This issue’s column on strategies for success in gastrointestinal (GI) research features comments from M. Sawkat Anwer, DMVH, PhD, Distinguished Professor of Biomedical Sciences and Associate Dean for Research at the Cummings School of Veterinary Medicine at Tufts University. Dr Anwer has been performing GI research for more than 40 years and is the former chair of the National Institute of Diabetes and Digestive and Kidney Diseases Hepatobiliary Pathophysiology study section. As part of this issue of *Cellular and Molecular Gastroenterology and Hepatology*, highlighting the important role veterinary researchers play in the GI research community, Dr Anwer offers insights into the unique challenges and opportunities associated with establishing a successful research program at a veterinary school.

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### GI Research in a Veterinary School

Veterinary schools across the globe encourage their faculty to conduct research to improve animal health and, by extension, human health. The ability to conduct research is considered an important day 1 competency for veterinarians by the World Organization for Animal Health. However, research opportunities for faculty and students vary greatly among veterinary schools. There are several reasons, including a lack of financial support and research infrastructure, especially in underdeveloped countries. Despite these limitations, animal health-related research has been increasing with the growing understanding that human health is related directly (zoonotic diseases) and indirectly (animal products) to animal health. In addition, animals and human beings suffer from diseases, including gastrointestinal (GI) diseases, that have similar etiologies and courses. Thus, research conducted to understand the pathophysiology of GI diseases in animals can provide insights into human diseases and animal clinical trials in naturally occurring GI diseases, and facilitate drug development for human beings as well as animals.

A successful career path in GI research at a veterinary school generally is similar to that in a medical school. The common attributes required for success include excellent research training, an ability to collaborate with other investigators, peer-reviewed publications, and extramural funding. One difference between medical schools and veterinary schools, however, is that research resources, including core facilities, are limited at veterinary schools and there are few investigators conducting GI research at any single institution. In addition, veterinary scientists interested in GI diseases of small animals (dogs and cats) cannot obtain funding from the National Institutes of Health (NIH) unless the proposed research can be shown to have relevance to human diseases. On the other hand, veterinary scientists interested in basic science research related to GI diseases can compete for NIH funding. I have been associated with the Cummings School of Veterinary Medicine at Tufts University since 1983. Although I have been supported by grants from the NIH, I have seen young faculty struggle to establish their own research programs. I suggest ways, based on my own experience, for veterinarians to prepare for a career in GI research and to circumvent some of the challenges.

### Research Training Opportunities for Veterinarians

Excellent research training is the first step for a successful research career, and there are many opportunities at veterinary schools for research training. Most veterinary schools in this country have summer research training programs supported by the NIH and by organizations for veterinary students. This initial training can lead to more intensive research training, such as masters and doctoral programs in the biomedical sciences. One challenge here is that there is only limited NIH support for masters and doctoral programs for veterinary students. However, the Office of the Director of the NIH, through the Office of Research Infrastructure Programs, recently initiated more programs for veterinarians. In addition, there are opportunities for veterinarians to engage in GI research during residency training in veterinary internal medicine and as
postdoctoral fellows in established laboratories. The National Center for Advancing Research in Translational Sciences has shown renewed engagement as a result of the One Health concept, and offers Clinical and Translational Research Award programs associated with veterinary schools. Three veterinarians currently are participating in such a program at Tufts.

Establishing a Research Laboratory in a Veterinary School

The next step is to establish a research program with institutional support and then seek extramural funding. Key components are the laboratory space and equipment and the research environment. Very often, junior investigators coming from well-equipped research laboratories are unaware of the basic needs of a research laboratory. It is important to seek advice from mentors and fellow scientists to ensure that the laboratory has everything needed. When I came to the Cummings School as an assistant professor, I was delighted to have a big laboratory. However, it was an empty laboratory and I had to equip it with everything from pipettes to general laboratory equipment, which used most of my start-up funds. Core facilities (e.g., animal and imaging facilities) should be readily accessible. Most veterinary schools provide start-up funding as well as competitive pilot grant funding for junior faculty members. However, the start-up funding level may be limited compared with that in most medical schools. To circumvent this, it is important to apply for pilot grants and seek collaborations with established investigators on campus, which also highlights the importance of seeking a position in an institution with established investigators in the field. Another important consideration is to have protected time to establish a research program. I was hired to establish my research program and at the same time direct a course in veterinary pharmacology. If I had known then what I know now, I would have asked that the first year be devoted to research only.

