

Food Animal Veterinarians: An Endangered Species?

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Are Too Few Veterinary Graduates Choosing Food Animal Practice? What is the Problem?

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Introduction

Are too few veterinary graduates choosing food animal practice? What is the problem? The answers to these questions are multidimensional and require consideration of relevant background of veterinary demographics, veterinary education, veterinary students, animal agriculture, private and public food animal practice, veterinary licensing systems, and changes which have occurred, or not occurred, in the last few decades. The problem is not confined to the number of veterinary graduates choosing food animal practice; it is much larger. The major shift in orientation of veterinary students towards small animal practice and away from other important sectors of veterinary medicine is a concern.

We are living in a time of rapid social, political, economic, and technologic change. Many of these changes are profoundly altering the veterinary profession and the kind of services that the public requires from veterinarians. A consideration of veterinary history reveals that when veterinary colleges educated veterinarians to address important contemporary needs of society, the profession flourished, but when they have not, veterinarians were held in low esteem and the profession and veterinary education were neglected (Pritchard 1993). In 1998, it was said, The time is opportune to change the focus of the veterinary medical profession from animal

disease to animal health in all its dimensions (Pritchard 1988).

It is remarkable how veterinary colleges and the profession worldwide are facing similar questions about their future at the same time. Colleges are changing their curricula, licensing authorities are considering changes in the requirements for licensure to practice, and the demographics of veterinary students have changed. Forty years ago students had similar backgrounds and a mixed animal practice outlook, while today students are more diversified and have specific professional goals.

Historically, the political justification for the establishment and maintenance of veterinary colleges was animal agriculture. The 31 veterinary colleges in North America were established primarily to educate veterinarians to serve animal agriculture. Many practitioners reminded us that most of the colleges were founded as part of the land grant universities under the Morrill Act of 1862. Originally these universities started as agricultural and technical schools. What about the terms of reference of the veterinary colleges now? Who should be concerned?

In this paper, I briefly summarize several studies of veterinary education and the profession published in the last 14 years, followed by a review of veterinary employment information, before addressing the question about too few graduates choosing food animal veterinary medicine as careers, and some potential solutions.

Reports on Veterinary Education and the Profession Last 15 Years

Several reports on veterinary education and the profession have been published in the last 15 years which focus on similar themes about the state and future of the veterinary profession. They are important to consider in any discussion of the future of food animal veterinary medicine.

PEW Report. In 1988, the PEW Report on Future Directions for Veterinary Medicine described the history of veterinary medicine, its successes and what needed to be done to meet the needs of society (Pritchard 1988).

Its recommendation included:

1. Change the focus of the veterinary medical profession from animal disease to animal health in all its dimensions.
2. Abandon the unrealistic concept of the universal veterinarian who can minister to the health needs of all creatures great and small.
3. Restructure veterinary practice to better serve the needs of society and the veterinary profession in the future.
4. Make research a higher priority for individual veterinarians, the veterinary medical profession, and for veterinary medical Colleges.
5. Establish a more rational system of funding for veterinary medical research.
6. Improve the quality of veterinary services delivered to all species of animals in response to the escalating expectations of the public as to the health of all animals important to people.

7. Strengthen the general education of veterinarians.
8. Focus the education process and the practice of veterinary medicine on the ability to find and use information rather than on the accumulation of facts.
9. Strengthen the basic biological science of the veterinary medical curriculum.
10. Make the achievement of educational, experiential, and cultural, racial and ethnic diversity among veterinarians a goal of veterinary education.
11. Reorient clinical veterinary education to enable a student to elect in-depth instruction and clinical experience with a practice theme (class of animals or a single species), rather than require all students to obtain clinical experience with numerous species.
12. Change the emphasis in the veterinary curriculum from almost total concentration on clinical practice to include important public sector needs for veterinarians.
13. Move towards a national perspective or strategy of veterinary medical education.

The U. S. Livestock Market for Veterinary Medical Services and Products (1995) indicated that ***The fundamental task for food animal veterinarians is to shift from a fee-for-service or task oriented business relationship to to fee-for-advice or information oriented business relationship that is focused on the financial performance of the livestock enterprise .***

If the food animal practitioner desires more income compared to other opportunities, then they will have to **increase the value of their veterinary services**. This means that veterinary services must account for a greater part of the costs of livestock production than they have been in the past. This means that routine tasks must be done by veterinary technicians at a lower cost to the producer.

AVMA-KPMG Report. In 1999, the KPMG Report sponsored by the American Veterinary Medical Association, the American Animal Hospital Association, and the American Association of Veterinary Medical Colleges focused on economic and lifestyle issues (Brown & Silverman 1999). Questions posed, including the adequacy of veterinarians incomes, the effect of women in the profession, the global demand for veterinary services, the inefficiency of the delivery system, the supply of graduates, and the skills, knowledge, attitude, and aptitude of veterinary students and veterinarians.

CVMA Report. In 1998, a Task Force of the Canadian Veterinary Medical Association published a report on the Future of the Veterinary Profession in Canada, *Veterinary Medicine in Canada: Opportunity for Renewal (CVMA 1998)*.

Concerns included the lack of diversity of graduates, a potential surplus of veterinarians trained for clinical practice and a deficit of veterinarians for many non-practice activities such as food safety and environmental veterinary medicine. The high percentage of women entering the profession, and the excessively high academic entry prerequisite were concerns because there is no data to suggest that academically superior students become better veterinarians. Also, the high

percentage of veterinary students who choose small animal practice after graduation may cause an oversupply of small animal practitioners.

Three issues in **veterinary education** were identified which required immediate attention for the veterinary profession to remain relevant in the 21st century; the changing curriculum and making it relevant to societal changes; post-DVM/retraining programs and continuing veterinary education and veterinary extension; and recognition and rewarding of good teaching. In 1997, a CVMA membership survey on limited licensure and undergraduate clinical tracking, a majority of Canadian veterinarians did not support either limited licensure or tracking; 69% and 60%, respectively. Yet the Canadian veterinary colleges were being criticized for not providing enough specialization or specialty clinic rotations and certain segments of society and business were demanding that veterinarians be highly skilled in specialized areas. The Task Force stated that our veterinary colleges must educate generalists but simultaneously provide exposure in specialized areas for interested students.

To enable students to acquire increased practical expertise, it was recommended that the core curriculum be confined to the first 3 years. The final 12 months should consist of college rotations, paid practice externships, and approved electives of the students' choice, which may include exposure to research, industry, government, and other non-practice environments.

To solve many of the problems facing the profession, it was suggested that selective, specific and short term post-graduate DVM programs encompassing both clinical exposure opportunities such as internships and graduate degrees should be encouraged. Time spent in post-DVM education in whatever form is more productive and efficient than an equal time spent in pre-veterinary education. Graduate education is an essential component of veterinary colleges, and is another way of raising the level of the DVM to meet consumer expectations or societal relevance. These programs could also be used to upgrade practitioners wishing to update or enhance their skills in one specific field of veterinary medicine or to make career changes.

The report called for a National Action Plan to fulfill the common vision of the profession in Canada, namely: ***The profession will be composed of carefully selected and educated veterinarians, providing optimal animal health to serve the needs of society while achieving professional growth and personal fulfilment.***

RCVS Consultation Document. Veterinary Education and Training: A Framework for 2010 and Beyond. Veterinary surgeons in the UK were consulted about the education needs of the profession from 2010 to 2020 (RCVS 2001). A strategic review of the education and training needs of the profession was done to ensure that the College's policy on undergraduate provision, continuing professional development and postgraduate training adequately reflected the anticipated future needs of the profession. The terms of reference were to undertake a review of the key issues

facing education and training in the veterinary profession, and to formulate a draft education strategy for the College to meet those challenges over the next ten years, taking into account the following areas:

- the need to confirm the College's definition of threshold standards of professional competence;
- the role of employers and practices in the education and training of new veterinarians;
- whether registration should continue to be life-long (re-accreditation/revalidation) and the likely impact of any changes in policy on the education system;
- the College's future policy on continuing professional development;
- the role of postgraduate certificates and diplomas.

Undergraduate tracking was not supported based on the belief that there is considerable value in retaining the breadth of the current veterinary degree with its opportunities for comparative study across the species. Most schools in the U. K. have introduced a core-elective curriculum plus electives, and have rationalized course content, freeing up time previously spent on didactic teaching in favor of problem-based and self-directed approaches to learning. It was concluded that the following broad principles should be retained:

- the veterinary degree course should continue to provide a broad, vocationally directed, science-based education sufficient to prepare graduates for lifelong development within their veterinary careers.
- the primary concerns of the course should continue to be the well-being of animals and the protection of public health
- the degree should cover clinical training across all common, domestic species at the level of threshold (Day 1) competencies, but allow some choice for additional study in mixed practice, individual species, or disciplines within electives.
- generic clinical skills, such as history taking, problem solving, sample/data collection and evaluation and communication skills, must be emphasized, and in order that students understand the context in which they are learning from an early stage in the course, extra-mural studies should continue to play an essential role in the education of undergraduates.

Extra-mural studies or rotations in veterinary practices or other areas of veterinary activity such as veterinary public health, diagnostic laboratories, research laboratories and government offices are considered a successful part of the clinical education of veterinary students in the U.K. Only practices and other institutions which attain certain standards should be recognized by the schools and the Royal College as appropriate places for extra-mural teaching. There are two distinct components: animal husbandry extra-mural rotations are done in first and second year, and the clinical extra-mural studies in the clinical years.

Essential Competencies. The RCVS drafted guidelines on the essential competencies of the new veterinary graduate (Day One Skills). The specification of Day 1 competencies is, by implication, the starting point for continuing education and training, and continuing professional development.

The Professional Training Phase. A professional training phase leading to a licence to practice in a specific veterinary area, would build on the educational base provided by the undergraduate curriculum. This phase would be undertaken in defined areas, in practices registered for that area, such as companion animals, production animals, equine, mixed practice or meat and food safety. Only satisfactory completion of the professional training phase would lead to granting a license to practice. The professional training phase could also be taken in a non-practice environment such as state veterinary medicine.

Effective June 2002, the Royal College of Veterinary Surgeons began Stage 1 of a Pilot Study to test the validity and usefulness of Year 1 competencies and skills list (RCVS 2002b). Ten new graduates from each of the six veterinary schools will participate in the study. Stage 2 of the Pilot study, from 2003, will involve a similar sized group of new graduates, and will test out the feasibility of the professional training phase from the perspective both of the graduates and their employing practices, following their progress for two years.

CVMA Task Force on Education, Licensing, and The Expanding Scope of Veterinary Practice. (Prescott et al. 2002)

The CVMA Task Force on Education, Licensing, and the Expanding Scope of Veterinary Practice in its opening statement said **Concern has been expressed that the relatively narrow and inflexible education and licensing system limits the development of the veterinary profession** . (Prescott et al. 2002).

In defining the problem facing veterinary medical education and licensing the CVMA Task Force said:

From the perspective of the future of the veterinary profession, small animal practice has come to dominate veterinary medicine at the expense of other important veterinary needs. There is a shortage of veterinarians entering non-companion animal practice fields that used to be well served by veterinarians (food animal practice, veterinary public health) and important areas of potential growth including biomedical research and ecosystem health. However, to view the veterinary profession only as a dichotomy does an injustice to the broad range of veterinary practice in different animal species and non-practice areas of the profession, all of which have become and will continue to become increasingly specialized and complex.

There is no reason to think that the major trends observed over the last 40 years will not continue into the future. Has the time come to recognize this and to move in a formal way to a new stage in the evolution of the veterinary profession?

Strengths and Weaknesses of the Current Veterinary Education and Licensing

System

The strengths and weaknesses of the current veterinary education and licensing system have been described by the Canadian Veterinary Medical Association Task Force on Education, Licensing, and the Expanding Scope of Veterinary Practice (Prescott et al. 2002)

A. Veterinary education system

Strengths:

It attracts intelligent, well educated and highly motivated students to the profession and provides a broad ranging education which exposes students to a wide range of topics.

There is a strong comparative medicine base, so that students can extrapolate across species.

The faculty are dedicated, highly qualified and work in publically funded institutions with strong academic bases.

There is the opportunity to learn entry level clinical skills in many areas. Graduates have the flexibility to practice in diverse areas, and to change practice areas without restriction by the licensing system. In addition, there is a common standard, since graduates must pass the common North American Veterinary Licensing Examination (NAVLE).

Weaknesses:

The vast amounts of material to be covered, which is largely aimed at the generalist veterinarian, with great breadth but perhaps little true depth.

Mastering this increasing volume of material is very hard on students, and is getting harder every year.

The generalist paradigm of veterinary education may waste clinical resources as well as student's intellectual capacity and potential. It is difficult to add anything extra to a packed curriculum, so that new topics or understanding are undeveloped.

Many new graduates are under-confident and tend to go into small animal practice, perhaps partly because this is the option they most readily understand, but also because the majority of students intended anyway to practice small animal medicine when they entered veterinary Colleges.

There is a distinct lack of interest by many students in certain areas, notably food animals. The current system serves agriculture poorly: there may be an inadequate caseload in food animals, partly because of biosecurity issues, most students have no background in agriculture, and students who do may not be encouraged as much as they could be.

A packed curriculum aimed at the generalist veterinarian does not encourage developing the existing or potential diversity of the profession. The packed curriculum may also result in students having a narrow conception of what a veterinarian is or could become, since many students operate at the managing-to-survive level.

