficient high quality dogs and need for science to support the performance and current best practices that have been recommended by the Scientific Working Group on Dog and Orthoganol detector Guidelines (http://swgdog.fiu.edu/), which is now under the National Institute of Standards and Technology (NIST) direction (http://www.nist.gov/forensics/osac/sub-dogs.cfm). The gaps in performance that can occur with canine teams are often gaps in the human half of the team, whether that is in training, directing or interpreting the dog's response. The research to optimize the performance of these canine teams falls into several categories. Much of the work to date has focused on the canine, including genetics, behavior, and physiology. The interaction between the dog and the handler is also an area of important research as the dog works as part of the team, responding to the handler and communicating back to the handler. The best dog and handler teams represent a blend of art and science. In order to expand the abilities of all dogs and handlers, additional research needs to be directed at the dog, the handler and the partnership.

Availability of dogs is a critical challenge!

Quantity
The majority of dogs are imported from Eastern Europe. The availability is decreasing and price is increasing.
Quality
Reliable and economic performance requires healthy and genetically sound dogs. Purchasing dogs from international vendors is a gamble.
Diversity
DHS supports canine teams with diverse skills requirements. Natural variation in genetics can provide for various phenotypes to meet these needs across agencies.

What have we learned?

* Genetic selection can lead to reliable improvement in physical and behavioral traits.
* The early development experience can influence a dog's performance and success.
* Ongoing research is essential to optimize the performance and success.

What do we recommend?

