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The Economics of Veterinary Medicine: Emerging Challenges and Opportunities for Economists

Clinton L. Neill, Matthew J. Salois, and Ryan Blake Williams

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Introduction

For decades, veterinary economics has been synonymous with the study of animal disease and its resulting economic impacts, primarily focused on zoonotic and farm animal issues. Naturally, this area of study has opened the door for collaboration between economists and veterinary medicine professionals. These collaborations have enhanced statistical modeling efforts of epidemiological events and provided robust literature on the economic importance of controlling disease outbreaks. Yet, in 2011, the American Veterinary Medical Association (AVMA) approved and initiated an investment in veterinary economics via the Veterinary Economics Strategy Committee in response to a growing concern about the economic burdens facing its members and the increasing economic issues within companion animal medicine (Dicks, 2013). This shift in focus toward the economic welfare of the larger veterinary industry and pet owner insights is indicative of growing concerns beyond studies related to animal disease and farm animal issues.

While there have certainly been economic studies on non-disease related issues, there has been a lack of dedicated effort to address broader issues related to the human side of veterinary medicine. Most notable about the AVMA's initiative was the establishment of the AVMA Economics Division, which has hired several economists to spearhead data collection and research. Moreover, the desire for a deeper understanding of the industry has spurred the entire veterinary profession to engage more with the field of economics, especially agricultural economics—and applied economics more generally—as that field has long been involved in the epidemiology–economics intersection. Within the last few years, colleges and schools of veterinary medicine have begun to hire their own economists to explicitly work on economic issues in veterinary medicine. The most recent schools to do this are Cornell University, in conjunction with the establishment of the Center for Veterinary Business and Entrepreneurship, and Texas Tech University, with the advent of their new School of Veterinary Medicine. This trend is global in nature, with agricultural economists working at the National Veterinary School in France and the Royal Veterinary College in London, among others. We do not wish to contend that this model is preferred, only that it can be viewed as a signal to our profession.

The veterinary profession has demonstrated a clear desire to address concerns about its sustainability, but that need alone is an inadequate explanation for the degree to which the veterinary sciences are engaging with applied economists. By integrating economists in veterinary medicine programs, there is a clear message that economics expertise is desired in the realm of veterinary sciences, and there are many opportunities for agricultural economists to make important contributions. This article reviews past, present, and future work in the field of veterinary economics.

In what follows, we discuss the need for a transdisciplinary approach to issues related to veterinary economics, a review of the various types of literature on the topic, and what we believe to be the next steps in expanding the field of veterinary economics. The relationships between human, animal, and ecosystem health are complex and of great importance to a healthy and thriving global society; it is critical that economics be involved with that research. Much of the existing literature addresses the markets for veterinary services and veterinary education, but there are still many remaining opportunities for contributions by economists. Finally, we suggest areas of research that the economist is uniquely positioned to pursue, including professional thriving, competition in the veterinary services markets, the role of structural biases in markets for animal care, and the role of animal ethics in the food-animal supply chain and beyond.

The Need for Transdisciplinary Work

The field of veterinary economics closely resembles that of human health economics. Health economics can generally be defined as "a branch of economics concerned with issues related to efficient, effectiveness, values, and behavior in the production and consumption of health and health care" (Krabbe, 2016 https://www.sciencedirect.com/topics/social-sciences/health-economics - :~:text=Health%20Economics%201%20Health%20Economics.%20The%20size%20of,values%20for%20%28hypothetical%29%20health-state%20...%20More%20items...%20). The field of veterinary medicine experiences similar issues related to animal health, healthcare access, behavior, values, and more, all of which are in need of study in order to further the prosperity of those involved in the industry.

Just as the field of health economics collaborates with human health professionals, veterinary economics must engage in a transdisciplinary approach to solve pressing issues. Moreover, the importance of veterinary medicine in our food systems, human-animal interactions, and public health issues requires an understanding of many general economics fields. Not only is it vital to understand epidemiological concerns but also issues of labor, education, finance, behavior—both producer and consumer, industrial organizations, marketing, and management, among many others.

