

# The Future of Food Supply Veterinary Medicine: What the FSVMC-Bayer Study Tells us and How Can AABP Use this Information?

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## Abstract

The Food Supply Veterinary Medical Coalition (FSVMC) was formed in 2004 with a mission to assure the public that food continues to be abundant, safe and wholesome by ensuring that veterinarians are appropriately involved throughout the food supply system. The premise of the Coalition is that food production is enhanced, both in safety and wholesomeness, when veterinarians are included in all steps of production and processing. Listed alphabetically, the following organizations are the founding members of the Food Supply Veterinary Medical Coalition (FSVMC): American Association of Avian Pathologists, American Association of Bovine Practitioners, American Association of Food Hygiene Veterinarians, American Association of Small Ruminants Practitioners, American Association of Swine Veterinarians, American Association of Veterinary Medical Colleges, American Veterinary Medical Association, Association of Veterinary Consultants, and the USDA Food Safety and Inspection Service. Although not officially a member, the Canadian Veterinary Medical Association was very supportive of this research program, and was instrumental in data collection in Canada.

This study was commissioned by the FSVMC in May 2004 to implement a far reaching research program to examine the demand and supply trends for food animal veterinarians and the issues shaping those trends. The study was funded by the FSVMC and a grant from Bayer Animal Health. Similar in spirit to earlier extensive research on the veterinary profession provided in the KPMG mega study and the Pew report,<sup>4,16</sup> the final report, entitled "Estimating FSVM Demand and Maintaining the Availability of Veterinarians for Careers in Food Supply Related Disciplines in the United States and Canada" consists of over 1600 pages that describe many different studies on various facets of the supply and demand for food supply veterinarians. Representing 16 months of literature review, data collection and analysis, the entire report can be found at the following website: [http://www.avma.org/public\\_health/fsvmc/fsvmc\\_toc.asp](http://www.avma.org/public_health/fsvmc/fsvmc_toc.asp). Three summary articles have also been

published in the *Journal of the American Veterinary Medical Association (JAVMA)* that highlight the major findings from the research program. The first article<sup>8</sup> deals with veterinary student career path attraction to food production medicine in the USA and Canada. The second article,<sup>1</sup> examines career switching and the retention of food supply veterinarians in the career. The third article<sup>15</sup> addresses the patterns of growing demand for food supply veterinarians. Each article contains recommendations to improve the profession based directly upon the results from this research.

The research program that examined demand issues from 2004 thru 2016 in food supply medicine was comprised of thirteen panels of experts who participated in a multiple-round Delphi forecasting exercise. The research program addressing career attraction and career retention issues consisted of 17 studies, seven focus group studies and ten surveys, which provided insight into FSVM career path attraction and retention in the United States and Canada. Unlike some previous studies, this study found that there will likely be a 4% to 5% yearly shortfall in bovine-interested veterinarians graduating from US and Canadian veterinary colleges over the next 10 years. As demand for these veterinarians will rise only a modest 1% per year, most of this shortfall will be due to a lack of supply of new bovine-interested veterinary college graduates. To alleviate this shortfall, multiple tactics were suggested to: increase the likelihood of recruiting bovine-interested veterinary students into veterinary college, create cattle interest in students already in veterinary college, help these students as they begin their careers post-graduation, and provide further ongoing support to prevent them from switching from bovine medicine in their first five years of practice.

## Résumé

La *Food Supply Veterinary Medical Coalition* (FSVMC) fut fondée en 2004 avec la mission de garantir au public un approvisionnement constant et abondant de nourriture saine et sans danger pour la santé, en

s'assurant que les vétérinaires prennent la place qui leur revient dans le domaine de l'approvisionnement alimentaire. La Coalition se base sur la prémisse que la production de nourriture bénéficie, à la fois en innocuité et en qualité, de l'implication des vétérinaires dans toutes les étapes de la production et de la transformation. Par ordre alphabétique, les organisations fondatrices de la *Food Supply Veterinary Medical Coalition* (FSVMC) sont les suivantes : la *American Association of Avian Pathologists*, la *American Association of Bovine Practitioners* (AABP), la *American Association of Food Hygiene Veterinarians*, la *American Association of Small Ruminants Practitioners*, la *American Association of Swine Veterinarians*, la *American Association of Veterinary Medical Colleges*, la *American Veterinary Medical Association*, la *Association of Veterinary Consultants* et la *Food Safety and Inspection Service* du département de l'agriculture des États-Unis. Bien qu'elle ne soit pas un membre officiel, l'Association canadienne des médecins vétérinaires a largement appuyé ce programme de recherche, pour lequel elle a recueilli les données au Canada.