Other problems are that veterinary teaching hospitals are focused on tertiary care and externship programs are relatively short. In addition, evaluation of clinical performance of students in their final year is difficult and unreliable. There is no formal, required, internship after graduation. High student debt load and high starting salaries in practice in fact may discourage further education, although statistics on recent graduates in the United States suggests that entry level competence concern may in fact exceed concern about high debt load. High student debt load discourages adding an extra year to the program. A fifth year has in fact recently been added to the program at the Faculté de Médecine Vétérinaire in St Hyacinthe, although this reflects unique features of the pre-university CEGEP system in Québec.

In summary, the explosion of knowledge, the increasing complexity and standards of the different groups served by veterinary medicine, the changing nature of employment opportunities for veterinarians, and the increasingly high costs of education for students make education of the universal or generalist veterinarian for existing needs extremely difficult. In addition, the very wide but low (in terms of depth) door through which all graduates now enter may inhibit the profession from taking advantage of the expanding opportunities for the profession to better serve society in fields such as public and ecosystem health.

B. Veterinary licensing system

Strengths:

The integration of Canadian and United States systems through the NAVLE. There is flexibility for veterinarians to practice in diverse areas, and to change practice areas without restriction by a licensing system.

Weaknesses:

Licensing bodies lack the resources to conduct evidence-based evaluation of the competence of new graduates or for competency-assurance. They have devolved the responsibilities for assuring entry-level competence to the Colleges. The DVM degree is a general license to practice in which competency issues are addressed through the complaints process and which relies on practitioners to confine their practice activities to the areas in which they are competent.

The licensing system is largely run provincially by practitioners, which inevitably maintains the *status quo*.

There is no on-going re-certification program and the current licensing system does not recognize special training or skills unless an individual is Board certified.

Summary of Reports on Veterinary Education and the Profession

The important findings of these reports are:

Veterinary medicine has a public responsibility to serve the needs of society
 Veterinary students and new graduates are not participating in the broad scope and diverse sectors of the profession. There has been a major shift of student interest to small animal practice and away from non-companion animal veterinary medical careers

Animal agriculture is not being well served by veterinary medicine because of a declining student interest and inadequate numbers of highly qualified veterinarians in all aspects of food animal veterinary education.

In the recruitment of students there is an excessive emphasis on high academic records at expense of other attributes considered necessary to be a successful veterinarian

Because of the massive increase in knowledge, the overcrowded curriculum, and the many clinical skills to be acquired, students find it impossible to learn and become competent and confident at graduation. The generalist paradigm of the curriculum is unsatisfactory.

There are concerns about the skills, knowledge, attitudes and aptitudes of veterinary students and new graduates.

The undergraduate curriculum needs to be changed to allow a core curriculum in first two to three years, and an in-depth clinical experience in a practice theme in the private or public sector in fourth year (variations of streaming or tracking in fourth year). An objective should be the achievement of essential competencies on graduation (Day 1)

Extramural studies or practitioner externships are will become important and a necessary part of the education of veterinary students.

The consequences on the profession of the high percentage (75 to 90%) of women entering profession are uncertain. Females work part time and do not want to invest financially in private practices. The future of private practice is now a concern.

Postgraduate professional training phase (Mandatory internship) and competencies at the end of Year 1 may be desirable

Recognition of the importance and rewarding of good teaching

Too few veterinarians engaged in research careers. Insufficient high quality research. Failure of veterinary colleges to expose students to research careers.

Importance of postgraduate continuing education and lifelong learning

The income of veterinarians is inadequate

Employment of Veterinarians in United States, Canada, United Kingdom and Australia

United States

In the United States in 2001, of those veterinarians in private clinical practice (75% of total), approximately 74% were engaged in small animals, 8% in mixed

animals, 4% in large animal exclusive, 6.9% in large animal predominant, 4.5% in equine practice; and other activities accounted for 3.5%.

In 2001, veterinarians in public and corporate veterinary medicine, colleges and universities accounted for 46%, federal government 7.7%, state or local government 6.3%, uniformed services 5.3%, industrial 17%, and other 17%.

In 2000 and 2001, approximately 50 to 55% of new graduates entered small animal practice, 10% mixed animal practice, 5 to 6% large animal practice, 2 to 3% equine practice, 23% took advanced studies mostly internships, and 4% entered other activities including governmental veterinary service, industrial veterinary medicine and military veterinary medicine. It is clear that the majority of new graduates entered small animal practice and the percentage continues to increase annually.

Canada

In Canada, in 2002, of veterinarians in private clinical practice (78% of total), 55% were in small animal, 29% in mixed animal, and 14% in large animal practice.

Demographic Survey of Veterinarians in Ontario. In a survey of veterinarians in Ontario in 2002, it was shown that the number of large animal veterinarians in Ontario has been decreasing, attributable to two factors (Osborne 2002). First, there is a natural migration from large animal practice throughout the career of a veterinarian. One-half of the veterinarians who began their careers in large animal practice leave after the first year of practice, and another 10 percent leave within the next five years. For the next 30 years, there is status quo. That is to say, "If you can survive the first five years, you will stay for 30." The number one reason for leaving large animal practice was being on call too much. The second most important issue was inadequate salary, followed by working conditions and then health problems. A redistribution of work away from large animal practice and toward small animal practice was the fifth most important reason cited. The second factor contributing to a declining number of large animal veterinarians is a declining interest in large animal medicine. Since the 1950s, there has been a clear trend away from large animal practice. In the fifties and sixties, more than 70 percent of veterinarians practiced large animal medicine at some point in their career. This started to fall off in the seventies, and has fallen to 40 percent. The combination of declining interest coupled with a natural migration away from large animal practice has created fewer large animal veterinarians today than there were yesterday.

United Kingdom

In the U. K. in 2002, 73.5% of time spent in general practice was in small animals, 8.4% in equine practice, 7.5% in cattle, 1.3% in sheep, 0.4 % in swine, 0.2% in poultry, 1.0% in exotic animals, 1.1% in meat hygiene, 0.1% in fish, 2.7% in licensed veterinary investigation, 3% in practice management, and 0.4% in other activities (RCVS 2002a)

Australia

In 2001, the average amount of time devoted to each species on a national level was: dogs 50%, cats 28%, horses 10%, cattle 10%, sheep 1%, pigs <1%, poultry <1% and other species <3% (Heath & Niethé 2002).

Almost all private practitioners reported spending some time on dogs and cats, but more than half did no work at all with the other species listed. For example, 51% did no work with horses and another 31% spent no more than 10%; only 11% of private practitioners reported spending more than 20% of their time with horses. The situation was similar for cattle: 58% did no work and another 23% 10% or less of their time with them. Only 14% reported spending more than 20% of their time with cattle. In the case of sheep, 81% did no work and only 1% spent more than 10% of their time with sheep. Less than 10% did any work with pigs or with poultry, and less than 1% spent more than 10% of their time with them.

In the cities, 54% of time was spent on dogs and 35% on cats, but in country towns those percentages were 41% and 22%.

There was also a difference between male and female practitioners in country towns. Whereas the average male spent an average of 54% of his time on dogs and cats, the percentage for females was 79%. There was little difference between males and females in the cities, except that males on average reported spending more time with horses than did females.

In summary, services being offered by the veterinary profession across Australia are increasingly being focused on the pet-owning community. These trends are occurring not only in urban centers but also throughout rural and regional Australia. These findings, together with the shift in gender balance, clearly indicate that the profession is undergoing change on a scale never experienced before and probably unparalleled in any other profession. These changes present major challenges for those responsible for making decisions which will influence the future of veterinarians in the Australian community.

Survey of Veterinary Students in United States 2002

Upcoming third and fourth year veterinary students in 27 U. S. veterinary colleges in 2002 were asked if they anticipated making a career in food animal practice (Wren 2002). The responses were varied and ranged from 2% to 40% of students expressing an interest in food animal practice or mixed animal practice. Considering all colleges, only an average of 10 to 15% of students are interested in food animal practice as career. However, at Kansas State, 25% of the graduates of 2001 accepted positions with a food animal component. For some colleges, less than 10 students of classes of 80 to 100 students expressed an interest in food animal practice as a career.

The situation is similar at every veterinary school. People still want to be veterinarians, but the face of student body has changed. There are more women students in veterinary schools (often outnumbering male students), and there is a dramatic reduction in students wanting to pursue food animal medicine.

This is causing a crisis in the food animal medicine world. Who will be the bovine and other food animal practitioners of the future? Who will take over for those veterinarians retiring or leaving practice or fill new veterinary needs? This will definitely be a critical issue for the American Association of Bovine Practitioners and food animal practices in the next 10 and more years as practitioners retire and want to sell their practices to younger colleagues, says in-coming AABP President Patty Scharko. There are many opportunities for typical food animal practice or mixed practice, but today's graduates want more free time and less long and full weeks. It's often difficult to get new graduates out into the country.

There is a significant need for food animal veterinarians, especially in the smaller towns of rural America, says Dr. R. Smith, President of the Academy of Veterinary Consultants (AVC), which represents feedlot and beef cattle veterinarians. Those areas also need veterinary services for other food animals, horses and small animals, so there is also a great opportunity for mixed animal practitioners.

Survey of Students of Western College of Veterinary Medicine

Students of the Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, were surveyed in October 2002. All students were asked to indicate their professional preference when admitted to the veterinary college and their current interest. At admission 17%, 41% and 22% of all students were interested in small animal exclusive, mixed large animal predominant and small animals, and mixed small animal predominant and large animals, respectively. One percent were interested in dairy cattle practice, 7% equine practice and small animals, 3% beef cattle, and 0% in swine practice. Seven percent were interested in careers such as academia, research, wildlife, poultry, drug industry and regulatory veterinary medicine.

The current interest of Classes 2003, 2004 and 2005 are 24% in small animal exclusive, 38% in mixed large animal predominant and small animals, 18% in mixed small animal predominant and large animals. Three percent are interested in dairy cattle practice, equine practice predominant and small animals 5%, 1% beef cattle practice, 1% in swine practice, and 10% in other careers. Why are so few interested in a career in a species specific food animal practice career?

Summary of Veterinary Manpower Situation

Within the last 10 to 15 years, there has been a major increase in the percentage of veterinarians in North America and elsewhere entering small animal practice either directly after graduation, or after being in mixed or large animal practice for a few years. Concurrently, there has been a major decline in the number of new graduates entering and remaining in mixed animal or food animal practice. There has also been a similar decline in interest of new graduates in veterinary public health and regulatory veterinary medicine, ironically, at a time when food safety and quality are major concerns of society.

Is the Profession Losing Its Way?

In his paper *Is the profession losing its way?*, Nielsen makes three assumptions about the veterinary profession which are necessary to accept in any discussion about its future: 1. the profession deals with health and disease in vertebrates (including people); 2. it has comparative medicine as its foundation; and 3. it serves society as its principal purpose (Nielsen 2001).

According to Nielsen the specific signs that the profession is losing its way are as follows:

- the profession is disinterested in vertebrate health problems and issues associated with environmental degradation;
- failure to sustain its academic and research base;
- serious erosion or stagnation of its laboratory infrastructure;
- failure to provide graduates with sufficiently high entry level competence to practice modern health and production management in food producing animal herds;
- very low participation rates in the clinical specialty boards and colleges;
- increasingly disproportionate share of its members occupied in small animal practice with too few in other sectors of the profession;
- low participation in public health and ecosystem health;
- leadership preoccupied with shorter term economic issues.

Are Too Few Veterinary Graduates Choosing Food Animal Practice? What Is the Problem?

In recent years, new veterinary graduates have shown a declining interest in food animal veterinary medicine in both private and public practice. There are many vacancies and opportunities in all sectors of private food animal practice including mixed animal practice, and specialty practices in dairy cattle, beef cow-calf, beef feedlots, and swine. There are also many opportunities in public practice including food safety and inspection service, and regulatory veterinary medicine. There also has been a growing shortage of new graduates entering research and teaching careers, and in diagnostic laboratories.

The magnitude of the shortage has not been documented but in the last 10 years many practitioners have found it difficult to recruit new graduates into food animal practice, especially in rural veterinary practice.

Potential Implications and Consequences. The potential consequences of this lack of participation in private and public food animal veterinary medicine are increased vulnerability of livestock industries to exotic diseases, increased public health risks from food safety and quality problems, lowered public confidence in animal agriculture, threats to the national economy and standards of living, and loss of opportunities for veterinarians to meet the needs of the livestock industries. A shortage of veterinarians to serve these sectors will lead to a loss of veterinary

expertise and skills necessary to educate the next generation. Competitors with the skills and knowledge will seize the opportunities, and push veterinary medicine to the side because we have failed to respond to changing circumstances and new societal needs (King 2000a).

A declining interest in food animal veterinary medicine also may result in veterinary colleges reducing resources for large animal clinics, the closure of teaching ambulatory clinics and discontinue support of externships in food animal practice. Food animal faculty may not be recruited or developed in the same numbers as before, and current food animal faculty positions vacated for whatever reason may be reallocated to other areas namely small animals. Also, the number of postgraduate students decreases, research programs decline or disappear, and most importantly, undergraduate students are not exposed to careers in food animal veterinary medicine. The failure of the veterinary profession to adequately serve food animal agriculture is then inevitable.

There is a larger picture here. It is not just about food animal veterinary medicine. Enhancing the diversity of the profession may not involve expanding into new areas but rather encouraging students to seriously consider the diversity which is already available within veterinary medicine. The lack of interest of veterinary students and recent graduates in non-companion animal activities may not only be depriving them of potentially lucrative and stimulating career opportunities in non-traditional, non-private practice fields but also may result in a lack of veterinarians in areas critical to society.