Perhaps one of the most prominent topics that incorporates many of these areas of study is that of One Health. The concept of One Health (and its precursor, One Medicine) dates to the 1800s, when the importance of simultaneous consideration of human and animal health was promoted by Rudolf Virchow following his research on *Trichinella spiralis*. The success of that endeavor, and subsequent efforts to monitor and address human-animal health interactions, led to an awareness that the One Health approach is of significant global importance and the One Health Initiative Task Force (OHITF). The OHITF included representatives from the AVMA, the American Medical Association (AMA), and the American Public Health Association (APHA). The One Health Commission (OHC) was chartered in 2009 ("History," 2015).

The veterinary scientist plays an important role in our global society, caring for livestock, helping ensure the success of animal protein production operations, addressing food safety concerns, providing health services for our companion animals (who increasingly are family members), improving performance—and enhancing welfare for—animals used in sporting activities, developing pharmacological treatments that benefit both animal and human, and they are on the front lines of public health crises. The health and, by extension, most efficient use of resources in the production of food animals directly impact our environment via demands for feed and water and in greenhouse gas emissions (Salois, 2015). As the global population grows, humans are expanding the areas in which they live and work on the planet, which puts more people into closer contact with more species. According to the U.S. Centers for Disease Control (CDC), more than 60% of known infectious diseases in humans can be spread from animals to humans, and 75% of novel or emerging diseases originate within animal populations ("Zoonotic Diseases," 2017).

There are many opportunities for One Health to address important challenges to our world ("What Is One Health?" 2020), yet there remains a relative lack of ongoing transdisciplinary research compared to the volume of disciplinary research in these domains. One potential reason for this is that the mechanisms by which One Health challenges can be addressed often require significant trade-offs. It is easy for society to support valuing human health over animal health and human and animal health over ecosystem health, but these relationships are nuanced because, ultimately, the health of one depends on the health of the others. Further, both trade-offs and complementarities require some mechanism for valuation, and the applied economist is the appropriate scientist to be considering those valuations. To that end, it makes sense that veterinary scientists, as the global leaders in One Health, would engage our profession on these topics. There exists a growing opportunity—and, we contend, obligation—for applied economists to engage human and animal health scientists in collaborative research as part of the global One Health mission.

What Do We Know? What Do We Need to Know More About?

As previously mentioned, veterinary economics is not necessarily a new field of study. A depth of literature relates to animal health and disease in economics, agricultural economics, animal science, and veterinary medicine outlets. The predominant economic issues that these works study are the market efficiencies, externalities, and impacts on food animal production. Economic theory has guided these studies to accurately account for issues surrounding the economic welfare of farms, industries, and consumers. Yet there are other facets to the field of veterinary economics that are equally as important to those economic agents.

A more recent set of work in the field that has become common are those concerning issues of income and debt of veterinarians and veterinary professionals. This body of literature is born of the concerns of rising educational debt and stagnant incomes (Dicks, Bain, and Knippenberg, 2015; Neill, Holcomb, and Brorsen, 2017; Bain, 2020a,b). The topics of starting salaries and debt upon graduating from a veterinary program have received the most attention, as the debt is continually rising and real income is growing at a significantly slower rate, if at all. The growth rate of starting salaries

prominently declined during the Great Recession (Mattson, 2020). Educational debt has been increasing due to increases in tuition, which in turn is a result of less public funding for higher education (Maccabe, 2018). Work beyond that of new veterinarians has focused on the factors that affect earnings throughout a veterinarian's career (Brown and Silverman, 1999; Neill et al., 2018; Salois et al., 2020). For new and experienced veterinarians, differences in earnings are predominately related to practice type choice (small/companion, equine, mixed, food animal, etc.) and demographic characteristics. There is little difference in salaries based on where one obtained their degree (Neill, Holcomb, and Brorsen, 2017; Salois et al., 2020).