En 2004, la FSVMC a lancé un vaste programme de recherche pour examiner l'offre et la demande sur le marché du travail des vétérinaires spécialisés dans le domaine des animaux de consommation et les facteurs qui influencent leur disponibilité professionnelle. L'étude a été financée par la FSVMC et avec une allocation de Bayer Animal Health. Le rapport final était conforme à l'esprit de la méga-étude KPMG et du rapport Pew<sup>4, 16</sup>. Intitulé « *Estimating FSVM Demand and Maintaining the Availability of Veterinarians for Careers in Food Supply Related Disciplines in the United States and Canada* », il relate plus de 1600 pages d'études sur les divers aspects de l'offre et de la demande des vétérinaires du domaine de l'approvisionnement alimentaire. Colligeant 16 mois de recherche bibliographique, de cueillette de données et d'analyse, le rapport complet peut être consulté sur le site Web suivant : [http://www.avma.org/public\\_health/fsvmc/fsvmc\\_toc.asp](http://www.avma.org/public_health/fsvmc/fsvmc_toc.asp). Trois articles publiés dans le *Journal of the American Veterinary Medical Association* (JAVMA) résument la recherche en mettant en lumière les principales conclusions de celle-ci. Le premier article<sup>8</sup> traite des facteurs qui poussent les étudiants en médecine vétérinaire à se spécialiser en médecine des animaux de production aux É.-U. et au Canada. Le second article<sup>7</sup> examine les changements de carrière et ce qui aide à maintenir les vétérinaires dans le domaine de l'approvisionnement alimentaire. Quant au troisième article<sup>15</sup>, il s'attaque à décrire la demande croissante des vétérinaires dans ce domaine précis. Ces trois articles proposent des façons d'améliorer la profession, sur la base des conclusions de la recherche.

Pour examiner la demande en médecins

vétérinaires du domaine de l'approvisionnement alimentaire prévue entre 2004 et 2016, le programme a réuni 13 équipes d'experts dans un exercice de prévision selon la méthode Delphi en plusieurs rondes. Une autre recherche, rassemblant 17 études, sept rapports d'autant de groupes de discussion et dix enquêtes, a donné une bonne idée de ce qui attire et retient les médecins vétérinaires dans le domaine de l'approvisionnement alimentaire aux États-Unis et au Canada. Contrairement à des recherches publiées auparavant, cette étude a indiqué qu'il fallait s'attendre à une pénurie annuelle de 4 % à 5 % de vétérinaires spécialisés dans les bovins diplômés des collèges vétérinaires américains et canadiens au cours des dix prochaines années. Comme la demande en vétérinaires de ce domaine n'augmentera que d'un modeste 1 % par an, la grande part de cette pénurie proviendra du manque de nouveaux vétérinaires diplômés intéressés par les bovins. Pour remédier à cette pénurie, plusieurs tactiques ont été suggérées, dans le but : d'accroître le recrutement d'étudiants intéressés par les bovins dans les collèges vétérinaires, de stimuler l'intérêt envers les bovins chez les étudiants déjà dans un collège vétérinaire, d'aider ces étudiants dans leur début de carrière et de les appuyer par la suite pour les empêcher de quitter la médecine bovine au cours de leurs cinq premières années de pratique.

## Introduction

The future demand and supply for food supply veterinary medicine (FSVM) professionals has been the topic of much debate and discussion. Many experts from academia, industry and government have concluded that the North American veterinary profession is facing a shortage of food animal veterinarians in the public, private, industrial and academic sectors<sup>6,18</sup>. Various societal trends and economic events have led to growing concerns about these issues<sup>11,21</sup>. Driving forces affecting the supply and demand of FSVM professionals range from worries about food safety, public health and animal welfare to negative consequences from changing dietary habits to industrial consolidation in agribusiness and the threat of bioterrorism/agroterrorism. These changes and threats have the potential for altering the structure of labor markets and the future demand for FSVM professionals. In addition, the threat of zoonotic diseases, public anxiety about biodiversity, and the impact of large and highly concentrated food production systems on the environment are expected to influence the supply and demand for food supply veterinarians.<sup>2,3,5,12</sup> While this large study focused on supply and demand issues for multiple food supply veterinary medicine career paths, this paper will primarily focus on the results of the study that are of interest to bovine practitioners.