Basis for this Presentation

This presentation is based on my personal experience of teaching veterinary students for many years, being interested in veterinary education, and E-mail and letter responses from 85 bovine practitioners on the AABP-List serve to a list of questions submitted in September 2002, and with the same questions, interviewing four focus groups of large animal practitioners in Alberta, October 2002.

This paper deals with the issues listed below and provides some potential solutions to the question: ***Are Too Few Veterinary Graduates Choosing Food Animal Practice? What is the Problem?***

Five issues were considered.

- 1. Needs and Expectations of Society***
- 2. Background of Veterinary Students and Their Preveterinary Education***
- 3. The Veterinary Curriculum***
- 4. The New Veterinary Graduate***
- 5. Food Animal Practice (Private and Public)***

- 1. Needs and Expectations of Society**

Expectations of Clientele and Society

Remarkable trends and changes are occurring in society's expectations of all sectors of the veterinary profession. Animal owners expect competent service and are willing to pay or invest in the costs necessary.

Modern progressive livestock producers have capital investments of millions of dollars and they want cost effective animal health and production veterinary services.

Consumers are concerned about food safety, especially drug residues in meat and milk, and the possible transference of antimicrobial resistant bacteria from animals to humans through the food supply. Farm animal welfare is a major concern because of the intensification of food animal agriculture.

Food Animal Agriculture

Food animal agriculture accounts for a very large part of the economy of Canada and the United States, not only from farm cash receipts but from the spin-off economic activities in processing and domestic and international marketing, and retail marketing of meat, milk, eggs and other animal derived products.

Large and dynamic changes are occurring in animal agriculture. Production units are enlarging and food producing industries are becoming integrated. Owners and managers of livestock enterprises, while fewer in number, are becoming increasingly educated, informed, and sophisticated as they rapidly assimilate new technologies. The world population is increasing along with demands for animal derived protein and fibre which needs to be produced more efficiently and economically as margins decline and off-farm costs increase.

With all of these changes, it would appear that the present and future requirements for food animal veterinarians should be strong. Despite this, there is a growing shortage of food animal veterinarians in North America who are competent to provide profitable services to livestock farms with little evidence that this situation will soon be reversed. This situation partly reflects the current demographics, in which less than 2% of the North American population is agriculturally based. The primary pool from which food animal veterinarians traditionally might reasonably be drawn is relatively small, as is the segment of the national electorate which understands and supports animal agriculture.

The livestock industry has high expectations of veterinarians and considers the costs of veterinary service to be an important investment in profitable animal production.

Dichotomy Between Companion Animal and Food Animal Veterinary Medicine

There is a dichotomy between companion animal and food animal veterinary medicine which influences decisions which veterinary graduates make about entering which kind of practice. These differences also influence veterinary education.

Companion Animal Veterinary Medicine

In recent history, in developed countries, more people means more pets and more small animal veterinarians. This has resulted in many small animal practices and much duplication of facilities and resources. Most small animal practice is done in clinics; a very small amount is done by making house calls to provide veterinary care. However, demographically there may be less demand for small animal practice in the next decade.

Most new veterinary graduates feel more competent and confident to enter general small animal practice than they do for food animal practice.

Pet Superstores with small animal clinics are becoming common which is leading to a corporate structure for small animal practice.

Small animal practice provides opportunities for veterinarians to work part time; a few days per week without causing any disruption in client veterinary relationships. This is a major advantage for female veterinarians.

Clients are not very knowledgeable about small animal medicine and do very little veterinary medicine on their pets.

Individual animal is fundamental and most care of small animals is almost exclusively individual animal oriented.

Small animal practices now routinely send vaccination and health check reminders to clients about their pets.

The companion animal bond is important and students are taught it well.

The family pet can be an emotional issue. Family members love their pets.

Euthanasia of pets is a major issue and in general a last resort especially for owners who are attached emotionally to their pets and wish to spend large sums of money to provide veterinary care to prolong the life of animal.

Economics not a major factor for some clients. However, some clients are unable to afford the high costs of difficult or complex cases which may require extensive diagnostic work and surgery and follow-up medication.

Clients do not see the veterinarian do many diagnostic or therapeutic procedures; most is done in the absence of the owner.

Veterinary technicians are now an integral and necessary component of small animal practice.

Clients believe that veterinarians are very knowledgeable and skilled

Clients are very grateful to their veterinarian for the care to the pet and bring thank-you cards, flowers, cakes and cookies to veterinary clinic.

Many opportunities available in small animal practices.

Small animal practice may be very sophisticated. Many clinical specialties can be applied (at least 26)

Food Animal Veterinary Medicine

The herd of animals is fundamental. Emphasis continues to grow on veterinary services which are health management and production oriented with a concurrent decline in individual animal medicine.

Most veterinary service is provided on the farm; a small amount is done in large animal clinics.

Most food animal veterinarians live and work in rural communities.

Meeting the veterinary needs of a progressive livestock producer is a fulltime career for progressive food animal practitioner; it is not a part time job.

The producer sees almost everything the veterinarian does first hand and evaluates and judges competence on the spot.

The progressive producer is knowledgeable about health and production and does more and more veterinary procedures on own.

Producers may complain about the costs of veterinary services and may not be as grateful to the veterinarian who has worked all night on emergency calls.

Economic viability is critical. Veterinarians are linked economically to the economic prosperity or failure of livestock producers. The results of health and production management advice given by the veterinarian, and implemented by the producer are commonly long term and not readily appreciated.

Culling, slaughter, and euthanasia are common options if cases are not easily and economically treatable.

Untreatable diseases frustrating to the student and new graduate.

The number of food animal practices is not growing.

Number of food animal species specialists growing, albeit slowly.

Much more difficult for the new graduate to be competent and confident compared to small animal practice. Some feel competent to enter mixed animal practice. Very few choose practices which confine their services to one of the species such as dairy cattle, beef-cow calf, beef feedlot, swine, or veterinary public health.

2. Background of Veterinary Students and Their Preveterinary Education

Veterinary Students

Veterinary students are academically superior based on high academic grades in preveterinary courses. About 20 years ago, the numbers of females entering the profession began to increase rapidly and now, depending on the veterinary college surveyed, 75 to 90% of the students are females. Most students are from urban backgrounds and only a very small percentage have had meaningful animal farm backgrounds. This may be a reflection of the small percentage of the population, less than 2%, which now make up the farm population. (A meaningful farm animal background is one in which the person has worked with animals on a regular basis, helped to make a primary living from farm animals, and understands the essentials of agricultural economics applied to an animal farm). Historically, the veterinary graduate with a farm background usually was comfortable and confident working with farm animals and more easily identified with a rural lifestyle. The small percentage of students with farm backgrounds may be related to the small percentage of graduates entering farm animal practice although this is controversial.

Increasingly, students in their first few years of veterinary college have decided on their career goals and most are interested in small animal practice. In the last decade, an increasing percentage of students would have preferred an undergraduate clinical tracking program in a single species in their clinical years. However, 20 to 30% of students, or even higher in some colleges, prefer a mixed animal species clinical program usually because they are uncertain of what they want to do after graduation and wish to maintain their options.

Recruitment of Students into Food Animal Veterinary Medicine. The challenge for the veterinary profession is: How will it recruit a sufficient number of students to pursue a full-time career in food animal veterinary medicine in the broadest concept which includes both private and public practice?

In a survey of graduates from the Ontario Veterinary College between 1982 and 1986, those from a rural background were 3.7 times more likely to have entered large animal practice; those from a farm background, 3.02 times more likely (Lissemore & Stowe 1989). Before admission, a higher percentage of women expressed an interest in small animals and the percentage increased dramatically by graduation. Before admission and by graduation, the percentage of men interested in large animals was greater than for women. Less than 50% of those who entered large animal practice at graduation remained in large animal practice; most who left moved into industry, government, or research and academia. Of the graduates from 1982 to 1986, those interested in small animals on admission, 87% were still engaged in small animals in 1988 and only 28% interested in large animals were still in large animals.

Attraction to the veterinary profession starts early at an early age. For example, 50% of Atlantic Veterinary College students report that they decided to become a veterinarian by age 10. In an Australian study published in 1996, 30% of students had made their decision to become a veterinarian by age 12 and most while they were still in school; only 9% decided after they were 18 years old. Interestingly, in both studies, women reported making a veterinary career choice earlier than men.

To promote diversity in the applicant pool, the profession needs to portray itself to young children as doing more than ministering to the needs of companion animals (pets). This could be done through school visits by veterinarians, through mentoring of young students in 4H, by organizing VetCamps (for school-age students but being careful to portray the diversity of the profession at such camps). Interestingly the male:female ratio at the Atlantic Veterinary College VetCamp (for students in grades 6,7, and 8) is 20:80 the same ratio as for applicants interviewed, and admitted pools of DVM students. The profession is simply not capturing the interest of males.

In a longitudinal Australian study men and women were asked to rank the factors most important in their decision to study veterinary medicine. Men listed a desire to be independent of bosses and the financial attractiveness of veterinary practice (they can find these attributes in other, often more lucrative careers). Women listed a love of animals, the image of veterinarians as portrayed in TV programs, an interest as a child in living things, and an interest in the scientific study of disease.

A recent survey of veterinary students in the United States identified some characteristics of students in third and fourth years who have decided to pursue a career in food animal medicine, and what their expectations are for this career (Wren 2002). To help understand where the future food animal students might come from, it's important to take a look at the current students who are planning to pursue food animal medicine. Perhaps by understanding what type of students are interested in bovine medicine now, the industry will be able to develop programs to target, recruit and retain veterinary students who want to be a part of the food animal profession. A selection of their comments about why they are interested in food animal practice is as follows.

Simon Alexander from the University of Pennsylvania says, for him, practicing food animal medicine is the only way to stay a part of agriculture. Farmers are some of the best people I know, and I can't imagine a better job than helping them with their herds, he says.

For Les Williams of Mississippi State, after realizing that his career was in veterinary medicine, the food animal aspect was a given. Because of my love for all areas of beef production, I naturally aligned my career plans along with food animal medicine.

Steven Hjartarson's own experience at home with livestock initiated his interest in food animal production and medicine. These interests grew throughout my undergraduate, as well as veterinary courses, the Washington State student says. I enjoy the people and locations of food animal/mixed animal practices.

The father of University of Missouri's Jason Nickell is a food animal practitioner, and the majority of his practice is devoted to food animal medicine.

Because of this, the veterinary profession and the ups and downs of food animal practice became commonplace, Nickell said. At first, I had no interest in pursuing a DVM. However, I soon recognized that I had a very strong interest in veterinary medicine with a strong focus in food animal medicine. I also enjoy communicating with the clients.

Animal Science Students. Many students majoring in animal science, especially those with a meaningful farm animal background, desire to enter veterinary medicine but have been unable to compete with urban students with higher academic grades. Selecting the best of these animal science students, based on their potential to complete the professional course, and who have the greatest potential to contribute positively to food animal veterinary medicine, directly into an quota undergraduate program in food animal veterinary medicine could be a consideration.

Admissions Procedures. The selection of veterinary students is a highly controversial topic. The process is not scientific but in part empirical. The subject has been addressed in several recent papers (Kogan & McConnell 2001; Turnwald et al. 2001a and 2001b and McConnell & Kogan 2001). Most colleges claim that they attempt to select the best and the brightest. Traditionally, academic performance in

the students preveterinary education (GPA), and a standardized national examination like the GRE, have been used to select students for an interview. Academic performance is usually weighted more heavily in the final selection than the results of the interview or other attributes of the applicants. Eighty-four percent of veterinary schools in North America interview applicants. Seventy-two percent of the colleges fix the interview weight in the selection process at about 28% (Turnwald et al. 2001a).

Veterinary practitioners have commonly said the emphasis should not be on the academic record (cognitive attributes) but equal emphasis should be on non-cognitive attributes such as practical intelligence, industriousness, self-disciplined, orientation to service, leadership qualities, good social skills, insights into the veterinary profession, communication skills and personal effectiveness. The College of Veterinary Medicine, University of Colorado, now uses subjective criteria as the sole method of selecting veterinary students (McConnell & Kogan 2001).

While Intelligence Quotient (IQ) test scores and college grades correlate well, they are only weak measures of potential for practical intelligence (Sternberg & Kaufman 1998). Intelligence has been redefined to incorporate practical knowledge so that real life is where intelligence operates and not in the classroom. The true measure of success is not how well one does in school, but how well one does in life .

The value of meritocratic tests like the Scholastic Assessment Test and the Graduate Record Examination, which are similar to IQ tests, in predicting later success in life has been seriously questioned. These tests cannot measure key frontal-lobe abilities, or those which are generally regarded as essential to human intelligence and which make us truly flexible, adaptable, and survivors in a complex world. In fact, although IQ scores correlate reasonably well with school grades, they correlate only weakly with measures of creativity, and they generally account for only about 10% of variation in the success of individuals in later life (Sternberg & Kaufman 1998).

Frontal-lobe abilities, which are not measured in meritocratic tests, include those such as planning, organization, and the integration of complex information to perform sequential tasks. Analytical abilities are required to analyze and evaluate the options available to oneself in life. They include things such as identifying the existence of a problem, defining the nature of the problem, setting up a strategy for solving the problem, and monitoring one's solution to the problem (Sternberg & Kaufman 1998). All of this seems very relevant to the kinds of abilities we would like to identify in prospective veterinary students. It begs the question: How well are we selecting veterinary students?

The animal and veterinary related experiences of prospective students should be evaluated and given appropriate priority. Students with a meaningful farm animal background and a desire to pursue food animal practice should be given equal opportunity if they have an optimal academic potential for completing the professional program. Some veterinarians feel that students with a rural address should be given preference rather than give high priority to grades achieved as a preveterinary student. One speaker at this conference, a dairy cattle practitioner from California, when asked how he would select students for his practice, replied.... go check out the

men's football team and select the athletes....we need athletes in my kind of practice...and, select those with a rural address .

