

College of Veterinary Medicine Faculty Interest Summaries 2019

Luiz E. Bermudez

Mycobacterial pathogenesis and new therapies to mycobacterial infection. *Mycobacterium tuberculosis*, *Mycobacterium avium*, *Mycobacterium abscessus* and *Mycobacterium avium* subsp *paratuberculosis*. Infection of the human and animal host interaction with mucosal surface, survival mechanism in the host, biofilm and its role in disease. Macrophages, Natural Killer cells and T lymphocyte participation in host defense against mycobacterial infection.

Mark R. Ackermann

My research has emphasized respiratory disease and most notably infections of human strains of respiratory syncytial virus (RSV) infection in newborn lambs as a model for human infants. There are no vaccines or currently effective therapies for RSV despite the fact that nearly everyone becomes infected with RSV and that it is the leading cause of hospitalization for viral pneumonia in human infants. For the last 15 years, we have characterized the kinetics of the development of clinical signs, lesions and viral parameters as well as adaptive and innate immune responses with funding from the USDA and NIH. For the last 7 years we have assessed various novel oral and nebulized therapies against RSV in collaboration with pharmaceutical and biotechnology companies as well as our own therapeutic approaches. Additional ongoing research activity includes inflammatory bowel disease of dogs and cats and previous research activity included: *Mannheimia haemolytic* pneumonia of cattle, Bovine Leukocyte Adhesion Deficiency of Holstein calves, Atrophic Rhinitis in pigs, *E. coli* infections in pigs, and Colisepticemia pneumonia/air sacculitis in turkeys.

Rob Bildfell

The majority of my research efforts are in the form of pathology-related support services for my colleagues, ranging from projects involving the pathogenesis of neoplasia to virulence mechanisms of *Mycobacterium spp.* I have a strong interest in diseases of wildlife and exotic animal species, as well as diseases of public health significance such as cryptococcosis.

Chris Cebra

Dr. Chris Cebra main lines of inquiry involve energy metabolism and gastrointestinal disorders. Regarding energy metabolism, he has primarily investigated the diabetes-like characteristics of llamas and alpacas, but has completed projects on cattle and horses as well. Regarding gastrointestinal diseases, he has concentrated on causes of colic, parasitic disorders, and other enteritides of camelids. He has also initiated or collaborated on projects in a number of other areas relevant to large animal internal medicine including equine and camelid peritoneal fluid analysis, diagnostic imaging, infectious diseases, and immunology.

Patrick Chappell

Work in my lab broadly focuses on basic mechanisms underlying endocrine control of reproduction, exploring the role of the molecular circadian clock in the brain's timing of reproduction in female mammals, investigating how circadian disruption may initiate breast and prostate cancers, and how the hormonal control of reproduction evolved from more ancient species such as corals.

Lia Danelishvili

Dr. Lia Danelishvili's research is mainly focused on study the mechanisms of *Mycobacterium tuberculosis* pathogenesis. Dr. Danelishvili's research identifies and characterizes virulence genes and proteins that are required for the early events of macrophage infection, survival and cell-to-cell spread. She studies the molecular mechanisms of the pathogen-host interaction and the associated cellular processes, such as apoptosis, autophagy and necrosis. The multidisciplinary approaches employing bacterial genetics, high throughput screening libraries, gene knockout systems, cell biology, high-resolution microscopy, bioinformatics and mass-spectrometric sequencing are used in the laboratory.

Helio De Moraes

My focus is on vector-borne and emerging infectious disease of dogs and cats.

Brian Dolan

Research in my lab is focused on two main areas. The first is the biology of antigen presentation, the process by which the cells of the body alert the adaptive immune system to the presence of intracellular pathogens, such as viruses, or oncogenic transformation. We are trying to determine which cellular pathways are necessary to successfully present the foreign peptide on major histocompatibility complex class I (MHC I) proteins at the cell surface, which serve to flag down disease specific cytotoxic T cells. We are also interested in studying immune responses in wild animal populations as it relates to disease spread.

Charles Estill

Dr. Estill is a Theriogenologist in the Department of Clinical Sciences. Research areas of interest include corpus luteum physiology and control, nutritional influences on reproduction, and ontogeny of sexual development. Current projects include collaboration on studies of "A ram model of neuroendocrine determinants of sexual orientation" and "Role of Peroxisome Proliferator-Activated Receptor gamma on prevention/cure of Mastitis".