## Determining Factors That Attract and Retain Interest in Bovine Medicine

### *Data Gathering Methodology*

One portion of this research program assessed student and practitioner recruitment, job selection and career retention in the field of food supply veterinary medicine and the shape of future demand for food supply veterinarians. The first JAVMA article<sup>8</sup> examined issues surrounding the supply of food animal veterinarians. This article examined a series of factors that influence veterinary students to select different career paths, and evaluated the effectiveness of potential strategies for increasing the number of students who will consider a food animal career. A pervasive theme throughout this entire research project was a strong focus on understanding the phenomenon from the perspective of the “customer.” As such, the investigators tried to gain insight into career focus issues by directly asking the opinions of students and faculty. The latter group was thought to have unique insight into student motivations because of their exposure to a broad cross-section of students and their ability to observe them over time.

The methodology for conducting the “career attraction” portion of the study was the use of three surveys and interviews with four focus groups (at two colleges of veterinary medicine). The two colleges chosen (Kansas State University and the University of California at Davis) were selected because each had major food animal programs in beef and dairy cattle, and were located in states with a strong agricultural industry. The first focus group at each college consisted of 12 students in the first month of their veterinary school education, and the second group was comprised of 11 veterinary medical school faculty members representing a variety of disciplines. The focus group sessions began with the focus group moderator introducing the researchers, the topic being discussed, discussion guidelines, and a short self-introduction of each participant. Participants next engaged in a short written exercise designed to focus their thinking on the topics to be covered during the session. Following this activity the main discussion took place, typically covering five to seven topic areas. At the end of each focus group, a summary of the session was offered by the researchers, and the participants were debriefed on the purpose of the study.

The purpose of these four focus group interviews was to provide initial insight into the existing and emerging factors, both societal and economic, affecting the applicant pool of students attracted to food supply veterinary medicine. Specifically the investigators sought to better understand the factors that influence a student’s career path focus (i.e., a food animal career focus versus other options such as companion animals and equine).

Based on the results of these focus group inter-

views, and an extensive review of the literature on careers in veterinary medicine, general human resources and career selection, and job commitment, three surveys were developed to obtain information from first-year veterinary students, third- and fourth-year veterinary students, and Deans and faculty members at veterinary medical schools. The surveys were internet based and were conducted using e-mail addresses for faculty and students at all 32 colleges of veterinary medicine in the United States and Canada. Data from each survey was imported into the statistical program SPSS 13.0 for analysis.

### *Career Decision Factor Results*

Focus group participants identified nine factors as primary issues influencing the initial career focus of students as they entered veterinary school: life experiences, educational debt and salary, important and interesting work, family considerations, job availability, physical demands, lifestyle issues, animal care mentality and school experiences.

Results of two regression analyses indicate that those students planning to work with food animals after graduation 1) have higher levels of food animal experience prior to entering veterinary college, 2) have a desire to live in smaller-sized communities, 3) perceive that they will be able to fully utilize their veterinary knowledge in food animal medicine, 4) believe that small animal medicine is not prestigious, 5) have a production animal orientation, 6) tend to have a significant other, 7) are uncertain about the future of food animal medicine, 8) are not concerned about the physical aspects of food animal medicine, and 9) tend to be male.

### *Conclusions About Increasing the Supply of Food Animal (Bovine) Veterinarians*

Based upon information gleaned from the focus groups and surveys, interviews with faculty, and a review of the veterinary career literature, the study authors developed a list of sixteen strategies that might be used to encourage more students to consider food animal (bovine-oriented) veterinary careers. They evaluated the efficacy of these strategies from a variety of perspectives including first year students, third and fourth year students, and veterinary school Deans and faculty. The three groups rated each of the 16 strategies on their effectiveness in encouraging more students to consider food animal medicine careers (1 = very ineffective, 7 = very effective). On the basis of the analysis of this data, the authors recommended the following 13 strategies for increasing the supply of food animal (bovine) veterinarians:

- Colleges of veterinary medicine should target students from rural areas that have significant

food production experience.