Also, perhaps it is time to consider an equity program for male students. Many veterinary practitioners expressed the view that the gender balance should be about equal. Why not have 50% females and 50% males? In North America, we already have an equity program for aboriginal students whose grades may not be as high as many of the other applicants, and who are considered as a separate pool of applicants.

Preveterinary Education

The preveterinary education in North America varies from a minimum of two years up to four years of a Baccalaureate degree. Many veterinary students have had several years of university education on entry into veterinary college in North America. Most preveterinary curricula do not require an agricultural emphasis nor a requirement for studies concerning the diversity and scope of the veterinary profession. Increasing the number of students who will pursue a career in food animal practice may be possible if there were a requirement to study animal agricultural courses. Many veterinarians and veterinary students contend that the preveterinary education is too long and could be shortened with the time saved used more specifically during the veterinary curriculum and after graduation in a mandatory internship. No more than two years of preveterinary education are required but a broad liberal university education is still highly desirable.

Karg (2000) has suggested an *in-depth course* in Introduction to Veterinary Medicine in the preveterinary curriculum which would inform prospective students of the scope and diversity of the profession.

3. The Veterinary Curriculum

The Omniscient Veterinary Graduate

From about 1950 to 1990, the curriculum of most veterinary colleges emphasized the education of the generalist, also known as the so-called omniscient veterinarian, who could provide service to all animal species, primarily domestic animals. The profession has had a long held belief that its strength was in being generalists. Our credos have included: *We understand the principles of veterinary medicine and science which can be applied to all species . Our strength has been in comparative medicine .* Traditionally, in their clinical years, students experienced all the species and discipline rotations and graduated with varying degrees of clinical expertise. They knew something about almost everything and could provide elementary veterinary service to all species. We have said to students, We have taught you the principles, you can now go into practice and acquire the knowledge and skills to provide the service to any sector of society . That omniscience was feasible and possible 25 years ago when the knowledge base was smaller and, more importantly, clinical skills were less advanced, and when

clients then did not have the high expectations they now have. However, many mixed animal practice owners today still prefer the veterinary graduate be competent in all species.

The PEW Report (1998) said, **It no longer makes sense for the profession to cling to an inaccurate and outdated view of the capacity of a veterinarian. The time when an individual could reasonably be expected to possess the needed skills and knowledge to minister to the health and needs of kinds of animals at a level acceptable to the public is long gone. It is an important part of the profession's history; but it has no validity now, and will certainly not be valid in the 21st century. It is important to recognize this reality for it affects many things that the profession does. The concept of a universal veterinarian is an anachronism, and it should be buried with honour. The impossible dream-the DVM who can provide the health care of all creatures great and small is inhibiting the progress of the profession. It is at the very root of the very serious problems facing veterinary education issues today** (Pritchard 1988).

Omnicompetence is unnecessary, undesirable, not possible, frustrating for clinical instructors, and students, and wasteful of resources (Halliwell 1999). It also could be argued that omnicompetence has held back progress in veterinary medicine and veterinary science. Spending all of our efforts on being a generalist has not allowed us to become advanced in specific fields. No longer can every veterinarian know something useful about everything. In fact, continued omnicompetence could result in *omni-incompetence*. Many veterinarians may be overtrained to do the things they are doing and undertrained for the opportunities available.

In preparing for the 21st Century in food animal medicine and companion animal medicine it has been suggested that two objectives are necessary (Blackwell 2001).

First, there must be adequate coverage of the core biomedical science subjects in the first two years, and possibly in part of the third year. Second, the remaining clinical semesters must be focused on the student career choice; that is ***species specific***. Such a system has been in place at the School of Veterinary Medicine, University of California for 30 years (Cardinet III et al. 1992).

Veterinary students should experience the richness of the basic sciences (the core curriculum) and then be given the opportunity to concentrate their education (species or discipline specialization) on the basis of their professional goals and the needs of society. (Radostits & Prescott 2001). **The core curriculum prepares students for the specialized curriculum of their choice.**

If 75-90% of our veterinary students in North America are interested in a small animal practice career, does it make any educational sense to require them to learn the specific food animal courses, including the clinical rotations, merely because they must pass the North American Veterinary Licensing Examination (NAVLE)? Why not concentrate the faculty and college resources, on the students who ***desire*** a career in food animal veterinary medicine? One can easily imagine the excitement in teaching and learning which would occur if the relevant faculty concentrated their efforts on the

food animal students in an undergraduate program beginning in first year with ever increasing emphasis throughout the four year DVM course? Graduates from such a program would be much more competent and confident than the traditional graduate, and further, would likely pursue their careers as lifelong learners with a much greater understanding. Still further, it is likely that a higher percentage would remain in food animal practice if they feel competent and confident, and empowered about by what they are doing. An interest in teaching and research careers would also be expected.

Undergraduate Tracking Programs. *Veterinary medicine has evolved into a vast array of specialties.* The body of veterinary medical knowledge has expanded to such an extent that it becomes less feasible each year to expect that a student can be taught all essential information within four years. The logical step to take is to allow students to concentrate their education on the basis of their desired career path. Veterinary colleges have various tracking and electives, but the student is still bound by the North American Veterinary Licensing Examination (NAVLE) to acquire knowledge in all aspects. If there is a reformation, to allow for speciation of the degree, the student and the colleges can be liberated to make more choices (Karg 2000).

There are several logical reasons for undergraduate tracking, and ultimately, designated licensure. The body of knowledge in each area of veterinary has expanded to the point where it is a challenge to master. It is often said that veterinary colleges attempt to teach everything to every student. In reality, veterinary colleges have continued to emulate human medicine with an emphasis on individual animal medicine. As a result there is a dichotomy between how companion animal medicine and food animal health and production management are taught, and learned (see earlier). Companion animal medicine is individual animal oriented, and students are exposed to highly sophisticated diagnostic equipment and extensive use of the laboratory. Most new graduates feel reasonably competent and comfortable to begin providing service in small animal practice after graduation.

Food animal health and production management on the other hand, is constrained by economics, is much more herd oriented, and it is **much more difficult** to teach students to be competent and comfortable to provide veterinary service to the modern livestock industry.

With undergraduate tracking, a more constructive educational environment would involve those students who desire an education in a particular area, rather than a mix of these focused students and those merely in attendance by requirement (Karg 2000). Only when students are encouraged to become actively involved in the process of education, in the design of courses and methods of assessment, as sources of knowledge and experience, and as active participants in the teaching, will veterinary education start to improve. Students can change from being passive recipients and regurgitators of information to active seekers of knowledge and understanding (Collins 1992). As veterinary educators we have underestimated the self-teaching and learning abilities of veterinary students. Why not let them plan their careers?

In a clinical tracking program, because of a smaller number of students in each program, it would be possible to have an *clinical competencies outcomes assessment* of every student before graduation. In a general program, it is not logistically possible to examine every student to determine if they have achieved a certain level of clinical expertise in the common clinical skills of all species.

Undergraduate tracking should result in improved clinical competency in a species or discipline. More graduates might become board certified in a clinical specialty, lifelong learning skills would be enhanced, more clinical research would be stimulated, referral centres of excellence would emerge, professional development programs would be more specific and effective, veterinarians would develop effective personal libraries, and overall, most importantly, society would receive highly competent veterinary service.

As food animal production continues to intensify, the expertise of the veterinarian will have to be at the **leading edge** of health and production management to provide economically useful herd health service. In addition, to their problem solving skills, their use of epidemiological techniques to detect and manage the determinants of production has given veterinarians a competitive advantage to deliver health and production management veterinary services.

Undergraduate Engineering as a Model for Veterinary Medicine. Nielsen (2001) has proposed that the professional engineering program in Canada is a model of university undergraduate tracking in different programs which could be introduced in veterinary medicine.

In a typical four year undergraduate engineering degree course, 25% of the curriculum is core, essentially in the first year. At the end of first year, the student must select an **engineering undergraduate program** for the next three years. Most programs have work related experiences during the four year course. The student commonly works for a period of time in an engineering firm each year, alternating college with the workplace. In each succeeding year, the student is given increased responsibility which **progressively improves competence**. The graduate may eventually become an employee of the firm. Accredited programs in engineering in Canada include civil, electrical, mechanical, chemical, petroleum, agricultural and others. The University of Alberta, Edmonton, currently offers 11 different programs and as of 2002, an additional three new ones. Such varied programs, and new programs, respond to the needs of society as new problems arise.

The Co-operative Engineering program at the University of Waterloo provides a **completely integrated pattern of academic study and industrial experience** in various phases of engineering with ultimate graduation requiring satisfactory performance in both areas. The degree program covers almost five calendar years, comprising eight terms each of about four months' duration of university work on campus which are combined sequentially and alternately with six four-month terms of supervised training in the practical experiences fundamental to the development of the graduate engineer.

In addition, important in this discussion, licensure as a professional engineer requires an **additional 2 to 4 years of postgraduate mandatory experience**, consisting of an apprenticeship, mentoring by a professional engineer, relevant experience, and demonstration of ability to accept responsibility. New programs in engineering are developed by faculty and the criteria are established by Canadian Engineering Accreditation Board (Canadian Engineering Accreditation Board 2000). New specialties are developed as needed by society.

Specialization in engineering is a seamless progression from undergraduate education, apprenticeship, and employment. It is flexible and has discouraged competing professions. The engineering model is successful, serves the needs of society, and the engineers are united and committed to the profession.

Quota Undergraduate Tracking Programs in Veterinary Education

An undergraduate tracking program in which the students are allowed to preferentially select the clinical rotations of their choice in third and fourth years **will not** ensure that a sufficient number of students participate in the scope and diversity of veterinary medicine necessary to meet the needs of society. In order to ensure a reasonable balance of veterinarians in the various categories of veterinary medicine, quota undergraduate tracking would be necessary. Students would have a common first year, and then apply for one of the undergraduate programs offered by the veterinary college. Quotas would be established for each program and students would be expected to know when they enter first year the program they intend to select. For example, for a class of 100 students, 50 positions would be reserved for small animals, 5 for equine practice, 30 for food animals, 5 for veterinary public health, 10 for biomedical sciences including ecosystem health. The traditional mixed animal practice with majors in food animals and a minor in small animals could be still be considered. Students would apply for one of the undergraduate programs and would be limited to that program. Each track would be able to concentrate its resources on students in that track. This would be a major reformation, not a revolution, of veterinary education and is deemed necessary to meet the veterinary needs of society. **Colleges have control of the admissions procedures and could set quotas for undergraduate programs.**

I contend that quota tracking would attract preveterinary students who desire a career in food animal practice, and, a significant number would be from farm backgrounds who desire to work in agricultural veterinary medicine. Widespread promotion of the availability of the program to potential students would be necessary and desirable. It also seems very reasonable to expect that state and federal governments would look favorably on a program which is directed to meet the needs of the livestock industry. Also, importantly, undergraduate programs would increase the participation of students in the diverse sectors of the profession to meet the needs of society.

Several arguments have been posed against radical tracking. They include: students don't know what they want to do and would like to try everything; it narrows career options; retraining would be necessary for students who decide they don't like

a chosen program; it would cause disruption of the educational system; if only a few students select a particular program, then not enough students will be available to operate certain clinic rotations. All of these arguments severely constrain the progress of veterinary medicine, and science.

Quota undergraduate programs also would allow an increase in total student enrollment to offset the shortage of veterinarians in all sectors of the profession.

Regional Centers of Excellence

The PEW Report (1988) said, **There is no way that a single veterinary college can adequately cover all of veterinary medicine or even a large part of it**. Because of limited resources, a veterinary college cannot allocate the faculty positions in all clinical specialties such as the health and production management of dairy cattle, beef cow-calf herds, beef feedlots, swine herds, sheep and goats, zoological medicine and several others. All veterinary colleges accept that premise. Given that reality, Regional Centers of Excellence of Teaching and Learning could be established in veterinary colleges across North America. Colleges should specialize using their existing best resources and opportunities available on university campuses, and clinical caseloads available in the region. By focusing resources unique to individual colleges and their geographic advantage, every college could develop one or more world-class teaching, research, and if appropriate, clinical centers that would be highly respected by the biomedical community, the world of veterinary medicine, and the animal owning public as a leading center in that facet of veterinary science and practice. Such centers would attract high quality students, command liberal quantities of research support, and attract clinical cases for its service programs.

A certain college might choose to excel in dairy cattle health and production management, another in swine, another in beef cattle health and production management based on their proximity to an adequate on farm clinical caseload. It is assumed that all colleges would continue to offer a small animal program because a small animal clinical caseload is not an issue for most colleges. The teaching program would attract professional students from other schools for some of their clinical instruction, and would provide postgraduate student education in species specialties in the case of food animals. Species specialist practitioners in close proximity to the veterinary college could participate as instructors and be appointed to the faculty as clinical associates or adjunct professors.

The PEW Report identified the need for colleges to share expertise through development of consortia to enhance communications among educators and provide a network for students to learn from sources remote from their home colleges.