Jean Hall

My research is concerned with how nutrition affects immunity. I am interested in nutrigenomic technology, or the study of how nutraceuticals affect the expression of genes involved in the immune response. My projects involve sheep and cows supplemented with selenium and its effects on immune responses, animal health, and animal production. In particular, we are interested in using selenium as a fertilizer to enhance forages fed to ruminants. I am also interested in the health benefits of dietary n-3 fatty acids and antioxidants in geriatric dog and cat foods. We are currently investigating these supplements in renoprotective foods used to slow the progression of chronic kidney disease in dogs and cats. In conjunction, we are assessing novel renal biomarkers used for monitoring disease progression and therapeutic interventions.

Claudia Hase

The genus *Vibrio* consists of a group of Gram-negative bacteria that naturally inhabit aquatic environments worldwide. Among this diverse group of microorganisms are a few human pathogens, namely *Vibrio cholerae* and *Vibrio parahaemolyticus*. In addition, our lab studies some *Vibrio* species that cause disease in aquaculture (*Vibrio tubiashii*) and corals (*Vibrio coralliilyticus*). We are applying various modern molecular techniques to better-understand the virulence properties and environmental survival strategies of these pathogens. In addition, we are developing detection assays that can be used in aquaculture facilities to reduce the economic impact of vibriosis.

Michael Huber

Research projects included surgical manipulation of endometrial cups in mares to manage infertility associated with pregnancy loss, and the impact of bone fragments on joint health. Focusing on some innovative ideas for limiting reproduction in BLM and Tribal horse and burro populations and development of an instrument to facilitate a surgical procedure.

Ling Jin

My lab is interested in understanding of the mechanism of viral diseases and virus evolution. Latency of herpesviruses is the main focus of research in my laboratory. My lab uses several different herpesviruses to study the mechanism of herpes virus latency-reactivation cycles, the pathogenesis of herpes viruses, such as Herpes Simplex Virus 1 (HSV-1), Herpes Simplex Virus 2 (HSV-2), Leporid herpesvirus 4 (LHV-4), Koi herpesvirus (KHV) and other animal herpes viruses, and host- virus interaction in central nervous system. In addition, my lab is interested in anti-viral drug development, new emerging viral disease diagnosis, such as deer pox virus, deer adenovirus, goldfish tumor virus. Currently, we have research projects on HSV, LHV-4, KHV, Bovine Herpes Virus 1 (BHV-1), goldfish tumor virus, and deer adenovirus.

Jennifer Johns

Research in our lab focuses on several areas:

- 1) Translational research utilizing mesenchymal stem cells (MSCs). We are currently evaluating:
 - a) How MSCs alter the bone marrow microenvironment and local immune response in canine osteosarcoma (a common bone cancer of dogs), and the resulting impact on tumor progression;
 - b) The role of MSCs in modulating the host immune response to infectious diseases, particularly bacterial infections, in veterinary species.
- 2) Research on tick-borne rickettsial infections, including granulocytic anaplasmosis and related obligate intracellular bacterial infections.
- 3) Clinical research for veterinary diagnostic testing, with an emphasis on laboratory animal and exotic species, and hematopoietic disorders in domestic animals.

Anna Jolles

Dr. Anna Jolles is a disease ecologist and epidemiologist at Oregon State University, where she has appointments in the College of Veterinary Medicine and the Department of Zoology. The Jolles lab studies the ecology and eco-immunology of infectious diseases in wild mammals. Current study systems include infectious diseases of African buffalo, feline immunodeficiency virus in African lions and Hanta virus in small mammals in Oregon. We collaborate with Dolan's group on comparative immunology across a broad range of mammal species, and with Clint Epps (OSU Fisheries & Wildlife) on pneumonia in desert bighorn sheep.

Michael Kent

Dr. Kent's research focuses on diseases of fishes and parasitology. Currently he is leading projects investigating diseases of importance to zebrafish in research facilities as this fish is now a very important model in biomedical research. Two groups of pathogens that he is studying are mycobacteria and microsporidia that infect zebrafish. He also is investigating diseases of importance in wild salmonid fishes, and presently is studying multiple pathogens associated with pre-spawning mortality in Chinook salmon.