- Professional veterinary associations, firms in industry and government agencies should increase the number and dollar amounts of scholarship funds reserved for veterinary students pursuing a food animal career.
- Students that concentrate in food animal medicine should participate in paid summer externship in practice, industry, or the government sector.
- Develop and disseminate information that accurately reflects the varied career duties of a food supply veterinarian in an effort to promote the idea that FSVM careers will allow one to fully utilize his/her veterinary knowledge.
- Educate students in both pre-veterinary programs and in initial years of veterinary school on issues related to the proper handling of large animals in order to overcome concerns about the physical aspects of a FSVM career.
- Professional veterinary associations should provide seminars, tutorials and other forms of advice and assistance in helping new veterinary school graduates establish food animal practices.
- Students that specialize in food animal medicine should receive financial assistance in the form of tuition relief for each year that they work in this occupational area in an underserved area of their state, as well as low interest loans or grants to cover the costs of start-up equipment.
- Veterinary students should receive greater exposure to the benefits of careers in food animal veterinary medicine. This exposure should include paid summer externship opportunities, increased numbers of food animal faculty, treatment of food animals in the first semester of veterinary college, increased numbers of food animal courses, orientation sessions focused on food animal careers, and further study into creating regional centers of excellence.
- Veterinary students in food animal medicine should receive career selection assistance through assigned, enthusiastic faculty role models and dedicated job placement services.
- Professional veterinary associations should actively promote the benefits of a food animal veterinary career to all constituencies with an emphasis on how careers in this area provide meaningful work of importance to the nation and society, allowing one to fully utilize his/her medical training.
- Professional veterinary medical associations should establish formal programs that get their members involved with high school students, either in group presentations or one-on-one

mentoring, in order to provide early food animal career exposure to potential students prior to college.

- Colleges of veterinary medicine should provide courses in the first year of study that cover the basic tenants of production animal medicine in order to provide exposure to students who lack this experience in their background.
- Government, industry and professional associations should actively communicate with veterinary students regarding the job opportunities available to food animal veterinarians in their respective areas.

### **Preventing Food Supply (Bovine) Veterinarians From Switching Careers**

One major concern in the demand and supply of food supply veterinarians deals with career switching and commitment. In order to create meaningful strategies aimed at increasing student and practitioner commitment in this area, a thorough understanding of the forces influencing switching and career retention in the field of food supply veterinary medicine (FSVM) was needed. This research generated information about students and practitioners that changed from food animal medicine to other occupational areas in the veterinary profession. Three studies were conducted to examine job satisfaction, changes in occupational area, and commitment to a career in Food Supply Veterinary Medicine. Study one examined the career focus switching behavior of students during their veterinary education. Study two examined occupational commitment, job satisfaction and occupational switching behavior among food animal veterinarians who had graduated within the past five years. Study three assessed current employment challenges, occupational commitment, occupational stress, job satisfaction and turnover intentions among more senior veterinarians (i.e., those that had been in the workforce for six or more years).

### **Career Switching Among Students**

Career switching is a minor phenomenon that occurs with low frequency among students in colleges of veterinary medicine. Only about one in five fourth-year veterinary students reported that they had changed their career focus to an area that was different from what they originally intended when they entered veterinary medical school.

The overwhelming factor that generated this switching in career focus was the development of a new interest as a result of course work. Exposure to new material in courses interested students so much that they decided to explore new areas of veterinary medi-

cine as a career option. Comparing the few food animal students that did switch to a new occupational area in veterinary medicine with those that changed from companion animal medicine, those switching out of the food animal area were concerned with time demands from being on-call, being unable to make full use of their medical/surgical skills, and not making enough money to pay off student loans. This finding is surprising in light of the fact that employed food animal veterinarians report they can make full use of their medical skills, make more money on average than companion animal veterinarians, and do not experience more time management issues than other occupational areas. It should be noted that these are reported by students as being minor reasons for changing occupational areas from food animal medicine when compared to the development of new interests through course work as a motivating factor. An opportunity exists for colleges of veterinary medicine to develop FSVM interest among students focusing in other areas, and to retain those currently interested in FSVM careers by developing and offering interesting and exciting courses focused on FSVM in the first year of veterinary college. Whenever possible, the selection of positive faculty role models should be utilized to teach these courses.