On this topic, the Report concluded:

All the veterinary colleges in the United States and Canada by working in concert can offer quality academic programs in all facets of veterinary medicine needed by the profession. Unless cooperative efforts of some type are undertaken, too high a proportion of every school's resources will be squandered on weak programs in their efforts to provide for all needs, and it

will continue to be impossible nationally to achieve the level of quality needed in all the practice areas, disciplines and specialties important to veterinary medicine. Too many programs such as food safety, laboratory animal medicine, epidemiology and preventive medicine, and others, will continue to fall between the chairs, with no college addressing these needs. For cooperative programs to be successful, veterinary schools must develop centers of real excellence which will attract the very best faculty and students and support truly outstanding teaching, research and service programs. Centers of excellence in name only will do little to advance the ability of veterinary medicine to serve national and international needs

VETERINARY UNDERGRADUATE CLINICAL EDUCATION AND SKILLS EXPERIENCE

A major challenge in veterinary education is achievement of competent clinical skills in the new graduate. The nature and scope of activity in the clinical sciences have expanded multiplied far beyond anything imagined 25 years ago. The level of clinical competence on graduation is highly variable between students depending on preveterinary student background and animal and veterinary related experiences.

Survey of Bovine Practitioners Regarding Entry-Level Skills of New Graduates.

Bovine practitioners in the US were surveyed by mail to determine the individual animal medicine and animal production procedures done most frequently in bovine practice and the skills expected of entry-level veterinarians (Morin et al. 2002a)

Practitioners still use a variety of individual animal medicine skills on a frequent basis and expect entry-level veterinarians to be proficient in these skills (Morin et al. 2002). The type and average size of cattle herds served by practitioners had a marked influence on the frequency of use of particular individual animal medicine and production skills but less influence on proficiency expectations for entry-level veterinarians.

Individual Animal Medicine and Production Skills

Sixteen individual animal skills received the highest overall proficiency scores, suggesting that practitioners believe these skills should be emphasized in veterinary college.

The most frequently performed procedures involved individual animals in were:

1. Administration of injections
2. Oral administration of medicine
3. Pregnancy diagnosis by rectal palpation
4. Venepuncture
5. Treatment of pneumonia
6. Manual extraction of calf
7. Treatment of diarrhea
8. Auscultation of lungs
9. IV fluid therapy

10. Auscultation of heart
11. Auscultation of gastrointestinal tract
12. Intravenous fluid therapy
13. Vaccination and anthelmintic programs
14. Control of respiratory disease in a herd
15. Breeding soundness examination of a cow
16. Fecal floatation

The skills most frequently mentioned for which students need hands-on experience were:

- " Pregnancy diagnosis
- " Surgery
- " Obstetrics
- " Venepuncture
- " Physical examination

An list of additional procedures or skills done at least once a month and less than once a month is available (Morin et al. 2002a).

Proficiency was strongly correlated with frequency. The majority of respondents expected complete knowledge and excellent skills in administration of injections and oral medicine, venepuncture, IV fluid therapy, and fecal floatation. Herd size had a marked influence on the frequency with which practitioners performed procedures on cow-calf enterprises. Eighty-seven percent of US practitioners working with cattle, also work with other species. Respondents who work exclusively with dairy cattle expected a higher levels of proficiency than those who work with beef cattle. Larger herds are serviced by species specialists

Animal production skills which were expected included:

- " Nutrition skills; these are important and were deemed deficient in new graduates
- " General production and herd health skills and were deficient in new graduates
- " Vaccination and anthelmintic recommendations are the most important practice-entry animal production skills and which were deficient in new graduates
- " Entry level veterinarians were perceived as deficient in communication skills, and are felt to be important for all veterinarians.

There was a high correlation between proficiency and frequency for individual animal skills. But proficiency expectations for animal production skills were not as high, probably because practitioners have not persuaded producers of their ability to cost-effectively implement health management and production programs and to serve as advisers about farm management. The high correlation between frequency and proficiency suggests that if practitioners began doing more production work more frequently, proficiency expectations for entry-level veterinarians might also increase.

Surgery, Anesthesia, and Restraint Skills

In another survey, bovine practitioners expected entry-level veterinarians in bovine practice to have good skills and require little supervision in a number of surgery, anaesthesia and restraint procedures. Practitioners identified surgical and restraint skills for entry-level veterinarians, indicating that improved veterinary training programs are needed (Morin et al. 2002b).

The surgery, anesthesia, and restraint skills expected of entry-level veterinarians in bovine practice (Morin et al. 2002b) were as follows:

- " Castration was the surgical procedure performed most frequently
- " Four additional surgery, anesthesia and restraint procedures done at least once a week were:
 - " Epidural anesthesia
 - " Dehorning
 - " IV or IM sedation
 - " Tattooing
- " An additional 11 procedures were done at least once monthly:
 - " Wound management
 - " Hoof examination and treatment
 - " Ear implant administration
 - " Local or regional administration of the flank
 - " Uterine prolapse repair
 - " Vaginal prolapse repair
 - " Casting for restraint
 - " Supernumerary teat removal
 - " Roping (for animal capture)
 - " Corrective or cosmetic hoof trimming
 - " Caesarean section

The majority of respondents performed the following procedures or skills less than once a month

- " Omentopexy or surgical abomasopexy
- " Episiotomy
- " Repair of teat obstruction
- " Local anaesthesia of the horn
- " Nictitating membrane flap
- " Umbilical herniorrhaphy
- " Local anaesthesia of the eye and orbit
- " Excision of interdigital fibroma
- " Enucleation or exenteration
- " Orthopedic splinting
- " Exploratory laparotomy
- " Fracture repair by casting

If veterinarians are the most qualified individuals to diagnose and treat disease in individual animals, then veterinary colleges should ensure that opportunities are available for students to acquire adequacy in the skills. This may require subsidization of certain aspects of the caseload, the development of unique off-campus experiences in private veterinary practices, or on farms, or restructuring of large animal clinical teaching programs from being discipline-based to species based, especially in colleges with a small food animal caseload (Tyler et al. 2002).

Surveys of recent graduates and their employers indicate that their major deficiencies include practice entry skills of the common diagnostic and surgical procedures done routinely by veterinary practitioners, practice management skills including business, personnel management and client relationships, knowledge of animal behaviour, and clinical nutrition. (WCVMS Survey, 2001).

In summary, it behooves the veterinary profession both in private and public practice, to describe the clinical skills and the levels of competence and performance which new graduates should have on graduation for entry into practice.

Core Competencies Outcomes Assessment

There is a lack of quality control of the clinical skills of the new graduate because of a lack of a valid outcomes assessment in final year. Many students complain about the lack of meaningful feedback during their clinical years. Most graduates in Canada pass the NAVLE which is based on veterinary information and knowledge but it does not evaluate clinical skills which are a major concern of veterinary employers. Accreditation of veterinary colleges in North America is not based on any independent evaluation of the clinical skills of graduates.

There is increasing recognition that colleges of veterinary medicine need to more explicitly define the attributes expected of their veterinary graduates (Walsh et al. 2001).

The need was emphasized in the PEW Report Future Directions for Veterinary Medicine, and in the KPMG-LLP study on the current and future market for veterinarians and veterinary medical services in the United States. Those studies concluded that major changes in the profession are needed to meet expectations of the profession and society. Colleges of veterinary medicine must define the complement of professional characteristics, as well as the knowledge and skills, required of their graduates on graduation. ***To do so is of vital importance, not only so that graduates will be fully competent providers of veterinary care, but also so that they will be able to meet the breadth of responsibilities implicitly and explicitly placed on members of the veterinary profession and be able to successfully compete in the existing and expected marketplace*** (Walsh et al. 2001).

Faculty of colleges of veterinary medicine have traditionally expended considerable effort in defining the admissions criteria for the selection of students, defining the curriculum, teaching in the classroom and in the clinic rotations, using modern methods of teaching and in curricular reviews. However, relatively little effort

has been devoted to defining the overall set of specific professional characteristics, knowledge, and skills that students are expected to have attained by graduation. Ensuring that these attributes meet the expectations of the stakeholders of the educational programs and, especially, the overall needs of the veterinary profession has also not been evaluated systematically or reviewed (Walsh et al. 2001). **I believe this to be a major deficiency of veterinary education.**

Three steps are essential to ensuring that the attributes attained by veterinary degree graduates will allow them to meet the expectations placed on them as members of the veterinary profession and the **needs of society** (Walsh et al. 2001).

First, the attributes that students should have acquired by the time of graduation must be defined.

Second, an internal assessment process must be established to ensure that students are meeting these expectations of the faculty of the college.

Third, an external outcomes assessment must be established to ensure that the goals of the veterinary degree program are appropriate and being met.

When in place, this 3-step process provides key feedback which can then be used to further develop the veterinary degree program and refine the attributes expected of its graduates.

Outcomes Assessment Projects. A set of attributes was used as a basis for an outcomes assessment completed by California practitioners to determine whether graduates from the University of California School of Veterinary Medicine are meeting certain expectations (Walsh et al. 2002). Based on the assessment, 62 defined attributes appear to reflect very well practitioners' views and expectations of DVM graduates. The assessment focused attention on several areas, including private practice management, work expectations for successful practice, and surgical capabilities. For each, California practitioners recommended that the definition of the expectation be expanded and that the level of achievement by graduates be improved. Defining a set of attributes expected of veterinary graduates is a key step in obtaining an effective outcomes assessment of a professional educational program (Walsh et al. 2002).

A survey of veterinary technical and professional skills in students and recent graduates of a veterinary college found that most participants felt that they had not received instruction about professional skills, but those who had felt more competent about them (Tinga et al. 2001)

The process of outcomes assessment and its application in professional health science education has been reviewed (Trent 2002). Outcomes assessment in veterinary medical education as part of the accreditation review process for the American Veterinary Medical Association of the Virginia-Maryland College of Veterinary Medicine have been developed and validated by a 20-member accreditation committee (Black et al. 2002).

Outcomes assessment has been done at the Tufts University School of Veterinary Medicine by surveying faculty, all known employers of Tufts graduates, all

internship and residency directors, and students entering and leaving the the School over specified years (Kleine et al. 2002).

Competence means the ability to do something successfully and efficiently. A new veterinary graduate should be able to do certain tasks successfully and efficiently which would include the common tasks encountered in a practice situation. Such lists of competencies have been described and are available. However, veterinary colleges have traditionally educated generalists and it has not been possible for students to become competent and confident in all the species because they have not centered their attention on the tasks and accomplished them successfully and repeatedly so that they can do them competently and confidently. It is interesting to note that the training and evaluation of veterinary technicians is much more rigorous than the same in veterinary medicine. Technicians must be able to demonstrate they can do certain procedures before they graduate. That is not done satisfactorily in veterinary medicine.

Clinical Caseload

The caseload has been (or should be) the lifeblood of a modern accredited veterinary college. The caseload exists for the education of the students and faculty including preclinical, paraclinical and clinical faculty.

The size and nature of the food animal clinical caseload in some veterinary colleges has become an issue in veterinary education. With an inadequate clinical caseload, students do not have the opportunity to acquire practice entry-level clinical skills, it is difficult to teach problem-solving skills, faculty cannot maintain credibility, and research ideas do not emerge. In addition, colleges need teaching animals and resources to teach basic clinical exercises such as animal handling, clinical examination and diagnostic techniques.

Historically, colleges have operated *in-clinics*, and *ambulatory clinics* which provide on-farm teaching. The clinical education received by a student in an in-clinic with an adequate and varied caseload is unique and difficult to duplicate in a private veterinary practice. The student has the time to interview the client, examine the animal, discuss the clinical and laboratory findings with the clinician and fellow students, hospitalize the patient if necessary, and follow the case from presentation to its final disposition, whether discharged with written discharge notes, sent to necropsy, or sent to slaughter for salvage, all under the supervision of a clinician. The student is expected to read the literature about the cases and then present some of the cases in clinical rounds for detailed discussion with clinicians and fellow students. It is the responsibility of the clinician to intellectually stimulate the student and expect high standards of performance. The clinician should expect critical thinking and coherent arguments.

However, in-clinic food animal caseloads in many veterinary colleges have declined to below the numbers and kinds of cases deemed necessary to teach students the basic clinical skills. In addition, with an increasing emphasis on biosecurity, and the economics of transporting food animals to a teaching clinic, it is very likely that in-clinics for food animals will not grow in the future. The caseload of

large animal teaching clinics of the future will consist primarily of horses, some cattle, small numbers of sheep and goats, and no pigs. Cattle caseloads will be dependent on economics, ease of transportation of the animals, and the levels of biosecurity which can be assured.

For modern food animal veterinary medicine, the **ambulatory clinic** for on-farm teaching is of paramount importance. In an editorial on In-House Caseloads and Educational of Veterinary Students in Production Animal Medicine Gilbert writes:

Society expects service and leaderships from the veterinary profession in a range of traditional and newly recognized roles. In the field of production animal agriculture, these include diagnosis and treatment of disease; prevention of animal disease and suffering; promotion of animal health and welfare; economic and efficient production of food, fiber and hides; protection of public health; and preservation of the environment. Of these, only the first is arguably best taught within the walls of a teaching hospital. Experience of the animals in their production environments is essential for optimally learning the other skills and knowledge required (Gilbert 2002).

He goes on to say: If veterinary colleges are failing in regard to education in production animal medicine, it is not in failing to develop in-hospital caseloads, but in failing to recognize the expanded role required of modern veterinarians in the animal production industries and to make the necessary curricular changes necessary to accommodate newer demands. Societal demands in respect to animal welfare, public health and the environment are real, urgent, and likely to be persistent. If we do not meet these demands, others will. Failure of the veterinary profession and veterinary educators to respond adequately will erode the prestige of veterinary medicine and the professional domain of veterinarians.

Because the demands of modern agricultural animal medicine are superimposed on increasing demands for service and education in an ever-widening array of clinical specialties, species of importance, and nonpractice career options, innovative strategies will have to be developed to meet the challenges. These are likely to include effective and mutually beneficial cooperative arrangements and partnerships at regional and national level, including veterinary colleges, other educational institutions, and stakeholders such as commodity groups, government, and other professions .