Nicole LeBlanc

I focus my research in veterinary cardiology on the application of three-dimensional cardiac imaging to improve diagnostic utility of non-invasive cardiac assessment. Another research focus involves the pharmacologic assessment of transdermal drug applications for feline patients. I also investigate the efficacy of arrhythmia monitoring with noninvasive devices, as well as interventional approaches to both acquired and congenital heart disease.

Christiane Löhr

My research focuses on the molecular pathology as it applies to a wide range of diseases especially carcinogenesis, cancer prevention and treatment and infectious diseases. As a board certified anatomic veterinary pathologist with an appointment in the Veterinary Diagnostic Laboratory I encounter new or poorly understood disease conditions with regularity. Such cases provide excellent opportunities to identify specific, potentially novel, causes and mechanisms of disease processes. Much of my research is conducted in collaboration with colleagues in the College, on campus and outside the University. I find it very rewarding to provide critical input and data to large projects and to contribute to the training of researchers at all levels.

Kathy Magnusson

Our human population is aging. The percentage of the population in this country that is over the age of 65 is projected to increase from 12.6% in 2005 to 20% by 2030. With this increase will come a rising financial burden to both families and society, unless we can prevent the declines that are currently associated with aging. Declines in brain functions during aging, including memory and cognitive flexibility, affect almost half of the human population over 65 years of age. This interferes with people's quality of life as they get older. It also can become an economic burden, because they can no longer live independently. Pet animals can also experience these changes, which may limit their functional lifespan. These problems suggest that there is a decline in the optimal functioning of regions of the cerebral cortex and hippocampus. The N-methyl-D-aspartate receptor, a subtype of glutamate receptor, is highly expressed in these brain regions and plays a role in many of the functions that decline during aging. Our laboratory has found a selective vulnerability of the NMDA receptor to aging. This

decline in NMDA receptors correlates with declines in memory function. We will be exploring the effects of drug or micronutrient intervention on these receptors during aging with the use of stereotaxic surgery, chronic drug administration, and/or behavioral testing using mice as our model system. We may also be examining the effects of interventions on receptor binding density, and subunit mRNA and protein expression with the use of receptor autoradiography, in situ hybridization and Western blots, respectively.

Erica McKenzie

Dr. Erica McKenzie is a specialist in large animal medicine and sports medicine and rehabilitation. Her research interests are largely related to exercise physiology and muscle function. Some of her projects have therefore included studying effective drugs for preventing muscle damage in horses, and the study of specific aspects of exercise physiology and disease in racing Alaskan sled dogs. As a large animal clinician, Dr. McKenzie occasionally performs research projects relevant to internal medicine in alpacas.

Jan Medlock

My research interests are in infectious diseases and ecology, using my background as an applied mathematician. I am currently working on a variety of subjects, from more theoretical work on dispersal of organisms to more practical projects on influenza, dengue, and African sleeping sickness. I am also interested in the application of mathematics and statistics to biology in general: I have recently begun working with Dr. Shay Bracha to analyze large amounts of genomics and proteomics data on canine cancers.

Kirk Miller

Dr. Kirk Miller is certified in Canine and Feline Practice through the American Board of Veterinary Practitioners. He was in private small animal general practice for more than 12 years before joining the faculty at OSU. Dr. Miller is a Clinical Instructor and teaches the Small Animal Primary Care rotation, which takes place at the Oregon Humane Society in Portland. His current research projects include looking at the natural incidence of dirofilaria immitis in dogs in the northern Willamette Valley and another project evaluating a novel spay technique in cats.

Tim Miller-Morgan

Dr. Tim Miller-Morgan is an extension veterinarian focusing on aquatic species and the ornamental fish industry. He leads the Oregon Sea Grant Aquatic Animal Health Program, which provides the ornamental fish industry, aquatic research laboratories, and public aquaria with cutting-edge, scientifically based, conservation minded disease management techniques, consultation and training. Our research focus is on applied research aimed at current and emerging animal health issues generally associated with the management of wild-caught ornamental fish species and the management of disease throughout the chain of custody from the collector/farmer to the end consumer the ornamental fish hobbyists.

Milan Milovancev

My research topics can be broadly categorized as (1) cancer related or (2) clinical challenges in soft tissue surgery. My cancer related research centers around improving our understanding of the biologic behavior of canine sarcomas (e.g. soft tissue sarcomas, oral fibrosarcomas, and osteosarcomas) as it relates to development of novel diagnostic, prognostic, and therapeutic methods. The research I perform related to clinical challenges in soft tissue surgery is generated from specific problems encountered during my clinical treatment of patients. These include development of novel minimally invasive surgical techniques, evidence-based evaluations of different surgical methods, and case-based reports.