### **Career Switching Among Employed Veterinarians**

Early career veterinarians in the food animal sector are satisfied in their current job and do not intend to leave it. When comparing food animal medicine to other areas of the veterinary profession, this group reports a high degree of satisfaction. This may be one reason that contributes to the low turnover rate despite the fact that many have desirable career options outside of food animal medicine and many job offers. The few that did change occupational areas during the first five years of work were asked what motivated them to switch jobs. The important drivers included the desire for a more balanced life between work/family and more recreational/cultural activities. Early career job changers had less pride and enthusiasm for food animal medicine, low job satisfaction and many attractive career alternatives.

Career switching is also uncommon among employed veterinarians that worked six or more years. Most senior veterinarians that had changed jobs stated they were happy in their former positions and that they had received adequate benefits, worked for a stable employer in a desirable area, and were able to use their medical/surgical skills. The main reason that employed senior veterinarians left their former jobs was because they received a more attractive offer in an alternative employment setting.

The high praise for the life of a food animal veteri-

narian as reported by those who actually perform this career explains much about the low levels of turnover in the profession. Senior food animal veterinarians said they were satisfied, proud and enthusiastic about their careers. They prefer food animal medicine to other areas in the profession and do not intend to leave it. Information regarding the high levels of job satisfaction and low turnover intentions among both early and senior career food supply veterinarians should be shared with veterinary students in the early stages of their career selection process.

### **Future Demand and Probable Shortages for Food Supply (Bovine) Veterinarians**

In the food supply veterinary medicine (FSVM) area, there has been growing concern and some controversy over the adequacy of both the future supply of veterinarians and the extent that demand for their services will either decline or grow. Many conclude that FSVM, and veterinary medicine in general, is being pressured by multiple professional and societal forces and is at a crossroads.<sup>13</sup> There have been multiple authors who suggest that the veterinary profession is undergoing profound changes and must adapt to new demands.<sup>7,10,11,14,17</sup> Consolidation in the food system and the increasing size of producer operations where veterinarians serve has had a large impact on food supply veterinarians, dramatically changing the skill sets required of them as they focus on herd health systems rather than individual animal interventions.<sup>9</sup> There are many additional changes, including globalization of the food supply system, changing societal trends (including urbanization and the changing gender composition of the veterinary workforce<sup>21</sup>), and emerging new needs that FSVM professionals have a unique capability to address. There are increasing demands for countering emerging disease threats that affect both animal and human health, and related concerns about biodiversity and the impact of highly concentrated food animal operations on the environment.

The KPMG Mega Study<sup>4</sup> projected future demand for all veterinarians from 1997 to 2015. This study found strong increasing demand for companion animal veterinarians. However, the picture for food supply veterinarians presented by the Mega Study authors was bleak. They concluded that over the 18 year forecast period (1997-2015), there will be 0% growth in demand in the academic and government sectors, and a -1.7% decline in demand for veterinarians in the private large animal practices.

### **Future Demand Research Methodology**

Predicting and understanding the future of a com-

plex profession such as FSVM is never an easy task, and the changing larger context of this profession makes the simple linear extrapolation of historical trends with econometric models, as was used in the KPMG Mega Study, more problematic. Historical trend forecasting techniques, such as econometric models, are informative where there are clear underlying economic or social phenomena that can be accurately measured and will have a continuing stable relationship to the variables being predicted. There is also a basic assumption that new predictors will not emerge to alter the historical causes of the criterion of interest. In a changing profession, such as FSVM, econometric predictors will be suspect as new causes emerge and the historical relationship between predictors and criteria change in non-linear ways.

Expert judgment-based forecasting methods, such as the Delphi forecasting method, is an alternative to historical trend-based methods and is more appropriate for such changing situations. It is a useful method for identifying emerging trends that will drive future demand and supply, the likely patterns of future demand, and the likely match between supply and demand for food supply veterinarians in the future. In contrast to the KPMG Mega Study that used a single mathematical function of the economic factors to predict the future in all veterinary medicine sectors, the Delphi method can draw on insights of experts from different sectors and provide unique forecasts for the diverse sectors of the FSVM profession. The Delphi method<sup>19,20</sup> works well with a strategic planning process. It is useful in identifying trends that can be changed with strategic initiatives, as well as larger societal and economic factors that are less likely to be directly changed. It is designed to identify leverage points that are important to affect strategic initiatives.