A national canine breeding and development program

A Homeland Security Canine Center of Excellence

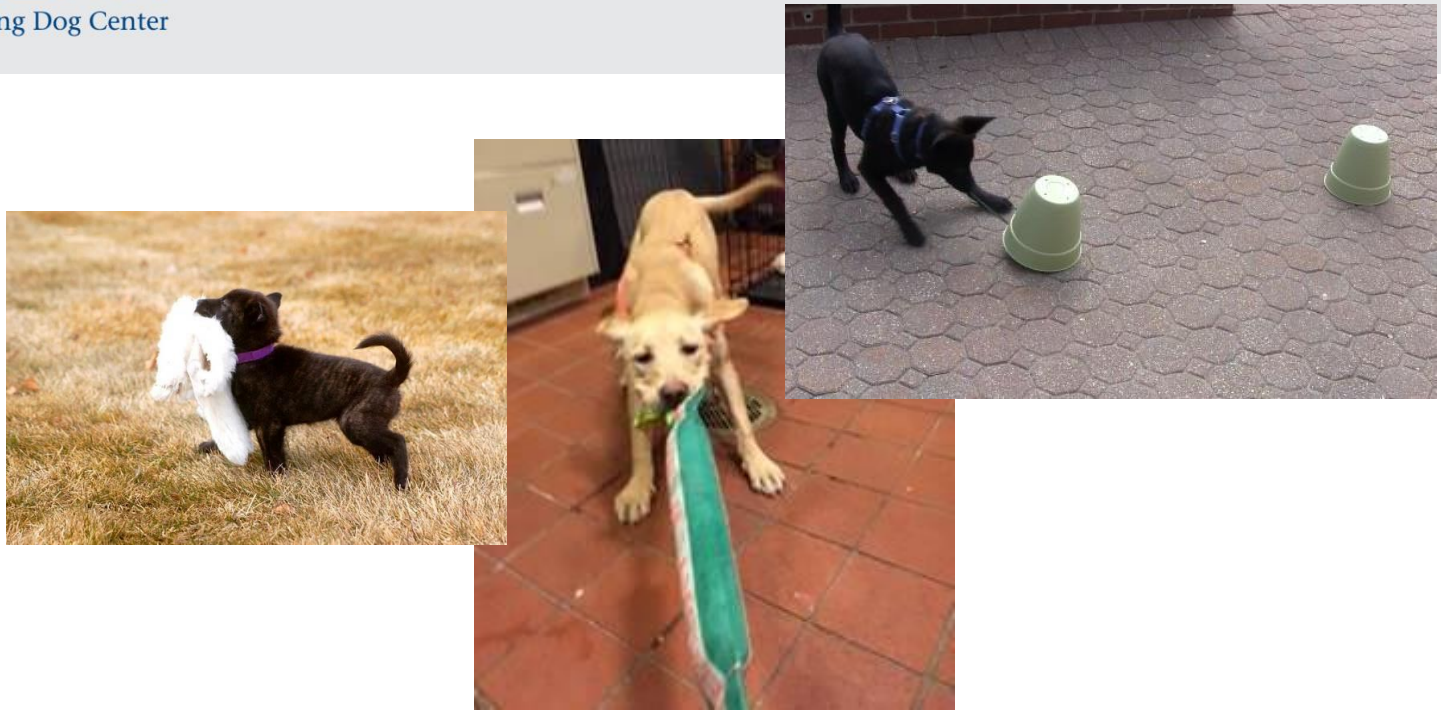
KEY ISSUES

Foreign Procurement of Dogs

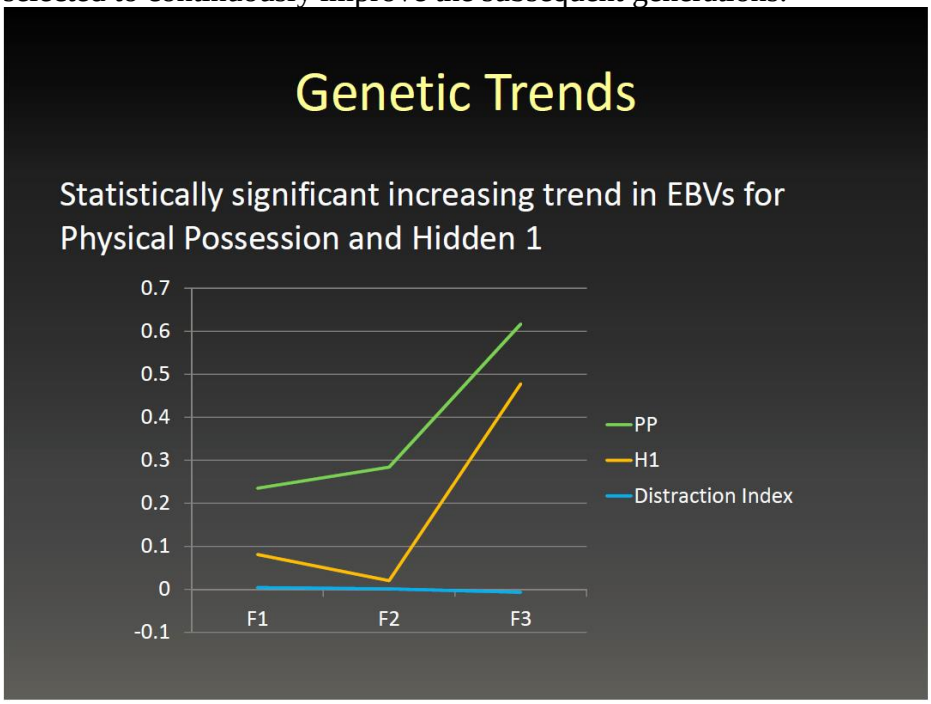
Although historically, Eastern Europe has been recognized for their ability to produce excellent working shepherd type dogs for the police and military, the demand for detection dogs has increased to the point that the quality of dogs has suffered and the price has increased dramatically. More developing countries are incorporating detection dog teams into their national security plan. The need to continually replace current dogs that are retired due to medical, behavioral or health reasons represents a constant necessity. The demands for detection dogs outside the realm of national security, (e.g. conservation dogs, medical detection dogs, gas leak detection, bed bug detection, etc.) has further increased pressures on the available resources for dogs with the desired physical and behavioral characteristics. Purchasing dogs through vendors who purchase through a variety of sources does not allow progressive improvement in the breed based on careful genetic monitoring, planning and selection or control of the early development period. As more emphasis is placed on passenger screening dogs, the emphasis on sporting breeds has increased. The US is a major producer of sporting Labradors, but due to historical procurement relationships, vendors are importing Labradors for detection work. Developing countries like Mexico are developing breeding programs, however major health risks (such as Chagas disease) have the potential to result in occult or overt health problems. With emerging infectious diseases like canine influenza, there is the risk that importation of dogs from foreign countries could be shut down cutting off the source of dogs, or worse yet these imported dogs could introduce new diseases to the US. From an economic standpoint, the jobs associated with raising and early training of these dogs could be kept in the US. In summary, the risks of relying on foreign sources of dogs to support our national security are high. While there will always be some exceptional dogs that originate from foreign sources, the foundation of our canine programs should be developed and maintained domestically.