Hong Moulton

Morpholino oligomers are a class of steric-blocking antisense molecules that have been widely used to knock down gene expression, modify pre-mRNA splicing or inhibit miRNA maturation and activity. Injection of Morpholinos into single-celled embryos of many creatures results in specific knockdown of targeted genes with little toxicity. Morpholino oligomers have revolutionary potential for treatment of a broad range of human diseases, including viral, bacterial, age-related and genetic diseases, but they suffer from poor delivery into cells. My long term research interest has been in inventing and improving methods for enhancing *in vivo* delivery of Morpholinos in a tissue-specific manner for a given disease by chemically modifying and/or formulating Morpholinos. My current research is 1) to develop and validate a high throughput *in vivo* model to assess the

efficacy and toxicity of intracellular delivery methods for steric-blocking antisense oligos, and 2) to investigate how host factors affect influenza viral infection using the Morpholino-mediated gene knockdown approach.

Sarah Nemanic

My research focuses on using diagnostic imaging to help diagnose diseases or monitor response to treatment in companion animals. I have several on-going research projects in small animal imaging using radiographs, CT, MRI and ultrasound. These projects include CT of awake hyperthyroid cats, pre and post methimazole treatment to assess whether volume measured on CT will correlate to dose of methimazole needed to control disease. The CT appearance of the medial retropharyngeal lymph nodes in cats with or without nasal disease including both rhinitis and neoplasia. The radiographic development of the forelimb of giant breed dogs with and without elbow dysplasia and shoulder osteochondrosis. A comparison between MRI and CT for optimal pre-operative imaging of feline injection site sarcomas. A comparison of CT arthrography and MRI for assessing the diseased canine stifle. The use of a stereotaxic apparatus to perform brain biopsies in dogs with intracranial disease.

Kathy O'Reilly

1). Development of assays for diagnosis and epidemiology of important veterinary and zoonotic diseases. (Prefer MS students only).

Manoj Pastey

Dr. Pastey's laboratory is conducting research work on the pathogenesis of influenza, HIV, and respiratory syncytial virus (RSV) and developing a new diagnostic method to detect Dengue virus, Bovine Herpes virus, and sexually transmitted infections in clinical samples.

HIV Research Study: Our laboratory is testing a poly herbal vaginal microbicide named "BASANT" that has been shown to inhibit a wide range of sexually transmitted pathogens including HIV. Preliminary studies have also shown safety and acceptability in Phase I (acceptability and toxicity study) human trials in India. Therefore, the next step is to verify the effectiveness of the BASANT in preventing HIV transmission *in vivo*. We are also working on a novel HIV protein that is required for replication in T cells. HIV sequestration in the CNS and the failure of antiretroviral drugs to penetrate through blood-brain barrier to eliminate latent CNS reservoir continues to be a major road block in AIDS therapy. Therefore, we are developing Nanotechnology based delivery systems to target the virus within different tissue compartments.

RSV Research Study: Respiratory Syncytial Virus (RSV) is a leading cause of bronchopneumonia in infants and the elderly. There are no vaccines or effective treatment available. Knowledge of viral and host protein interactions is important for better understanding of the viral pathogenesis and may lead to development of novel therapeutic drugs. In our lab, we have shown that Respiratory Syncytial Virus Matrix (M) protein interacts with cellular adaptor protein complex (AP)-3 and its medium (μ) subunit. We are also looking into the role played by Myeloid cell leukemia-1 (MCL-1), an anti-apoptotic member of the B-cell lymphoma-2 (Bcl-2) family, in Respiratory Syncytial virus pathogenesis.

New Diagnostic method: We are developing a new rapid diagnostic method to detect dengue virus, bovine herpes virus, and sexually transmitted infections at Point-of-Care within 30 mins at room temperature using recombinase polymerase amplification (RPA) technology without the need for sophisticated equipment.