Extramural Funding for Veterinarians

Once the laboratory is operational and preliminary data are being generated, attention should be focused on obtaining extramural funding. Because funding for veterinary research is limited when compared with human research, it is important for veterinarians to use institutional resources to help identify potential funding sources. The primary federal funding sources are the NIH and the US Department of Agriculture. US Department of Agriculture funding generally is limited to research conducted in food-producing animals. Although veterinarians can compete for NIH funding, the 2014 NIH Physician-Scientist Workforce Working Group Report found that R01 award rates for veterinarians are significantly lower than for MDs and PhDs. The factors contributing to this discrepancy have not been determined; one reason may be that veterinarians do not always qualify for or capitalize on NIH research awards. It therefore is important to highlight human disease relevance in NIH grant applications and to include physicians as collaborators. Veterinarians interested in small-animal (cat and dog) diseases may receive funding from foundations such as the Morris Animal Foundation, American Kennel Club, WINN Feline Foundation, American Veterinary Medical Foundation, and veterinary pharmaceutical companies. The funding from these sources can be modest, is competitive, and often is for a short period of time. In addition, the Cummings School and other veterinary schools receive donations in support of research from the grateful clients of its teaching hospitals. The major motivation for these donations, large and small, is to help find cures for diseases that affect pets. For research related to companion animal diseases, philanthropy may be an important source of funding, and it is important to maintain contacts with the institutional development office.

It requires a concentrated effort and time commitment to prepare a competitive grant irrespective of the funding agency. Once a funding source is identified, it is important to read the administrative and scientific requirements of the application carefully. At the Cummings School a dedicated staff of research administrators help faculty with the administrative aspects of their applications and ensures that all required documents are included. Some of the key features of successful competitive grant applications include the following. First, start preparing the application well ahead of the deadline with enough time for revisions. Second, have the grant application (especially the specific aims section) critiqued by fellow scientists, established investigators, and somebody outside the field. This approach provides input on scientific content as well as the significance and impact of the proposed studies. At Tufts, I moderate a junior faculty forum supported by the Tufts Clinical and Translational Research Award program. Participating junior faculty from all health sciences schools critique research ideas by fellow faculty. Such a forum helps veterinarians to explain and understand the human relevance of their research and has helped improve grant applications by these faculty. Critiques from an established investigator are very helpful in preparing a more realistic and focused application, as was the case with my first R01 application. Third, take advantage of grant writing courses, seminars, and workshops made available by your institution. Some of these courses, although time consuming, are worth attending because they provide guidance on how to highlight the significance and impact of the proposed research and to avoid common mistakes.

GI Research in Veterinary Medicine

Companion animals can suffer from GI diseases that also affect human beings, such as hepatic lipidosis/nonalcoholic fatty liver disease and cholangitis in cats, portosystemic shunts and biliary atresia in dogs, and hepatocellular carcinoma (HCC) and amyloidosis in both dogs and cats. Pet owners increasingly are interested in using knowledge gained from human medicine to improve the management of GI and other diseases in their pets. Human patients also benefit from better understanding of similar GI diseases in animals, large and small. This dual benefit can be achieved by more collaborative research between veterinarians and physicians.
GI research at the Cummings School is conducted by a small group of faculty and is focused on liver diseases including cholestasis, hepatocyte apoptosis, and HCC. More specifically, studies are conducted to define the signaling pathways involved in the cholestatic, choleretic, and anti-cholestatic effects of various agents, bile acid–induced apoptosis, gender differences in the development of HCC, and stem cell therapy in autoimmune liver diseases. These studies are supported by start-up funds, NIH grants, and private foundations. The long-term goal of this research is to better understand animal and human GI diseases in an effort to design rational therapeutic approaches.

In summary, veterinarians have a significant and critical role to play in advancing the goals outlined by the One Health initiative. Veterinary schools are in a unique position to prepare veterinarians for biomedical research, including GI research. In particular, veterinarians who actively collaborate with physicians are poised to make a difference in biomedical research in general and in GI research in particular.