Breeding programs

Major canine programs that utilize specialized dogs have relied on breeding programs to selectively improve the physical and behavioral phenotype (observable traits) of those dogs. Examples of successful programs include The Seeing Eye, Guiding Eyes and Canine Companions for Independence. For police and detection dogs, there have been several small US breeding programs, including the current DOD program for breeding Malinois in San Antonio, the CBP breeding program in El Paso and the former TSA breeding program. Following 9/11/2001, the TSA through a collaboration with Australian Customs and in collaboration with Auburn University, initiated a breeding program of sporting dogs (primarily Labrador Retrievers) for explosive detection. Peer review of the DHS S&T funded research at the TSA breeding program held on April 6, 2013 concluded that the program had met its research goals and represented a national resource that was able to improve canine performance success by approximately 10% per year through selective breeding. In addition, they were able to increase key traits (physical possession and hidden 1) associated with successful entry into the training program for explosive detection dogs and decrease hip dysplasia by decreasing hip laxity. Physical possession is the score a dog receives based on a screening test to determine their commitment to hold onto the tug and engage in tug of war with the handler.

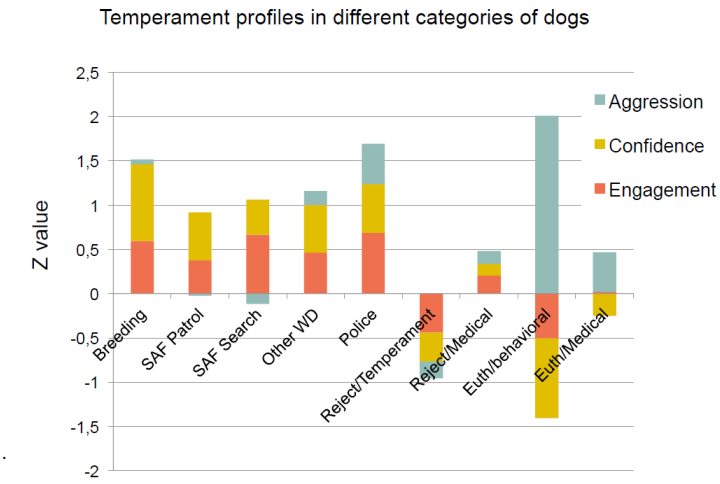


This physical possession trait has been shown to be heritable (0.67 or 2/3rds of this response can be attributed to genetics) and associated with future success. Hidden 1 is the trait tested when a towel is hidden under a row of flower pots and the dog is given the opportunity to hunt for it. Success is defined as hunting until they find the pot and actually knock it over to get at the towel. This trait also has a high heritability and prediction of training success. Using this data and hip scores the estimated breeding value (EBV) can be determined and optimal breeding pairs selected to continuously improve the subsequent generations.



*from Dr. Liz Hare, Dog Genetics LLC

The program was discontinued, however the remaining breeding females were provided to the Penn Vet Working Dog Center through a Cooperative Research and Development Agreement. Similarly, the Swedish Armed Forces had a breeding program that was terminated with the plan to rely on the production of dogs by private breeders. In Sweden, eventually this approach was abandoned and the breeding program restarted. The main reason cited for restarting a breeding program was that private breeders have different breeding goals, thus do not actively select for the dogs that are best suited for the needs of National Defense.