Sreekanth Puttachary

Even after a century of research to find a cure epilepsy still remains a disease that is not well understood. Dr. Sreekanth Puttachary's lab is focused on investigating the effect of drugs that target the endocannabinoid system (such as Cannabidiol) administered during epileptogenesis to validate their short-term and long-term impact on the disease progression. In simple terms, seizures are just the symptoms/manifestation of a disease referred to as epilepsy. People of all ages, gender, socio-economic background and demography are susceptible to this disease. More than 2.9 million people in the US suffer from epilepsy.

Stephen Ramsey

My lab's research combines computational and experimental approaches to better understand gene regulation: both how genes are regulated by population genetic variants and how gene regulation contributes to the pathogenesis of diseases like cancer and heart disease. In our five current projects we are (1) using comparative oncology approaches and transcriptome profiling to study cancers in companion animals (feline sarcoma, canine osteosarcoma, and canine prostate cancer); (2) developing machine-learning methods to aid in identifying which noncoding genetic variants have functions in regulating gene expression; (3) developing the machine-learning system for a "smart" bandage that will monitor wound healing; (4) collaborating with the Rockey Lab on genomics-based studies of chlamydia biology; and (5) using artificial intelligence methods to develop a "Wolfram Alpha"-like system for answering biomedical questions based on a huge database of structured biomedical prior knowledge.

Dan Rockey

Interactions between chlamydiae and the mammalian host. All species of chlamydiae are obligate intracellular bacteria that cause disease in a wide variety of animal species. In humans, *Chlamydia trachomatis* and *C. pneumoniae* cause a variety of diseases of the eye, genital tract and lung. These conditions affect millions of people worldwide and lead to billions of dollars in medical expenses yearly in the U.S. alone. Additionally, chlamydial infection is associated with certain types of arthritis and, most surprisingly, arterial sclerosis. Very little is known about how chlamydiae interact with the host to cause a particular chlamydial condition, and why some infected people have serious disease and others are asymptomatic.

Justin Sanders

My research is focused on host-parasite interactions and the impacts of ecological and evolutionary factors on these interactions. Current projects include: 1. Production of monoclonal antibodies that recognize a number of zebrafish cytokines and characterization of the zebrafish immune response, 2. Development and characterization of an elevated temperature zebrafish model, primarily for the study of the apicomplexan parasite, *Toxoplasma gondii*, 3. Improvement of diagnostic techniques for the detection of important veterinary parasites such as *Giardia intestinalis* and the liver fluke, *Fasciola hepatica*, 4. Identification and characterization of the transmission dynamics of aquatic pathogens. This work is being performed with salmonid fishes in the wild as well as with laboratory zebrafish in order to determine the factors involved in prespawn mortality of salmonids and to guide diagnostic efforts aimed at improving the health of zebrafish in laboratory fish colonies.

Mahfuzur Sarker

The long-term goal of my research program is to develop strategies to inactivate *Clostridium* spores and to control *Clostridium*-mediated diseases. We mainly focus our work on spores of *C. perfringens* (*Cp*) causing *Cp* food poisoning, which currently ranks as the third most commonly reported food-borne disease in the USA. *Cp* also causes non-food-borne gastrointestinal (GI) diseases in humans and GI diseases in domestic animals. Specifically, we investigate the molecular mechanisms of *Cp*: i) spore heat resistance; ii) spore germination; iii) spore-host interactions; and iv) spore inactivation.

Katherine Scollan

My research in the field of veterinary cardiology is focused on three-dimensional imaging of the heart including 3D echocardiography and computed tomography (CT). I am investigating the use of these imaging modalities to assess size and function of the cardiac chambers in normal and diseased hearts. In addition, I perform research in pharmacokinetics and efficacy of antiarrhythmic medications used in dogs and have an interest in the congenital cardiac diseases of camelids.

Stacy Semevelos

Her research focuses on comparative orthopaedics, particularly postnatal cartilage development and osteochondrosis in horses. She has discovered molecular expression changes in osteochondrosis and has explored the quantitative and spatial alterations of matrix molecules, growth factors, and cell-to-cell signaling in this important disease. In addition, she has discovered age-related changes in gene and protein expression patterns of matrix molecules, growth factors and paracrine factors in articular cartilage of normal growing horses throughout postnatal development. She has also investigated musculoskeletal disorders of llamas and alpacas, using molecular, biochemical, and histological techniques to evaluate suspensory apparatus breakdown in these species.