In addition to general studies on income, there have also been some studies on gender wage disparities in veterinary medicine. This work has centered on veterinarians farther along in their careers. As with most other industries, a wage gap exists; finding ways to identify and address this issue has become a critical topic for the profession (Smith, 2002; Morello et al., 2019; Neill, Kakpo, and Mack, 2021). This issue of gender wage disparity is even more of an issue because female veterinarians have been the majority in the profession since 2009 and currently make up 63% of practitioners (AVMA, 2019). According to the AVMA, the wage gap for new veterinarians' first job offers was about 3% on average in 2017 (Neill, Kakpo, and Mack, 2021; Salois et al., 2020). The wage gap has significantly declined in recent years for new veterinarians but grows with gains in experience. As found in work done by Smith (2002), productivity between female and male practitioners was not significantly different, but there existed a 9% wage gap after accounting for observables. In more recent studies, the gender wage gap is still evident within specialty practice areas and throughout the wage distributions. Specifically, among American College of Veterinary Surgeons graduates, women were more likely to be employed in academia and less likely to be practice owners (Morello et al., 2019). When looking at a sample of all veterinarians, women have a comparative advantage in earnings pursuing specialty certifications rather than owning a practice (Neill, Kakpo, and Mack, 2021). In addition, male veterinarians see higher wage returns than females for an additional year of experience. This points to a serious issue when finding solutions to the general problem of stagnant incomes. Work in this area of study in veterinary economics is rapidly expanding and one of the most researched topics.

On the other side of the income problem is educational debt. This issue has made newspaper headlines and has been a major focus of discussion among veterinarians for some time (Segal, 2013; Bain, 2020a,b). Since 2001, the average debt-to-income ratio has steadily risen, from about 1.2 to 2 in 2020 (Mattson, 2020; Salois et al., 2020). Over the period of 2001 to 2014, tuition for veterinary medicine programs increased at a rate of 5.1% per year for in-state students and 3.4% per year on average for out-of-state students ("How Much Will My Veterinary Education Cost?"). During that same time, educational debt increased at a rate of 5.1% per year, on average. This suggests that increases in debt are predominately a result of increasing educational costs. As previously mentioned, starting salaries for new veterinarians have experienced very modest growth, about 1% real income growth over the same period. If this trend continues, the issue of debt will remain a hot-button topic for years to come.

Emerging Literature in Veterinary Economics

In the last few years, a new set of literature in veterinary economics has emerged. This literature is centered around consumer expenditures/behavior, payment options for veterinary services, and firms' financial performance. The need to understand the demand for veterinary services has been a subject of interest for many years. Studies on veterinary demand have been performed every few years to update the industry on current trends. However, there is no consistent set of studies, methodologies, or data to assist the veterinary industry in tracking changes in consumer preferences. Some of the early data on the topic of consumer demand was collected by AVMA every five years via their Pet Demographic Survey (AVMA, 2018). This survey was extensive and used a stratified sample of 50,000 pet-owning households (Neill, Holcomb, and Brorsen, 2018). More recent work has used nationally representative surveys of approximately 1,000 households and probed about issues of online procurement of pet supplies, willingness to pay for telemedicine, and sources of pet acquisition (Widmar et al., 2020; Bir, Widmar, and Croney, 2017). Consumer demand is ever important as the growth in veterinary demand over time is suspected to be lagging the growth in supply, which leads to individual producer (veterinarian) welfare losses (Neill, Holcomb, and Brorsen, 2018).