In this study, the Delphi forecasting process was used to evaluate 13 different sectors of the FSVM profession. The FSVM sectors evaluated were:

- Six areas of practice: dairy, swine, poultry, beef cattle, small ruminants, and mixed food animal practitioners in rural settings,
- Five areas of government: state and provincial government service, three sectors of US Federal Government service (public health, animal health, and food safety and security), and Canadian Federal Government service, and
- Food supply veterinarians serving in industrial roles in pharmaceutical companies, and in academic roles in university settings.

These 13 sectors capture the major segments of the FSVM profession. Experts for the Delphi panel associated with each of these 13 sectors were identified

through a nomination process and their participation was solicited.

The Delphi method gathers expert opinion and provides a structured feedback process over multiple surveys. In this study, three survey rounds were used. After the initial data-gathering round, panel experts had an opportunity to consider the views of other experts on two successive rounds. By using internet-based surveys, experts were able to make new predictions without the dysfunctional group dynamics that often plague interacting groups. It sets up a learning process where experts have an opportunity to reconsider their judgments in the face of conflicting viewpoints. The feedback process used in the second and third surveys included a summary report that noted trends and identified data patterns that explained some differing views seen in each panel's survey replies (e.g., the views of those predicting more extreme versus less extreme patterns of labor demand). Also, item averages and the interquartile ranges (the range of replies for those between the 25th and 75th percentiles) were incorporated into the second and third surveys so that the data patterns from the prior survey could be easily reviewed while making the new ratings and forecasts. This process was intended to make each Delphi panel collectively "smarter" at the end of the process.

Each of the three surveys had a similar general design and required experts to:

- Rate the influence of 25 different factors on future demand in their sector. These items were gathered from the FSVM literature and helped them think through the issues driving demand.
- Predict the expected changes in demand in their sector in each of five time periods between 2004 and 2016.
- Rate the influence of 17 different factors gathered from the FSVM literature on the expected supply of veterinarians entering FSVM careers in their sector.
- Forecast the expected future shortages or surpluses of veterinarians for five time periods between 2004 and 2016 in their sector.
- In the final survey, an additional section had panel experts rate the effectiveness of 18 different strategies for eliminating the shortage of veterinarians in their particular sector.

### The Projected Shortage of Bovine Veterinarians

The expert panels concluded that, given current trends, we will see consistent manpower shortages through the 2016 forecast period. Table 1 shows the estimated manpower shortages projected. It can be seen that all bovine-related FSVM fields are estimated to

**Table 1.** Average future shortages in cattle-related FSVM (2004-2016).

Delphi Panel Sector	Mean %	Median %	Mid-50%	SD	N
Industrial - Pharmaceutical	-3.30 <sup>b,c</sup>	-2.8	-.8 to -5.1	3.78	12
Dairy	-3.80 <sup>b,c,d</sup>	-3.5	-1.6 to -5.4	3.24	21
State/Provincial Government	-4.85 <sup>b,c,d</sup>	-4.3	-1.8 to -6.6	4.79	36
Federal – Public Health	-5.24 <sup>b,c,d</sup>	-4.9	-3.0 to -8.6	3.78	12
Beef Cattle	-5.40 <sup>b,c,d</sup>	-4.6	-2.2 to -6.5	5.46	20
Federal – Canada	-5.45 <sup>b,c,d</sup>	-4.6	-3.3 to -7.1	3.64	10
Academe	-5.46 <sup>b,c,d</sup>	-5.0	-3.0 to -7.3	4.00	19
Federal – Food Safety & Security	-6.57 <sup>b,c,d</sup>	-5.3	-3.8 to -8.6	6.01	14
Mixed Food Animal	-6.60 <sup>c,d</sup>	-5.8	-2.9 to -9.8	5.00	20
Federal – Animal Health	-6.86 <sup>d</sup>	-5.6	-2.5 to -9.9	5.16	14

Notes:

1. The “Mean %” and “Median %” is the percent shortage (or surplus) averaged over five time periods for each panel. The “Mid-50%” is the interquartile range (middle 50% of estimates). “SD” is the Standard Deviation and “N” is the panel sample size. Negative numbers (-) indicate shortages.
2. There is an overall significant difference ( $p < .001$ ) between panel means (using a One-Way ANOVA test). The Duncan’s multiple range test was used to identify homogeneous subgroups. A common superscripted letter (<sup>a,b,c</sup>) identifies homogeneous subgroups where there are no significant differences. Panel means without a common letter are significantly different from one another.
3. The shortage/surplus estimates for each of five time periods from 2004 to 2016 were used to form the average shortage scale. These estimates were highly correlated and produced a strong single factor in a principal components analysis. The scale had a Cronbach’s alpha reliability coefficient of .77.

have significant shortages of manpower over the next 10 years. The mean overall shortage for bovine-related FSVM fields is approximately 5% per year. This means that for every 100 veterinarians needed in these fields, only 95 veterinarians will be available! Coupling this was the Delphi panels’ projection of an approximate increase in demand of 1% per year, the implication of this study is that there will be a significant shortage of bovine-related veterinarians over the next 10 years.

**Potential Tactics for Decreasing the Projected Shortage of Bovine Veterinarians**

Eighteen different tactics for lessening shortages were identified and each panel rated the effectiveness of each in eliminating shortages in their sector in the final survey. Based on their responses and the other findings in this study, the following recommendations can be made to improve the supply of and demand for future bovine-interested veterinarians:

- The profession should reconsider how colleges of veterinary medicine select, retain and educate students for food supply careers. Colleges need adequate resources to accomplish this task and must make difficult choices between competing demands.
- Private bovine practitioners and the larger bovine-related profession need to be a part of any solution. Initiatives are needed that will provide

career support and mentoring for students and early-career veterinarians. These efforts will continue the revitalized professional development process started in veterinary colleges and insure that we have an adequate cadre of bovine veterinarians.

- Student debt reduction and scholarship programs for students that enter into areas of need should be expanded. Both government and privately sponsored programs will likely be needed to eliminate a financial barrier to pursuing a bovine medical career.
- The shortages of veterinarians needed for government FSVM roles is a particularly striking result. The need to protect the public and the integrity of the global food supply system is an important priority, and having an adequate number of veterinarians in these roles is key. Developing effective partnerships with private veterinarians, particularly in rural areas, may help lessen the burdens presently placed on government food supply veterinarians and create a more effective system.
- Given the complexity of this change process, it is particularly important to have a systematic evaluation system that will track progress towards solving the shortage problem. An effective strategy must have multiple tactics focused on many outcomes. It is unlikely that all efforts will be perfectly implemented. Evaluating these

change efforts will provide opportunities for learning and improving on initial efforts.

- The future demand for bovine services is not the looming problem some have feared. The conservative demand increases projected by the Delphi experts will adequately sustain the bovine profession in most sectors. If labor shortages can be resolved, then opportunities to improve demand should logically be pursued.
- The unique skill sets that veterinarians can offer to clients can add value beyond the cost of their services. Utilization of technology, better practice management models, and a focus on emerging high-demand needs will increase demand for bovine veterinary services.
- The challenge of consolidation in the food supply system must be pursued as an opportunity. It will be a threat only if veterinarians do not adapt to this widespread reality. There are veterinarians that have established themselves as good examples that need to be studied. The learning points from these models need to be understood and communicated for all to benefit. Providing high value service for client operations will provide the economic platform for improving incomes, and this could contribute to resolving future labor supply problems before they arrive.

### Conclusions

Results of this study provide a substantial empirical basis for understanding the dynamics that will impact bovine-related veterinary career paths over the next 10 years. The supply and demand issues that have been described provide points of reference and leverage points for strategic initiatives. The picture of future demand opportunities and problematic labor shortages should motivate the American Association of Bovine Practitioners (AABP) as an organization, and all bovine medicine-interested practitioners, to work with all relevant stakeholders to change the projected patterns forecasted. The listing of tactics for resolving these issues is a good starting point, and other tactics can be developed. The future collective health and economic well-being of the US and Canada are at stake, not to mention the long-term viability of AABP as an organization. This study, commissioned by the FSVM Coalition, has helped us to

better understand the magnitude of the problem. Now it is up to all interested bovine practitioners to help develop and create the solutions.

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