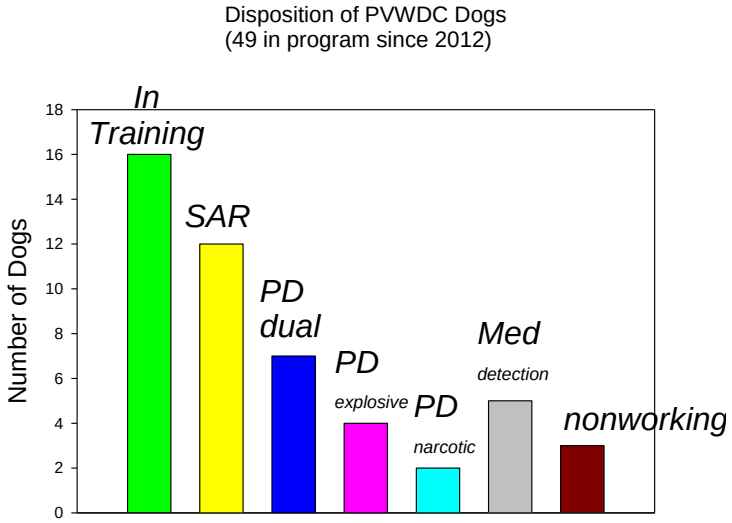
**From Erik Wilsson Swedish Armed Forces K9 Breeding Program presented at IWDBA 2014*

The Swedish experience has been that a breeding program provides dogs that are more stable, healthier, more likely to succeed, able to start work earlier and have a longer working life. The initial cost of a dog from a breeding program is likely to be higher, but the improved health and performance contributes to a longer working career, improved training efficiency and reduced cost over the working lifetime of the dog. With this knowledge, the Penn Vet Working Dog Center has launched a small breeding program primarily focused on research of how to improve the health and performance of detection dogs. A goal of the program is to provide key knowledge for private, government and academic organizations to collaborate on an effective strategy to domestically produce dogs with the health and behavioral traits to successfully support national security.

A National Breeding Center focused on genetic improvement would consist of a database of working dogs, a semen bank, genetic evaluations on individual and potential dogs, and standards for the selection of breeding stock. This Center does not need to be localized; it would be successful as a collaboration between multiple organizations with strengths in specific areas. For example, the International Working Dog Breeders Association (www.IWDBA.org) has a Working Dog Registry under development, and the Penn Vet Working Dog Center has a DNA

bank and a semen bank with samples from working dogs. The American Kennel Club is under used to support National Defense with their knowledge and expertise.

As we move toward the development of a coordinated breeding program, there are several interim steps that should be considered. First is a quantitative assessment of the performance (phenotype) of the dog. This information will be critical in identifying potential breeding animals and determining the heritability of these traits. This assessment should be used for selecting dogs but also for monitoring the performance of the dogs. For breeding purposes, longevity and health are critical factors that need to be included in selection criteria. In anticipation of a national breeding program, a preparative step would be to establish a national semen bank to capture the genetic potential of the dogs that are currently working at high performance standards. The cattle industry (Select Sires) has maintained such an approach for 50 years driving improvement in production based on clearly heritable traits. Once an active breeding cooperative is established, it should be physically located in multiple locations to limit the risks of catastrophic disease or environmental disasters. Research is needed to determine the optimal amount of early training to increase career success.
At the Penn Vet Working Dog Center puppies enter the program at 8 weeks of age and go through foundation training to enhance search, confidence, persistence and physical fitness. In the 3 years of the PVWDC, we have had 33 dogs complete the program. Of which 30 dogs have working careers. One dog was released for health reasons and 2 for lack of concentration.