One of the potential reasons for a lack of demand growth is financial access to veterinary care (Wiltzius et al., 2018). Brockman, Taylor, and Brockman (2008) find that consumers of veterinary medicine that elevate their pets to "family-member status" are more likely to make emotional, rather than cognitive, financial decisions regarding pet care. However, since veterinary care is predominately a "pay for services when rendered" model, the ability of many low-income or cash-illiquid pet owners to pay for services—despite their willingness to pay—decreases the overall number of transactions for practices. Recent and ongoing research examines the impact of pet insurance and payment plans on pet owner spending and access to veterinary care (Williams et al., 2020; Bir, Wolf, and Widmar, 2020). There is still a need for more work in this area to analyze the effects on an industry-wide scale and to determine the best options from a consumer and producer welfare perspective.

The welfare of the veterinary medicine service provider is another piece that is often overlooked but gaining momentum as the industry faces increasing corporatization on the companion animal side. Recent work by Dodge, Koontz, and Hadrich (2019) assessed factors associated with better financial performance of 45 companion and mixed animal practices. They found that solvency and investing in highly productive assets were key to increased financial performance. Again, continued work in all these areas is key to increasing economic welfare for the industry.

Broad Issues That Need More Engagement with Economists

Even with the recent expansion of veterinary economics as a field, there are still many issues that have not been addressed from an economics perspective. Economic theory and methodology are powerful tools to address each of these issues. It is up to the profession to provide the industry with the expertise to address each topic and provide solutions.

Veterinarian Thriving

A recent study by the AVMA (Salois et al., 2020) and two studies sponsored by Merck Animal Health (Volk et al., 2018; 2020) that surveyed current veterinarians found that overall job satisfaction among veterinarians has remained unchanged over the past five years. However, when aspects of the job are decomposed, that satisfaction has been increasing with increased salaries, while other factors have led to reductions in satisfaction (Salois et al., 2020). The veterinarian is tasked with providing health care for animals for whom she has moral concern; therefore, satisfaction with the career can depend a great deal on compassion satisfaction, or the pleasure derived from the work one does in helping others. According to Salois et al. (2020), compassion satisfaction has been on the decline among veterinarians while burnout and secondary have both been increasing. While these are not the experiences of all veterinarians, it is clear many veterinarians struggle to thrive.

According to Volk et al. (2020), severe psychological distress is on the rise among female veterinarians, and veterinarians are three times as likely to think about suicide than nonveterinarians. A query of the U.S. Centers for Disease Control and Prevention's (CDC) National Occupational Mortality Surveillance (NOMS) proportionate mortality ratio data returns an estimate that veterinarians are between 2.35 and 3.95 times as likely to die by intentional self-injury than the working-age population average. Tomasi et al. (2019) estimate similar rates using a sample of some 11,000 death records of veterinarians and provide additional analyses focused on differences in age at death, sex, clinical practitioner status, and species of specialization. The psychological sciences are actively employing their expertise in working to understand what leads individuals to engage in self-injurious behaviors. Where we can help in addressing this epidemic is by evaluating the economic factors that are key stressors and providing information that might aid in more successful choices by individuals in the veterinary profession to mitigate those stressors. Two areas of opportunity for this involvement are in addressing issues related to student debt and veterinary practice structure and financial management. Volk et al. (2020) indicate that of the top five concerns of veterinarians, student loan debt and ability to exit the profession rank numbers two and four, respectively. The AVMA Council on Education's Standard 9 requires curriculum on these topics, yet the median student loan debt among graduates of veterinary medical colleges has tripled over the past 20 years (Larkin, 2019), while the average salary for veterinarians has increased only 40% (Bureau of Labor Statistics, 2003, 2020). Possibly exacerbated by student loan debt, practice ownership by veterinarians has declined (Burns, 2019; Salois et al., 2020), which represents either a consolidation in economic rents among a diminishing number of veterinarians or that those rents are being captured by non-veterinarian practice owners. As economists, we seek to identify the change(s) in the market that may contribute to the returns to veterinary education during the same period that the cost of acquiring the necessary education has risen sharply.