Some veterinary colleges in the US have closed their ambulatory clinics and provided practitioner externships for students. Even worse, one veterinary college which does not have an ambulatory clinic has 6 radiologists! Regrettably, historically, veterinary practitioners in the immediate vicinity of veterinary colleges worldwide have not been significant supporters of the existence and operation of ambulatory clinics for veterinary students. Practitioners are territorial and competitive and dislike ambulatory clinicians practicing in their areas. On the other hand, practitioners have historically complained about the inadequate clinical and professional skills of new graduates. From where should the students get their clinical experiences?

Student Externships in Practice

Most veterinary colleges in North America allow students to elect during their clinical year, an off-campus experience usually in private practice, commonly called externships. These are expected to challenge students academically, enhance their clinical skills, and provide day-to-day realism about practice and nontraditional employment studies. Students are given considerable latitude in selecting and arranging their externships. Pre-approval of the practice by the clinical studies coordinator requires a detailed description of the practice signed by the on-site veterinary mentor. The practitioner mentor agrees to supervise the student's experience and to provide the coordinator with an evaluation of the student. Students must maintain a journal which details their daily activity and degree of involvement in each case or experience. Mentors must complete a standardized evaluation of the student's knowledge of the preclinical and clinical sciences, clinical abilities or skills, ability to solve problems, knowledge of current literature, ability to interact with clients, understanding of entry-level practice and business management, ability to maintain medical records and ability to care for patients.

The demographics and evaluation of externship experiences arranged by the Michigan State University Veterinary Medical Students found that externships offer an effective way to provide students choices in the attainment of clinical skills, abilities, knowledge, and potential (Sprecher et al. 2002).

For the student classes of Years 1999 and 2000, 88% of elected either one or two externships, and small animal practice predominated; non-private settings accounted for 21% of the total. The species emphasized at the externship locations were as follows: small animals 53.3%; equine exclusive 8.9%; exotic and/or pet avian 5.6%; mixed animal 5.6%; zoological 5.2%; canine exclusive 4.8%; leader or guide dog 4.4%; dairy exclusive 2.2%; swine exclusive 1.9%; feline exclusive 1.5%; other food animal 1.1%, and other species or emphasis 5.6%.

Students were highly motivated about their self-arranged off-campus experiences. The student journals provided the best insight into the academic rigor of the externship. Mentors were dedicated to their responsibilities and provided useful evaluations. In comparison to other categories evaluated, students lacked an understanding of entry-level practice and business management concepts. Many mentors failed to equate practice and business management with the clinical education of veterinary students.

The expansion of elective options such as externships in both private and public practice settings, within the clinical phase of a curriculum provides a compromise to redefining the DVM curriculum (Sprecher et al. 2002). If students in the clinical phase of the curriculum have specialized needs, they need off-campus experiences to gain skills and knowledge which may not be available in traditional veterinary college clinics. Education can take place where it most makes sense.

Notwithstanding the success of externships in general, and relative to the question of this conference, it is notable that in the Michigan experience, most externships selected were in small animal practice.

Extramural Studies in the U.K. Undergraduates in all six veterinary colleges in the

U. K. are required by the Royal College of Veterinary Surgeons (RCVS) to undertake 38 weeks of study in work placements in addition to the standard curriculum (Barnes & Taylor 1999). In their first two years, 12 weeks are spent primarily on farms, enhancing their understanding of animal husbandry. Throughout their final three clinical years, 26 weeks are spent observing and working with veterinarians, mainly in clinical practice (formerly called seeing practice, now termed extramural studies (EMS)). A study of how students change as learners as they proceed throughout their EMS experiences, their learning needs change. Students cannot remain as passive observers but must adopt the role of the active participant in the daily routine of the veterinary practice. Veterinary practitioners must become more actively involved in the learning needs of the student if the full potential of the EMS is to be achieved.

Professional and Business Development of Veterinary Students

Progress is being made in some veterinary colleges to address the educational needs of professional and business development of veterinary students. Veterinary practice is a small business enterprise, and if 75% of veterinary students enter private practice, then it behooves veterinary colleges to consider the incorporation of formal course instruction on professional and business development in the undergraduate curriculum. If undergraduate programs were offered, as described earlier under quota tracking programs, it would be possible to add a significant component of veterinary practice management to the curriculum for all students regardless of their particular undergraduate program.

To become successful as a veterinary practitioner, the veterinarian must be an accomplished, able, informed, thoughtful, and caring clinician (Lloyd & Walsh 2002). The KPMG study indicated that many veterinarians, although clinically competent, may lack some of the crucial skills, knowledge, aptitudes, and attitudes that typically are correlated with, and may be essential for their economic success. To address these problems, the National Commission on Veterinary Economic Issues (NCVEI) was established to study the skills, aptitudes and attitudes which are correlated with economic and professional success. A series of NCVEI meetings have been held to begin developing a consensus of what attributes are needed for the veterinary professional to be successful. A template for a curriculum which would achieve a broad set of skills, aptitudes and attitudes has been described (Lloyd & Walsh 2002). The model curriculum was developed from comprehensive input provided by consultants and educators.

Veterinary Business Curriculum. A veterinary business systems curriculum has been implemented at the College of Veterinary Medicine, Iowa State University, to teach the business and life skills needs of veterinarians (Draper & Uhlenhopp 2002). The curriculum consists of three formal courses and an entrepreneurial minor program. The courses include Management Pathways in Veterinary Medicine, Accounting and Operations Management, and Veterinary Entrepreneurship. The first course is a four-credit course offered to second and third year students. The objective is to assist students who intend to be associate veterinarians in a private

practice. The introductory business knowledge and skills necessary to sustain a successful veterinary practice are emphasized.

The second course provides a basic understanding of accounting and financial statements. Topics include legal responsibilities, tax implications of business structure, and how to use financial information in making economic decisions.

The third course is designed for students who intend to purchase, become a partner in a practice, or start their own practice. Students are required to do a series of individual projects related to the business case. These projects include: practice vision and mission statements; practice feasibility and analysis, establishing a fee structure for your practice; identify the profit centers from your practice; prepare a cash flow budget for your practice; perform a capital budgeting analysis on the purchase of a new piece of equipment; prepare a comprehensive marketing plan for your practice; write a job description for a new veterinary associate and a receptionist; obtain quotes for common forms of business risk insurance.

Small Animal and Equine Veterinary Education

Compared to food animal veterinary education, small animal and equine veterinary education in most veterinary colleges in North America have done very well in the last 10 to 15 years. The emphasis is on individual animal medicine from the simple to the very complex case. Cases in small animals and horses are resolved diagnostically and therapeutically almost as far as possible if necessary if the client is willing to pay for the service. The teaching of small animal and equine veterinary medicine is well advanced and the students are very attracted to these areas and to the level of expertise of the clinicians. Rural practitioners commonly said that the veterinary curricula now emphasize small animal medicine and surgery at the expense of food animal health and production management. Several disciplines including internal medicine, surgery, cardiology, neurology, dermatology, anaesthesiology, oncology, ultrasonography, and ophthalmology have become an integral part of small animal and equine medicine taught by board certified specialists in veterinary teaching hospitals. Referrals for these disciplines have also become a major activity. Veterinary colleges have responded by providing increased funding and resources to support teaching, research and service for companion animal practice. However, as Eyre as said, *No matter how creative we are and how hard we work, every institution cannot possibly respond to all the needs of society and maintain high quality in all disciplines* (Eyre 2001).

Food Animal Veterinary Education

Compared with small animal and equine veterinary education, there has been a steady erosion of food animal veterinary education in veterinary colleges in concert with a decreasing rural constituency and an increasing veterinary commitment to companion animals (Chenoweth 1996). The relevance of veterinary medicine to the food and fibre animal industries is under threat, paradoxically, at a time when improvements in transport and communications and reductions in international trade barriers mandate greater veterinary involvement in the reduction of livestock disease,

stress, and production constraints in livestock. In addition, veterinarians are being asked to adopt active roles in expanding areas of animal welfare and food safety; roles in which the profession needs to show, balanced leadership if it is to retain a significant agricultural presence into the 21st century.

The challenges to veterinary education are numerous, not the least being to convince educational leaders that fulfilling these obligations to the food and fibre animal industries is pivotal to the survival of a strong and relevant veterinary profession. Another challenge to veterinary educators is to design and develop useful, relevant and cost-effective veterinary programs for producers in which veterinary inputs are regarded as an investment and not just an expense. Food animal practice serves food animal producers and consumers, and must respond to the forces that influence the clientele it serves (Leman 1988).

Demographic, economic and sociological changes are collectively diluting the traditional role of veterinary colleges of adequately training sufficient numbers of veterinarians to serve the production animal industries (Chenoweth 1996). This is despite increasing needs by the livestock industries for effective veterinary inputs, and strong political imperatives for veterinary colleges to maintain viable educational programs with production animals. Real challenges exist to maintain such programs and to recruit and educate students to fulfill future requirements. This challenge must be met early in the educational process, especially as a growing proportion of production animal veterinarians will be drawn from nonfarm backgrounds. To accomplish this, it is necessary to achieve closer cooperation with, and stronger support from, industry and related educational programs.

The educational process itself needs to become more flexible to allow students greater choice both within the veterinary degree programs and from production animal expertise in other programs and institutions. The training of species/industry specialists appropriate for the production animal industries will require post-DVM training in a number of less than traditional areas such as nutrition, epidemiology, economics, data handling, food safety, facility design, and animal welfare. Advances in modern technologies should allow students an eclectic selection from a global smorgasbord of resources provided by the best authorities in their respective fields.

Health and production management veterinary service to livestock herds may not be sufficiently interesting and motivating to veterinary students and new graduates compared to individual animal medicine which commonly provides much more variety, interesting syndromes, and more rapid results following treatment, especially when surgical procedures and sophisticated diagnostic techniques are involved.

Ironically, at the very time in history when animal agriculture needs veterinary medicine the most, when the industries have become complex and economics is so important, when consumers are concerned about food safety and quality, we seem to be turning away from the responsibility (Chenoweth 1996).

To meet the teaching and learning needs of a centre of excellence in food animal veterinary education at the veterinary colleges requires a first-class teaching practice. Why not? We have sophisticated facilities, expensive diagnostic equipment like medical resonance imaging, scintigraphy, echocardiography, endoscopy, and

many different board certified clinical specialists for companion animal medicine. Why do veterinary colleges not have leading edge food animal field practices in dairy cattle, swine production, beef cow-calf herds, beef feedlots, and cooperative programs in regulatory veterinary medicine and public health? Such practices would be expensive, require considerable on-farm teaching and learning, and require animal health data laboratories.

A survey, conducted in 1998 to determine the influence of swine experience upon career choice following graduation, matched members of the Ontario Association of Swine Practitioners by year of graduation to either a small or large animal veterinarian, and determined and compared their experiences working with swine prior to and during veterinary school (Dewey et al 2000). The study demonstrated that swine veterinarians were 2.35 times more likely to have worked with pigs prior to veterinary school compared to their non-swine veterinarian counterparts. In addition, swine veterinarians were 3.22 times more likely to have acquired experience with pigs during veterinary school, either through summer jobs, volunteer work, or extracurricular involvements compared to non-swine veterinarians. It was also found that experience with pigs prior to veterinary school was not correlated with employment or volunteer experience with pigs during veterinary school. This study highlights the importance of veterinary school experiences on career choice following graduation.

Thus, the integration of hands-on experiences with swine into the early years of the veterinary curriculum may influence some students to choose certain career paths such as swine medicine and production (Dewey et al. 2000).

Food Animal Clinical Teachers. Practitioners in this survey indicated that it is very important for the veterinary colleges to recruit and employ the very best experienced food animal clinicians who can teach, motivate, and inspire veterinary students in the various sectors of food animal veterinary medicine. ***To be an excellent university clinician, who is up to date with the literature, who can maintain a critical number of progressive role model livestock producers as clients, and who can teach species-based health and production management, on the farm and in the data health laboratory, with the objective of illustrating to students how to make a good living doing that as a practitioner is a fulltime job and career.*** This includes such important activities as investigations of herd outbreaks of disease which requires considerable time, diagnostic services, telecommunication costs, technical resources and follow-ups. Such investigations are the bread and butter of clinical teaching and research and should be given high priority. As veterinary faculties we have not given high priority to clinicians doing on farm clinical teaching. We expect clinicians to acquire research funds, do research, and publish papers. It is a major challenge for veterinary colleges, and universities, to accept that such teacher clinicians are as crucial to the educational system as are researchers who spend a large part of their career writing detailed research grant requests and doing laboratory research. We need to reward them for their pursuit of learning and teaching on the farm where it all happens.

College and University Budgets

Veterinary college budgets have not kept pace with inflation and many have been reduced or remain static which impedes progress in the development of new techniques in teaching and learning. Faculty feel frustrated because of ever increased workloads of teaching, research and clinical service. Highly qualified board certified clinical faculty are being recruited by private referral practices making it very difficult for veterinary colleges to recruit certain specialists.

The funding of clinical specialists in veterinary college clinics is a major problem compared to medical colleges associated with human teaching hospitals where the specialists are funded publicly or by medical insurance plans. In veterinary medicine the college budget and revenue of the clinics must fund specialists.

In my experience, Universities and Colleges of Veterinary Medicine have never fully appreciated and supported the high costs of the clinical teaching and learning of food animal veterinary practice in the field, on the farm. Historically, it has been done superficially to satisfy superficial teaching and accreditation needs.