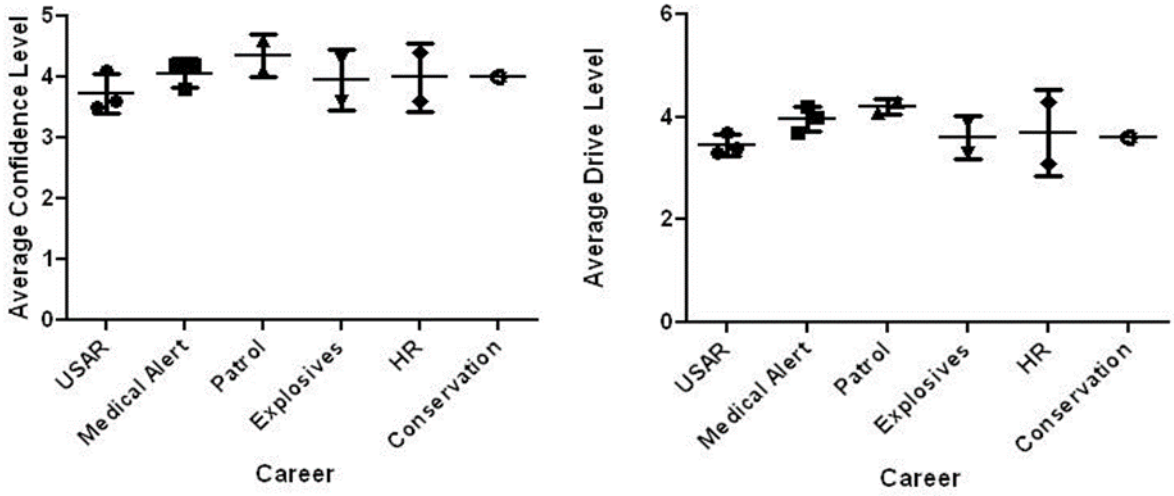


SAR = search and rescue and includes human remains and conservation dogs
PD dual = dogs trained in apprehension and odor (typically explosives or narcotics)
PD explosives are single purpose explosive detection dogs
PD narcotic are single purpose drug detection dogs
Med detection includes cancer detection and diabetic alert
Overall 91% of dogs that have completed the program have working careers.

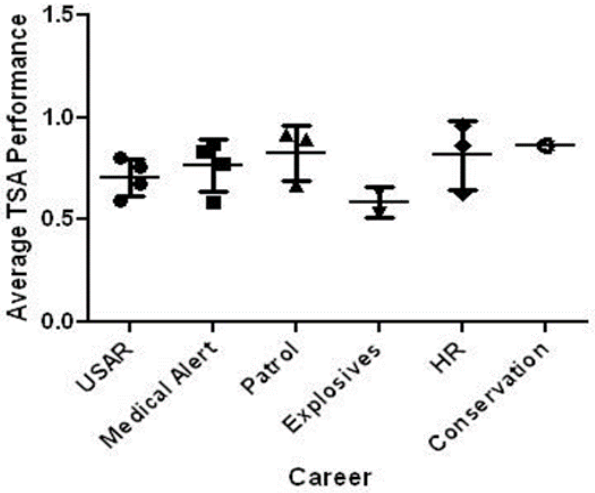
Research

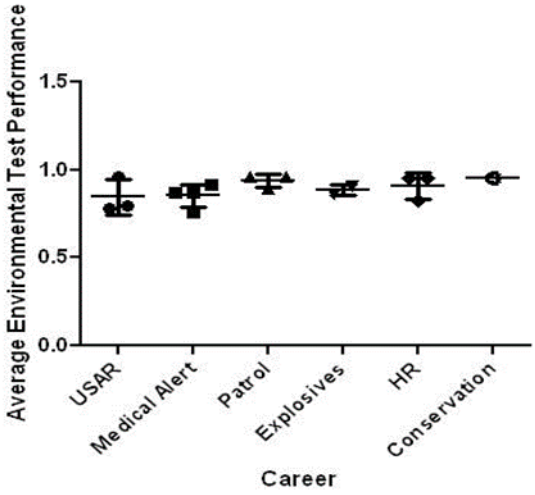
The science of genomics provides great promise for the future in our ability to find genes and metabolic pathways associated with behaviors such as olfactory detection, learning, and memory. Currently, 248 of the related dogs from the TSA program have been genotyped on a high-density genome-wide array. Although none of the traits tested so far show significant association with genetic markers, this is not surprising because of the complexity of behavior traits, which are thought to be expressed as a result of the interaction of many genes of relatively small effect and the environment. With the new, more detailed and statistically robust measured traits in use at the Penn Vet Working Dog Center and more advanced genomic methods, it will be possible to move toward making selection decisions with statistical models that include knowledge of each dog's genome.