Education

The dynamic of rising costs of acquiring the DVM degree and reduction in returns to the degree due to changes in practice ownership patterns present a significant challenge to the veterinary profession. Simultaneously, there continue to be shortage areas throughout the United States, with most of those shortages being in either food/farm animal or public practice. The shortage of public practice veterinarians is anticipated to continue its growth due to a proportionally large number of anticipated retirements. Of greatest concern is that the shortages are among those agencies responsible for monitoring/controlling zoonotic diseases—such as SARS-CoV-2 (COVID-19)—and food safety and inspection (U.S. Government Accountability Office, 2015). This is particularly troubling because the training of veterinarians in the United States has historically, and continues to be, subsidized by the public. With nearly all schools of veterinary medicine housed at land-grant institutions, and annual state appropriations to veterinary schools exceeding an average of $20 million annually (Moore, Hubbell, and King, 2012), it seems that it is time to evaluate the efficiency of the existing model. Efforts to reduce the total costs of training and total costs to students should be prioritized, despite the decline in the proportion of program expenditures coming from public funds (Moore, Hubbell, and King, 2012).

Fast-track models of veterinary education have the potential to reduce the cost of education for veterinarians. Fast-track models encourage applicants to pursue admission to the DVM program prior to

completion of the bachelor's degree or to forgo the bachelor's degree altogether. This type of program either combines the bachelor's and DVM to reduce the total years of postsecondary education by one or two years, or the student completes only the minimum prerequisites for admission to the DVM program at an accredited university or college. Because most students of veterinary medicine desire to pursue the profession prior to beginning their postsecondary education—on average, applicants report an initial interest in the profession before the age of 10 (Dicks et al., 2015), a fast-track DVM should be attractive to many students.

Diversity, Inclusion, and Structural Bias

The AVMA states a commitment to diversity and inclusion in the veterinary medicine profession on their website (www.avma.org). The AAVMC lists diversity and inclusion as part of the organization's core values and advocates for its membership to recruit and retain underrepresented faculty and students. The veterinary profession in the United States has been slow to become more representative of the population that it serves, continuing to be one of the least diverse professions (AAVMC DiVersity Matters; Greenhill and Carmichael, 2014). The existing literature on the topic largely focus on describing the issue or demonstrating that the lack of diversity in the profession impacts the willingness of underrepresented peoples to pursue the profession (see, for example, *The Journal of Blacks in Higher Education*, 1996, 2003; Elmore, 2003; Amass et al., 2011; Gyles, 2018). There is a lack of research on the markets for veterinary care in communities of underrepresented people. How do these markets compare to the markets for human health care? What role do cultural differences play in demand for health care in general, and specifically for veterinary care? What is the extent of the pay gap between white and underrepresented groups in veterinary medicine? Given the societal costs of illness and disease and the degree to which zoonotic diseases threaten the well-being of our society, these questions warrant serious attention.

The Market for Veterinarians

The supply of veterinarians has grown steadily and is expected to continue growing with the addition of several new veterinary medicine programs. In addition, the market structure for veterinarians is often described as monopolistically competitive, as prices for services are set at the firm level (Neill et al., 2019). Veterinarians are also highly competitive, as they are substitutable from a consumer perspective. This substitutability depends on the set of species treated by the practitioner, but within animal specializations, veterinarians are highly competitive and engaged in price competition both locally and nonlocally (Neill et al., 2019). Overall, few studies have examined the intricacies of the veterinary care market. With increases in corporatization, maldistribution of veterinarians, and shifts in producer and consumer composition, the need for research is increasing rapidly.

Another area in need of more research is in the realm of rural veterinary medicine. As previously mentioned, there are several shortage areas throughout the United States, particularly in rural areas. Recent literature suggests that veterinarians are increasingly less likely to locate practices in rural areas (Wang, Hennessy, and Park, 2016). Location of veterinary practices is largely driven by local median incomes but only partially driven by population (though one could argue that population and income are highly correlated). What is still unknown is how to incentivize veterinarians to locate in rural areas to provide these communities with veterinary care over the long term.