Veterinary Research

The percentage of graduate veterinarians entering research careers compared to 30 years ago is small. The Selborne Report in the UK. (Selborne 1997) suggested that the emphasis in the veterinary curriculum on clinical practice does not expose the student to the roles of research in advancing veterinary science. Clinical faculty do not emphasize the importance of research to students. However, most students do not want to hear about research and the unknown and the uncertain; they want to have the facts for clinical practice. Very few students are turned on by unknown questions in veterinary medicine.

In a recent plenary Woolridge Memorial Lecture at the British Veterinary Association Congress, Dame Bridget Ogilvie, recently-retired director of the Wellcome Trust, identified serious problems in veterinary research (Ogilvie 1998). They include an apparent unwillingness among veterinary graduates to enter academia, and major problems in the way veterinary research is structured and funded. She argued that a fundamental culture change is needed if the problems are to be resolved and made some radical proposals as to how this might be achieved.

Clinical research is in crisis, not just in veterinary medicine but in human medicine; not just in the U. K., and North America, but worldwide. Research is the continuing questioning and refinement of what we perceive as truth. The purpose of veterinary research is to improve our knowledge of the diseases and health management of the species of primary veterinary concern (Michell 1997). Clinical research is necessary to improve our understanding of the etiology, epidemiology, diagnosis, treatment and control of the common diseases of the species of primary concern. Clinical research allows us to test the hypotheses underlying our clinical decisions and allows us to practice evidence-based medicine rather than depend on empirical medicine. The last decade has seen an increase in the publication of well-

designed prospective and retrospective case studies and these need to be encouraged and improved. The importance of case studies reinforces the value of a critical clinical caseload in the veterinary teaching hospital. If the caseload is not available at the college, the case material in private practices will have to be used. Every up-to-date clinician prefers to practice the best evidence-based veterinary medicine possible within certain economic limits. The results of randomized clinical field trials to evaluate drugs and vaccines are being published and more are needed.

Good research requires funding and qualified researchers who have the time to do the work and publish the results. Successful veterinary researchers have developed research programs with both short and long term goals, all of which requires time, funds and collaboration with colleagues in a team. Researchers working in isolation are no longer common.

Clinical researchers are beginning to collaborate with a few private food animal practitioners who have access to a significant caseload, and in some cases large number of animals as in practices dealing with beef cattle feedlots, large swine herds, and poultry farms.. Some veterinary practices now have the equipment and the veterinarians with the training and intellects to collaborate very effectively in clinical research projects with university clinicians. Some practices provide veterinary service to clients with alternative livestock such elk, bison and deer farming which provide case material not readily available to veterinary colleges.

Very little has been written about the reasons new veterinary graduates do not pursue research careers. A major factor may be **economics**. Stipends for veterinary graduate students cannot compete with the salaries offered in veterinary practice or other endeavours. The profession can no longer expect veterinarians to sacrifice income for a research career. In North America, if stipends for graduate students were similar to salaries for new graduates going into practice, and if start-up research funds were made available there would be no shortage of graduate students.

Nevertheless, the small number of veterinary students who are interested in a research career must be identified, recruited and mentored during their professional career and encouraged to pursue their research interests. The School of Veterinary Medicine, University of California, Davis, has begun a program of financially supporting undergraduate students to do combined DVM and Ph. D. degrees over a period of 7 years.

4. The New Veterinary Graduate

Licensure to Practice

The self-regulating nature of the veterinary profession dictates that it will provide competent veterinary service to all our clients, whether owners of companion animals or food-producing animals, commensurate with what modern veterinary science can offer within the economic limitations of the client, and the welfare of the animals. Osborne (1991) asked: The veterinarian's oath: Are you keeping your promise? The issue of competence begins on Day 1 after graduation and continues throughout the career of the veterinarian. New graduates provide veterinary service

to the public who assume that the veterinarian is competent. The skills, knowledge, attitude and aptitude of new graduates and their competency on Day 1 are thus a major concern.

The North American Veterinary Licensing Examination (NAVLE) is a general examination and as such, perpetuates the paradigm of educating the omniscient veterinarian. Veterinary licensing authorities still provide a lifetime licence to practice on any and all species of animals. Many graduates move from large animal practice to small animal practice within 3 to 5 years with no formal certification program. This would be a major challenge for veterinary colleges if such retraining were requested.

The continued competence of the veterinarian depends on self-directed learning, and continuous professional development programs. There are many and varied continuing education programs and conferences but there is some concern that their quality may not meet the needs of the individual practitioner.

One major change in the profession in North America in the last 30 years has been the introduction of many board specialties in clinical and species disciplines. Board certification is now a requirement for employment as a clinical faculty member in a veterinary college. Board certified specialists are now also becoming more common in private veterinary practices, especially referral practices but not exclusively (see later).

Supervision, Mentorship and Career Guidance of New Graduate

Many new graduates feel that there has been insufficient supervision, mentorship and career guidance in practice. Supervision means overseeing and assisting as necessary of all or most of the veterinary activities, including client interactions, and business transactions, for the initial stages of employment of the new graduate. The amount of direct supervision required must be determined by the employer who evaluates the level of competence and performance of the graduate initially. Regular feedback, including praise for work well done, and constructive criticism as necessary about competency and performance are necessary for development.

A major problem of supervision in food animal veterinary practice is the lack of a suitable infrastructure for the direct supervision of clinical work on the farm. It is unusual to provide direct supervision of the new graduate, including monitoring the performance and providing useful educational feedback over extended periods of time. Where much of the service is provided on the farm, it is impractical and uneconomic to provide direct supervision. Veterinary medicine will have to find ways and means of rigorously evaluating the performance and progress of the clinical skills of new graduates in food animal practice on the farm.

A mentor is a wise and trusted teacher or guide who takes a sincere interest in the development of the new graduate. Mentorship in veterinary practice is developing a friendly and professional relationship with the new graduate by providing guidance and advice about both professional and citizenship development. Careful and considerate listening is a major asset of an effective mentor. Taking a regular interest

in the activities of the new graduate is vital. Recognizing and enhancing the strengths, and understanding the weaknesses of the new graduate and being patient and tolerant of inexperience are necessary mentoring skills. Sincerely praising work well done is an integral part of mentoring, and being helpful and considerate about errors in diagnosis or difficult cases or clients are important. The relationship must be trusting, honest, respectful, confidential, accountable, and mutually beneficial. The new graduate should not ever feel reluctant to seek advice from the mentor about daily practice activities or professional aspirations. An effective mentor is able to make the new graduate practice self-appraisal of performance. The aim of mentorship is effective development of the person as a citizen, family member, team member, and veterinarian to meet the needs of society. Ideally, an effective mentor is an inspirational role model for the new graduate to become personally self-motivated and self-disciplined which will enhance the unique skills of the graduate which invariably are different and perhaps superior to the mentor.

Practitioners also have a critical role to play in career development of new graduates. New graduates need guidance about how to develop a career path in veterinary practice which will be satisfying, rewarding, and meets the needs of the clients. This includes advice on the business aspects of investing in a practice. New graduates need to develop a sense of pride in the practice and made to feel that they are contributing to its success.

Postgraduate Mandatory Internship (Professional Training Phase)

There are few professions where an initial degree confers on the holder an unlimited, life-long licence to practise, and the veterinary profession does need to consider how long it can or should maintain its present position in this respect (RCVS July 2001). The RCVS has proposed a professional training phase of at least one year in practice, leading to the issue of a licence to practice within a broad, named area such as companion animals, production animals, mixed practice, food safety and public health. Day 1 and Year 1 competencies form the cornerstone for consideration of the primary degree and the professional training phase. The professional training in the specified area should be done within a registered practice or institution. The employer of the registered practice would be responsible for assuring that competence of the new graduate was achieved.

Effective June 2002, the Royal College of Veterinary Surgeons began Stage 1 of a Pilot Study to test the validity and usefulness of Year 1 competencies and skills list (RCVS 2002b). Ten new graduates from each of the six veterinary schools will participate in the study. Stage 2 of the Pilot study, from 2003, will involve a similar sized group of new graduates, and will test out the feasibility of the professional training phase from the perspective both of the graduates and their employing practices, following their progress for two years.

Later career moves into other areas of practice would require veterinarians to repeat the professional training phase in a registered practice. There would be periodic renewal of licensing to practice.

The RCVS also envisages fully licensed veterinarians working over two to ten years in practice obtaining modular Certificates leading to full qualification in a broadly named area (Companion Animals, Equine, Production Animals, Mixed Practice). A similar post-graduate study program for Canadian veterinarians leading to certification has recently been proposed, with the suggestion that this would remove the need for limited licensure.

A supervised postgraduate mandatory internship in a veterinary teaching hospital of a veterinary college with an adequate clinical caseload, or in a private veterinary practice with a busy caseload is an excellent experience for new graduates. It provides the opportunity for them to apply their knowledge base to clinical problems, under the supervision of competent clinicians. Interns soon learn their limitations and what is required to become competent. Under ideal conditions, interns have the time and resources to follow cases from their beginning to the end, including necropsy if applicable. There is no other experience like the first year of clinical practice under supervision. The learning curve in a one-year internship is very steep. However, the supervisor must challenge the intern intellectually and be willing and able to demonstrate both the common clinical diagnostic and therapeutic techniques, and allow the intern to do them under direct supervision as long as required. Internships also provide first-hand experience with clients, business management, personnel relationships and management, continuing education and development of a personal library, interactions with colleagues and the opportunity to develop one's area of professional interest.

Approximately 20% of veterinary graduates of North America colleges apply for internships in veterinary teaching hospitals or in some private practices each year. New graduates recognize that they need more supervised clinical experience. If more internships were available, it is highly likely that, many more new graduates would apply for them. If that is so, why does veterinary medicine not introduce internships as a mandatory requirement before granting full licensure to practice? The constraints probably are financial and practical. Veterinary graduates are commonly heavily in debt and reluctant to work for another year at a reduced salary. The practical constraint is the level of supervision which the registered practitioners in the practice are able or willing to provide. Veterinary practices participating in internships would have to agree to meet certain standards of teaching and supervision and be willing to certify objectively that the intern has met certain predetermined qualifications. If more internships were available, more internship graduates would enter clinical residency programs which would be an excellent method of improving the overall level of competence in practice.

A mandatory internship would be the easiest change to make in veterinary education. However, there is the potential for reducing the responsibility of the veterinary colleges to provide a basic clinical education. As mentioned earlier, it should be the responsibility of the colleges to provide the basic clinical diagnostic and therapeutic exercises necessary for the new graduate to provide veterinary services. Practitioners should not be expected to teach students the basic skills such as clinical

examination, handling animals, venepuncture, passage of stomach tubes, rectal examination, and other routine procedures. Most practitioners welcome veterinary students who want to enhance their clinical skills in a practical situation.

Designated or Limited Licensure. If a generalist undergraduate veterinary education is undesirable, unnecessary, and not possible, then undergraduate clinical tracking and as a consequence, designated or limited licensure, is an attractive alternative for consideration.

For many years, it was assumed that the basic veterinary degree provided the new veterinary graduate with the knowledge and skills to work in any and every facet of veterinary medicine for a lifetime. In North America, veterinary students have been required to write the NAVLE in order to obtain a state or provincial license to practice. The NAVLE is a general examination consisting of questions from all sectors of veterinary medicine but 60% are small animal oriented.

The fact that all veterinary graduates must pass a standard licensing examination constrains the flexibility of the educational establishment to develop new areas of competence that respond to societal needs and perpetuates the human and medical model and culture within our profession. If the profession cannot realistically use formal postgraduate education to enhance the competence of a significant portion of its members, as seems to be the case, it simply must look more seriously at substantial undergraduate tracking and, perhaps, a period of internship or residency before licensure to practice (Nielsen 2001).

Karg has written that it is time for the veterinary profession to seriously consider designated licensure within the veterinary degree (Karg 2000). Designated licensure means being licensed to practice only in a specific area of veterinary medicine such as a particular species or class of animal or discipline. Potential categories, each with its own full-length examination, could be: canine, feline, avian production, ruminants, swine, companion exotics (including birds, rodents, rabbits, reptiles, and ferrets), and zoo and wildlife medicine and surgery. Under designated licensure, undergraduate veterinary students would select a professional career path of study after their second or third year (of a four-year course) and spend their clinical years studying in that specialty. Thus designated licensure implies undergraduate clinical tracking.

Karg writes, *Most veterinarians practice on a limited number of species. The increasingly rare mixed practitioner is a person of considerable prestige, experience, and knowledge and is indispensable to the fabric of society. More is demanded of this Herriottesque veterinarians in terms of potential problems to be encountered than of any other private practitioner. Yet, the attempt is made to graduate such an individual in the face of a burgeoning knowledge base. It would be a daunting task, but not an unreasonable one, to ask this unique graduate to pass each full-length examination if he or she wants to be this complete practitioner* (Karg 2000).

The organized veterinary profession, not the universities, has the instruments necessary for leadership in making sure that society's needs are being met; namely, veterinary licensure, regulation of internships, setting practice standards, and college

accreditation (Nielsen 1999). *These tools (all having to do with standards) can be a powerful force for either changing or maintaining the status quo. They can allow the introduction of the engineering model in veterinary education and licensure, in which veterinary students would have to choose one of several major career paths, such as mixed animal practice, small animal practice, equine practice, food animal practice, public health, food hygiene, comparative medicine, zoo medicine, aquaculture, or ecosystem health, at the end of the second year of the North American four year professional degree course. Examination for licensure would be tailored to the career path chosen.*

Designated licensure would allow colleges to allocate quotas for each major area so that a certain number of students would be able to select and focus their efforts in areas like food animals (dairy cattle, beef cattle, swine), food safety and veterinary public health.

