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How veterinary biobanking provides opportunities to accelerate research

Marta G. Castelhano DVM; Kate E. Creevy DVM; Piper F. Mullins MIS

Cornell Veterinary Biobank, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853. (Castelhano); Department of Small Animal Clinical Sciences, College of Veterinary Medicine & Biomedical Sciences, Texas A&M University, College Station, TX 77843. (Creevy); Pan-Smithsonian Cryo-Initiative, PO Box 37012, MRC 5502, Washington, DC 20013. (Mullins)

Address correspondence to Dr. Creevy (kcreevy@cvm.tamu.edu).

Biobanks have arisen in response to the need for high-quality biological samples in biomedical research. Originally, biobanks started as small collections of samples assembled at individual academic institutions to support researchers with an interest in specific projects.[1] Over the past 30 years, however, these collections have evolved and expanded to serve the needs of a variety of emerging disciplines, including proteomics, genomics, and the field of personalized medicine. A biobank is defined as "a facility for the collection, preservation, storage and supply of biological samples and associated data, which follows standardized operating procedures and provides material for scientific and clinical use."[2] Samples held in biobanks contain important information, providing a snapshot not only of the evolution of species and the genetic diversity available but also of the health and disease status of specific individuals at a given time.

Understanding the evolution of biodiversity and the health status of individual members of a species is of particular interest in veterinary medicine. Evolution in domestic animals is a controlled process and, thus, lends itself to be more easily studied and understood than human evolution. Breeding programs have been successful in creating breeds and enhancing production traits, but have also created populations with low genetic heterogeneity, which may result in the appearance of deleterious traits. At the same time, the population structure of domestic species simplifies genetic studies, as it allows the use of smaller cohorts that have fewer susceptibility loci with higher impact.[3] Such studies may eliminate or reduce the prevalence of diseases and abnormalities in veterinary patients but depend on the availability of high-quality samples from biobanks.

Biobanks are also advantageous because multiple researchers can use the same sample collection to fulfill the needs of different projects, potentially reducing the number of animals used in research.

The benefits of biobanks for research purposes have been well documented, but biobanking can also be of benefit for those in clinical practice. For veterinarians advising breeders or breed clubs, for instance, biobanks support research that has the potential to improve the diagnosis and treatment of genetic diseases.[4] An article by Thasler et al[5] made the case that biobanks can be particularly beneficial for surgeons, highlighting biobanking as an excellent tool for translational research and a way for those in clinical research to stay connected with research findings.

By acting as a resource for biomedical research, biobanks bridge the gap between patient care and clinical innovation that, in turn, can benefit veterinary practice. In human medicine, clinical geneticists have seen the value of biobanks as tools to advance the field of personalized medicine,[6] allowing individualized patient care to go from an ideal to a new standard of care.

Critical Challenges

Biobanks face many critical challenges, regardless of the types of samples they contain. Common challenges include a lack of strategic or business plans; the difficulty in achieving sustainable funding; the variety of collection, processing, and storage techniques; the lack of standardized clinical data and bioinformatics systems; and the difficulty in providing samples for users outside the biobank's institution.

However, some challenges are unique to veterinary biobanking. In April 2017, the Texas A&M University College of Veterinary Medicine & Biomedical Sciences organized a workshop to identify and address some of these challenges. Representatives from veterinary, wildlife, and human biomedical biobanks came together to share their challenges and successes, to strategize, and to recommend best practices for the biobanking of animal tissue and blood samples.

Workshop participants identified a number of challenges that veterinary biobanks must overcome to operate successfully and sustainably. One major challenge is the lack of standardized electronic medical records coding that has arisen because most universities use custom electronic medical records systems and most veterinary practices use one of the many commercial software systems currently available. Unlike the case in human medicine, the lack of insurance reimbursement has meant there has been no incentive to develop universal coding. As a result, there has been no drive to standardize the medical coding terminology used by veterinary biobanks. Biobanks may also be reluctant to share samples they consider to be unique or unusual because of a lack of awareness of other collections, with each participating investigator assuming that his or her collection is the only such resource in existence. Increasing knowledge of other biobanks should generate confidence among researchers that sharing their own samples would lead to reciprocal access to other collections. Inadequate withdrawal guidelines and sharing infrastructures are also challenges, with differences between private biobanks and those housed at academic institutions and between biobanks containing samples from domestic species and those housing wildlife samples adding to the difficulties. Finally, veterinary biobanks often lack an emergency plan that would define irreplaceable samples and describe processes to manage them in an emergency.

Unique Potential

Despite these challenges, many of which are shared with human biobanks, the unique value of veterinary biobanks compels researchers to continue to build them. Compared with their human counterparts, veterinary biobanks are able to collect more samples more frequently because of less rigid consent requirements, less overview by internal review boards, and the fact that owners are more likely to permit collection of samples from their animals than they are from themselves.

Additionally, common companion animal species age more rapidly than humans, making it possible for a single researcher or institution to collect serial samples from patients over the entire course of their lives or throughout the span of a chronic disease. The potential that data gleaned from veterinary biobanking efforts may benefit not only veterinary medicine but also human medicine, through translational research, effectively doubles the value of every banked veterinary sample. Furthermore, every domestic animal whose samples might be added to a biobank is associated with an individual—an owner, producer, handler, or curator—who becomes a citizen scientist by participating in biobanking. At a time when science education and understanding is a critical global challenge, direct citizen connections to the scientific process should be nurtured at every opportunity.

Thinking more broadly, veterinary biobanks can include not only conventional clinical pathology and histopathology samples from common species, but also genetic, epigenetic, metabolomic, and microbiomic samples from domestic and nondomestic animals, including rare and endangered species. Samples from diverse species in zoos and aquaria as well as from animals studied in wild conditions can be banked for use in epidemiological studies, disease discovery, species conservation research, and more.

Although only a few institutions maintain well-established veterinary biobanks, any biological sample collection—from body fluids to tissue samples, residual clinical samples, and DNA samples—can be considered a biobank. Many veterinary practices already acquire and store such material, even if transiently, on a daily basis. Considering all the formal and informal sample collections scattered throughout veterinary clinics, teaching hospitals, and research facilities, the current unofficial “distributed veterinary biobank” in this country is massive in size, scope, and potential. What is needed to put this tremendous resource to better use is shared knowledge of the samples that exist, the many possible purposes of the various sample types available, and the means for individuals to deposit and retrieve samples.

The biobanking workshop identified important next steps to improve veterinary biobanking and research. Major recommendations were to encourage communication among biobanks with the aim of connecting collections through a database and to leverage workshop participants’ knowledge to improve sample collection and use. Find more information about veterinary biobanks and join the conversation at veterinarybiobankinginformation@listserv.tamu.edu.

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