Utilizing a battery of tests, the PVWDC evaluates the puppies in the program to determine if there are evaluations that can either predict future career success or be identified as heritable traits. Through a collaboration with CBP, we have implemented a testing protocol during early development through 14 weeks of age. We do not have sufficient data to evaluate the dogs that do not succeed in any career path (n=3 to date). USAR = urban search and rescue, Medical alert includes cancer detection and diabetic alert, HR = human remains detection, conservation is the training for finding invasive or endangered species.



This same group of dogs have been tested with the TSA testing battery at 3, 6, 9 and 12 months of age and environmental assessment at 4, 7, 11 and 14 months. The tests change over time but the average scores are shown here based on career path.





During the developmental phase, there are numerous opportunities to impact the performance of the dogs. We fully recognize that without the proper genetics we are starting at a huge disadvantage, however even some of the most highly heritable traits are only partially determined by genetics. The role of the environment can tip the balance in one direction or the other. In the experience of the PVWDC, of our 33 graduates, 30 have successfully been placed in working careers. We were able to recognize early signs of physical or behavioral problem and in most cases with appropriate interventions prevent problems that could have ended their career potential. A simple example is the development of a tooth that was malpositioned and could have interfered with this dog's career as a police dog. With a simple exercise we were able to redirect that tooth to its normal position

Rigorous research on health aspects like hip dysplasia and the role of exercise to improve function, the impact of diet and nutrition during growth and during work to optimize structure and reduce injury. The use of physical fitness protocols to develop body awareness has the potential to reduce the most common types of injuries in police, search and military dogs, which are those associated with cuts, scrapes and lameness. These approaches need to be carefully studied to evaluate the efficacy and the cost:benefit ratio.

At the PVWDC we have conducted studies evaluating the performance of CBP dogs working the border and the dogs in our program exercising in the heat. These studies have explored ways to keep the dogs hydrated and working effectively. We have learned that contrary to common medical understanding that these dogs can work with body temperatures in excess of 106F. We found that the type of hydration method did not influence how hot the dogs became. Because heat stroke is recognized as one of the preventable causes of death in military working dogs, we continue to explore ways to keep the dogs working safely under these adverse conditions. It is also recognized that dogs often stop working due to musculoskeletal injury or degeneration (low back pain is common in working dogs). Research is ongoing to determine if there are preventive strategies that can help keep dogs working effectively longer.

The science of olfaction is still not well understood. New techniques like functional MRI have helped uncover how the brain is activated when dogs are exposed to various odors, but much of the fundamentals of factors that could alter the ability of a dog to detect odors near the threshold of sensitivity remain unexplored.

The behavioral aspects of canine performance have received perhaps the most attention, evaluation of personality, even the aspects of being left pawed or right pawed have been studied. As part of behavior, the way the dog learns and retains information best is a knowledge gap. The impact of training techniques that are based on positive reinforcement versus coercive methods need to be evaluated for the impact on health, performance and longevity.

The arena of research on how to improve the selection and performance of the canine handler is in its infancy. Many organizations have opted to seek ways to eliminate or minimize the role of the handler. There is no data to demonstrate how to optimize the team.

The challenge remains in that there is no consortium to systematically and collaboratively address the factors, including genetics, development, behavior, health of the dog, handler skills and enhanced partnership between the dog and handler, that have the most potential to impact the detection dog working for national security. The goal to bring together diverse organizations that share the common goal of improving national security through developing and supporting the most effective dog handler teams could be accomplished through the development of a National Center of Excellence for Canine Detection that would partner government, industry and academics to move forward cohesively to bring new knowledge and ways to effectively and efficiently implement that knowledge across all canine disciplines that support national security.