Animal Ethics

As the animal protein supply chain continues to have reduced contact with the human population (Goldsmith and Martin, 2006), and the global demand for animal protein increases with population and wealth (Alexandratos and Bruinsma, 2012), there is bound to be conflict between livestock production practices and consumer beliefs about animal welfare (see, for example, Norwood and Lusk, 2011). This is not a new challenge but rather one that will continue to evolve. Opportunities will exist for economists to work with veterinary professionals to evaluate consumer preferences for how animal proteins arrive to them as a final product and how the livestock producer can respond to those preferences in an economically viable and humane fashion. Alternatively, there is an opportunity for these collaborations to provide the public with information about the costs to the consumer in terms of price and availability under their desired production preferences. The Farm System Reform Act of 2019 (116th Congress, S.3221), which would place a moratorium on large, concentrated animal feed operations, is a clear representation of the need for applied economists and veterinary science professionals to collaborate on sustainable solutions to align our moral concern for animals with our demand for animal protein.

The topic of animal rights and welfare extends well beyond food animal production. Animal use in rodeo, racing, and other competitive sport relies on the involvement of veterinarians to improve the performance of the animals while ensuring and enhancing their welfare. Ethical consideration of companion animals is widespread; yet, according to the ASPCA, animal shelters in the United States euthanize approximately 1.5 million unwanted animals annually at great expense to communities. Additionally, animals are used in the production of movies and television shows, product testing, pharmaceutical development, and scientific research. Markets represent the appropriate mechanism by which society manages these topics, with veterinarians and economists leading the discussions.

The Future of Veterinary Economics

In short, the study of veterinary economics is rapidly evolving. While animal health economics is still a large component of the field, the umbrella of veterinary economics is large enough to cover topics related to the human aspects of veterinary medicine. However, there is much we can adopt from the well-developed field of animal health economics. First, we believe a global consortium on the broad issues of veterinary economics is warranted. Much like the International Society for Economics and Social Sciences of Animal Health, an international working group on veterinary economics would facilitate a critical mass of researchers to address the most pressing issues facing the global veterinary medicine industry. In addition, an international working group would provide the means to incorporate a transdisciplinary cohort of scientists. This area of study requires expertise from diverse fields, including animal science, human medicine, environmental sciences, engineering, and many others. The solutions to tomorrow's problems in veterinary medicine require a systems approach.

More specific to the economics side of the field, we must go beyond the cost-benefit mentality of transdisciplinary work. Economics provides the opportunity to use theoretical and empirical methodology to solve pressing issues in veterinary medicine. The key to expanding the field of veterinary economics is in training the next generation of veterinary economists and developing tools from the broad scope of economics education. Offering classes that explore topics in veterinary economics will be a necessity so that more economists are exposed to the field. The agricultural and applied economics profession is primed for capitalizing on this expanding opportunity. This profession is the leader in the space of animal health economics and has the training to pursue relevant research funding. Besides, those economists who are now embedded in veterinary medicine programs and organizations were trained under the umbrella of agricultural economics. The future of veterinary economics is bright and needs more economists working in the field. So we ask, if not us, then who?

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Author Information: Clinton L. Neill (cln64@cornell.edu) is Assistant Professor of Veterinary Economics and Management, Department of Population Medicine and Diagnostic Services, and Dyson School of Applied Economics and Management, Cornell University, Ithaca, NY. Matthew J. Salois (msalois@avma.org) is Chief Economist and Director, Veterinary Economics Division, American Veterinary Medical Association, Schaumburg, IL. Ryan Blake Williams (ryan.b.williams@ttu.edu) is Associate Professor of Economics and Public Policy, School of Veterinary Medicine, Texas Tech University, Amarillo, TX.

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