Natalia Shulzhenko

My laboratory studies interactions between the immune system, metabolism and gut commensal microorganisms (microbiota) in mouse models and human diseases. Microbial cells exceed ten times the number of our own body cells and contribute to several physiological processes. With the advent of new genomic technologies, the role of microbiota in health and disease is a rapidly evolving field of research. We apply novel systems biology approaches such as network reconstruction to analyze host and microbiota simultaneously. Our recent work on chronic enteropathy in immune-deficient hosts revealed a crosstalk between the immune system, the microbiota, and the epithelial cells affecting both intestinal and systemic lipid metabolism. Using metagenomic sequencing, we plan to reveal the microbial players contributing to this disorder and to test them in a mouse model of this disease. In another project, we are studying adverse effects of antibiotics on the intestinal immune system and on microbiota and how this disruption contributes to metabolic syndrome and type 2 diabetes.

Sean Spagnoli

Sean Spagnoli engages in collaborative zebrafish research with individuals throughout the country. His own work involves improving the zebrafish as a model for biomedical research by exploring current biosecurity and hygiene standards and practices with regard to subclinical infectious disease and its effects on various experimental techniques.

Susanne Stieger-Vanegas

My research interests focus broadly in computed tomography and ultrasound of gastrointestinal, complex cardiac and musculoskeletal disease in dogs and New World Camelids. My interest not only includes the CT imaging of clinical patients, but establishing new imaging protocols to improve imaging of diseased veterinary patients using CT. Currently I have a focus in cats with lung disease, dogs and New World camelids with gastrointestinal and cardiac disease. In addition, I have a strong interest in understanding if additional techniques such as three-dimensional CT can improve the accuracy reading CT studies in evaluators less experienced reading CT studies. Furthermore, I am also interested in establishing new techniques such as elastography to evaluate patients with musculoskeletal disease. Elastography is a relative new technique used in human patients with injuries of the soft tissues and has in human patients so far predominantly been used to evaluate patients with suspected breast cancer. Current ongoing funded projects include CT of the gastrointestinal tract of dogs and New World Camelids with enteropathy, cardiac-gated CT of New World camelids with complex cardiac abnormalities, evaluation of the healthy and diseased supraspinatus tendon in dogs using ultrasound and MRI. In addition, I am involved in a dental study performing tooth root ablations of the tooth bud of the last maxillary molars (wisdom teeth in humans) using pigs as a model for future studies in human patients.

Sue Tornquist

My areas of research include hematology, metabolic disease and infectious diseases of camelids and use of immunocytochemistry in diagnosis and prognosis of neoplasia.

Jennifer Warnock

I am a Small Animal Surgeon with a practice focus on orthopaedic surgery. My major area of basic science research is on *in vitro* meniscal tissue engineering, using waste tissue obtained during clinical arthroscopy. Meniscal injury and deficiency is a major cause of pain, disability and irreversible osteoarthritis in dogs and humans. As the menisci have minimal to absent healing responses, creating autologous fibrocartilages *in vitro* through tissue engineering may be a viable strategy for addressing the meniscal deficient stifle or knee. My current work has focused on creating fibrocartilage-like tissue from synovial and meniscal cells cultured from clinical patients in need of engineered stifle tissues. Specifically, my lab has synthesized autologous, scaffold free, tensioned neotissues, to avoid the complications seen with use of synthetic, allogeneous, and xenogenic scaffolds in meniscal tissue engineering applications. My clinical research focuses on minimally invasive surgery and validation of surgical techniques. I have a long-term goal of bringing discoveries made in my laboratory (following efficacy and safety analysis) to the hospital to benefit my patients.

Katja Zellmer

My general research area is the pathophysiology and treatment of osteoarthritis – especially in horses. More specifically, we are currently investigating different routes of administration of the drug tiludronate, which is a bisphosphonate that decreases bone breakdown. This drug is exciting, as it is the 1st time that veterinarians are trying to affect the subchondral bone pathology in the development of osteoarthritis! Another area of research is the use of nanocarriers for the delivery of medication, gene therapy and interfering RNAs into osteoarthritic joints. Further, I am collaborating in the investigation into signaling changes that may be responsible for the development of osteochondrosis (a developmental joint disease) in foals, as well as in the use of synovial-derived cells for bioengineering of meniscal replacements in dogs. In the future, I am hoping that we will determine whether synovial-derived mesenchymal stem cells are of benefit in the treatment of osteoarthritis in horses.