5. Food Animal Practice Both Private and Public

ISSUES AND OPPORTUNITIES IN FOOD ANIMAL PRACTICE

ISSUES

Many issues influence whether or not new graduates choose food animal practice and whether or not they remain in such a practice as a career. What follows is a summary of the responses received from veterinarians to a list of questions posted on the AABP-L in September 2002, and at meetings with four focus groups of large animal practitioners in Alberta in October 2002.

Livestock Producers

Many veterinarians expressed the view that some livestock producers are inefficient, undercapitalized, and inadequate animal health and production managers all of which affects the enthusiasm and performance of the new graduate. Producers may not have health and production records, they don't comply with recommendations made by the veterinarian, they are too demanding for service, they do not respect and tolerate the inexperience of new veterinary graduates, and commonly complain about the costs of veterinary services and expect to obtain drugs and vaccines at reduced prices. Also, some producers are reluctant to pay for animal health and production management advice which is discouraging to new graduates who have been taught that such veterinary service is the future in food animal practice. The previous generation of veterinarians tolerated these characteristics and behaviours of producers, but the current generation will not. There are many other rewarding and satisfying careers for them to pursue.

In contrast there are many producers who are progressive, knowledgeable, leaders in the community, early adopters of new technology and methods of production, successful business people, information-oriented and have excellent records of health and performance, consult with their veterinarian as necessary,

comply with recommendations, and have a desire to improve their overall production and management. These are the producers for which veterinarians must be developing and providing health and management veterinary services.

Generation X and Y

Students and graduates of Generation X and Y want to balance their professional and personal lives. They want regular time off, they feel the physical work of farm animal practice is too difficult, they do not like the working conditions, and the rural lifestyle is undesirable for raising families because of the lack of amenities for organized athletics and entertainment. The emergency work in farm animal practice is a deterrent to many new graduates. Many graduates feel they cannot master the knowledge and clinical skills required in a mixed animal practice.

Lack of Supervision and Mentorship

Many new graduates indicated that inadequate support, supervision and mentorship were factors resulting in them leaving rural practice. New graduates need supervision and guidance and consultation about cases and handling clients. However, some practitioners indicated it is difficult to provide meaningful supervision and mentorship in a busy food animal practice when each practitioner is doing farm calls at the same time.

Female Graduates

Female graduates are less likely to work full-time compared to males, and less likely to invest financially in the ownership of a private practice. Most female veterinarians do not like the rigors and physical demands of food animal practice. Undoubtedly there are some women in food animal practice but they are the exception rather than the rule. Some have married farmers, enjoy the rural lifestyle and may practice part time doing individual animal medicine. The attrition rate of female veterinarians from food animal practice is also much higher than it is for males. Because women take time for maternity leave and to raise families, the veterinary associates in the practice, both men and women, must do a greater share than when fully staffed. Many practitioner owners indicated that food animal veterinary practice is a full-time career especially if herd health services are being offered. The livestock producer wants to have the veterinarian committed to the health, production and economic viability of the herd which is not a part time job. For many female veterinary graduates, veterinary medicine is a secondary source of income in the family where the male provides the primary source of income. Most female graduates enter small animal practice; only a small percentage enter food animal practice.

Rural Veterinary Practice

Many mixed animal practitioners in rural areas expressed concern about the future attractiveness of their practices for new graduates. While new graduates may enter the practice they commonly leave in a few years after gaining some experience. The failure of these practices to expand into multiple-person practices with multiple

skill sets does not allow the practice to be innovative so as to offer new herd health programs to the producers. It has been said that unless food animal practitioners develop and offer innovative, value added herd health veterinary services to progressive livestock producers, the ever decreasing need for individual animal medicine will no longer support rural practice. Inevitably, this means that a small number of species specialists veterinarians will provide consultative service to the larger enterprises. The primary objective of food animal practice is the production of wholesome and safe meat and milk through production-oriented health management. This means the promotion of Quality Assurance Programs and On-Farm-Food Safety Programs. Unfortunately, most veterinary students did not enter veterinary medicine for such a career; rather they wanted to practice animal medicine as it is done in companion animal medicine.

Many of these practices are also too small and do not have the critical mass of veterinarians in order to economically employ qualified paraprofessionals such as veterinary technicians. Small animal practice is an integral part of these practices which may detract, from the development of the knowledge and skills required to provide modern production-oriented food animal medicine to large livestock enterprises.

The age profile of these practitioners indicates they will retire in 5 to 10 years and there are few new graduates interested in financially investing in or purchasing the practice. Thus succession of mixed animal practices is a looming problem.

Rural Lifestyle

The rural lifestyle of small towns and hamlets, a long distance from urban centers is no longer attractive to most people including new veterinary graduates. There has been a steady stagnation or decline in small rural communities for the past 50 years in North America. Concentration of population and economic activity has been increasingly in larger communities. Most of the consolidation and concentration of the past 50 years can be attributed to changes in technology in agricultural and other primary activities, as well as in the transportation, communications and distribution industries. Schools and hospitals have closed in rural areas and small centres in order to provide larger facilities and a wider range of services in larger, regionally central, communities. Post offices, grain elevators, farm machinery dealerships, and other activities have followed a similar course. Rural people now routinely shop in distant communities where greater variety and lower prices are available. The modern amenities for family recreation and other activities may not be readily available in small communities.

The same pattern of concentration and consolidation is happening in veterinary practices. New veterinary graduates prefer to enter practices in larger communities or those which are near urban centers. Thus in the future, food animal veterinarians and large animal clinics will be located in few locations, which means more travelling for both veterinarians and producers. But it will probably be offset by the veterinarian spending much more time on the farm engaged in health and production management.

The attitudes of Australian veterinarians to issues related to rural veterinary practice have been examined (Heath & Niethé 2001). The country lifestyle and the type of work were major disadvantages for rural practitioners, and long working days and after hours demands coupled with sexist attitudes in the case of women, were main disadvantages. Remuneration, the tiring and often dangerous nature of the work, and social and professional isolation were major disadvantages. Personal qualities, including the ability to relate to rural people and to fit into rural communities were the most important qualities for a veterinarian in rural practice. Working and living in a rural area has lost its appeal for many new graduates who have an urban background. The amenities for raising a family such as recreational facilities may not be available as they are in a city. In some situations, the veterinarian's spouse may not find rural living acceptable.

The potential future of rural practitioners was closely linked to their ability to contribute to the financial viability of the whole animal enterprise and to the fortunes of the rural industries. Companion animals were a key part of the future work of rural practitioners. Rural practitioners are characterized by a strong commitment to rural life and work. The full range of professional skills required are likely to be beyond the scope of the undergraduate veterinary course, but the internet and other modern forms of distance education should help practitioners to acquire relevant skills.

The number of government veterinarians supporting animal industries in Australia has decreased from 45% in 1950 to 5% in 2000. The number of veterinarians in rural areas has increased but in the closely settled areas, the majority are females and less likely to work full-time, own a practice and do out of hours work than males. Eighty percent of recent graduates enter mixed practice but remain only 1.9 years. Only 20% remain in mixed practice after 5 years.

Veterinarians leave rural practices in Australia because of hours of work, and the rate of financial return for hours worked. Opportunities to develop their own career, and career opportunities for family members, and to be closer to family, friends and colleagues, are all considered to be important. Those who have grown up on farms with farm animals are less likely to be affected by these issues, and more of them will stay than in the case of those who do not come from farms. Encouragement and support from parents and local veterinarians may be an important stimulus, particularly boys from farms at rural high schools who face peer pressure distracting them from working to achieve the grades needed for veterinary college.

Spousal Occupation

Spousal occupation can influence whether or not a veterinary graduate enters rural practice and remain and invest financially in the practice. In dual professional income families, it is highly unlikely that a small rural community will provide employment opportunities for two different professionals, one a veterinarian and the other a non-veterinarian. However, in some circumstances, such as a veterinarian and teacher, there may be employment for both in the same locality.

Working Conditions

Large animal practice, especially bovine practice, is physically demanding and commonly involves long days, and requires being on a regular call duty roster for nights and weekends. Busy and hectic days and nights require considerable stamina and endurance. The time spent travelling to and from farms in a motor vehicle is an undesirable activity for some veterinarians. Inadequate animal handling facilities and other undesirable conditions on some farms are frustrating to some veterinarians, resulting in inefficient use of time and a feeling of discouragement. The nature of the clinic work and the cleaning up after procedures such as fetotomies and caesarean sections may be undesirable.

Large animal practitioners are at risk of physical injury from handling large animals. Getting kicked, having legs and hands and fingers squeezed in a chute, being charged by a fractious animal are common occurrences in large animal practice. Certain repetitive manual diagnostic procedures can cause cumulative traumatic injuries. Among bovine practitioners surveyed, musculoskeletal injuries were reported by 71% of respondents. Acute traumatic injury associated with rectal palpation of cattle was reported by 30% of respondents (Cattell 2000). The anatomical locations associated most frequently affected, in descending order, were the shoulder, elbow, wrist, neck, knee and hip. Symptoms occurred more frequently on the same side of the body as the arm used to perform rectal palpation.

Intellectual Challenge

According to some veterinarians, routine individual animal medicine in bovine practice can become mundane and not as intellectually satisfying as in small animal practice. Dealing with untreatable diseases can be frustrating and unrewarding. Some practitioners claim they still do considerable individual animal medicine and that herd health programs have not been widely adopted by livestock producers with the exception of routine procedures such as pregnancy diagnosis and breeding soundness examination of bulls. Some practitioners do not feel competent and confident to provide an integrated animal health and production management veterinary service to their producers. Opportunities for intellectual advancement in large animal practice may be limited in certain practice areas with a predominance of small uneconomically viable farms which may be a deterrent. However, practitioners do concede that the future in food animal practice is in more production-oriented health management of herds and getting paid for healthy and productive animals.

Veterinarians interested in herd health have traditionally done emergency veterinary work for several years and then gradually did more herd work and learned by experience in selected herds. Practical experience combined with attendance at continuing veterinary education short courses, which concentrated on the health and production aspects of a species or class of livestock, such as dairy health management was successful. The veterinary profession and colleges have traditionally accepted that specialization occurs following graduation and entry into private practice. However, the growth in numbers of well-qualified, species specialized veterinarians has been slow, partly because of an insufficient number of quality formal postgraduate training programs suited for the veterinary practitioner

who cannot afford the time or the financial resources to enroll in a conventional postgraduate program of 2 or 3 years duration.

Veterinarian s Salary

A common reason given for leaving large animal practice is insufficient income earned. However, many large animal practitioners claim that insufficient income is not a limiting factor because net income can be high in large animal practice. But income can be highly variable depending on the nature of the practice, management expertise, and the nature of the producers being served. In North America, salaries for associates and owners of large animal practitioners are competitive with those in small animal practice. Nevertheless, large animal practice is linked to the economics of the livestock industry and can be affected by variations in financial returns to the producers who are part of a free-market economy. New graduates must appreciate that veterinary practice is a private business and dependent on income directly from clients.

It is notable that practitioners who have specialized in health and production management of dairy cattle, beef cow-calf, beef feedlot, swine herds, poultry production have above average annual incomes which are very competitive with any other activity in veterinary medicine. This would strongly suggest that income is dependent on clinical expertise which in turn argues for improving species specific competence beginning with an undergraduate tracking program, perhaps a mandatory internship, a three-year residency in a species specific programs such as the Dairy Production Residency Program offered by the University of California.

OPPORTUNITIES AND NEEDS OF THE FOOD PRODUCING ANIMAL INDUSTRIES U.S. Livestock Market for Veterinary Medical Services and Products (1995)

In 1994, the AVMA studied the livestock market for veterinary medical services. Veterinarians and producers were surveyed and some important findings are:

1. The structure of agriculture is changing. The number of farms and ranches has been declining since the 1920s.
2. Four forces strongly influence changes in the structure of animal agriculture: industrialization, globalization, food safety linkages, and consumerism. These are all areas in which veterinarians training and knowledge can be applied specifically.
3. The fundamental task for food animal veterinarians is to shift from a fee-for-service or task oriented business relationship to a fee-for-advice or information oriented business relationship that is focused on the financial performance of the livestock enterprise.

The implications for veterinary medicine are as follows:

- * □ Food animal agriculture is diverging into two distinct markets: One market is characterized by large specialized animal production units in which livestock production is the operators primary occupation and source of income. The second is characterized by small, less specialized animal production units.

Food animal production may be ancillary to crop production, and farming may be a secondary occupation and source of income. Regional concentration of livestock herds is shifting.

- * □ Increased efficiency that causes increased production from fewer herds is especially evident in the dairy cattle industry and increasingly evident in the swine industry. Feedlot production is highly specialized; however, the beef cattle industry has a limited amount of vertical coordination in contrast to the broiler industry, which is less concentrated but has a high degree of vertical coordination.
- * □ Dairy producers are the largest users of veterinary and animal health products and services. Swine practitioners generate the highest individual revenue. Dairy cattle practitioners generate the highest percentage of revenue from livestock products and services, whereas sheep practitioners depend on pets and horses for more than 50% of their revenue. Beef and dairy practitioners generate about 90% of their revenue from bovine services. Sheep and swine practitioners generate about 25% of their revenue from bovine services.
- * □ Beef, dairy, and sheep practitioners generate more than 60% of professional service fees from technical services, whereas sheep practitioners generate more than 40% of professional service fees from consultative services.
- * □ Producers perceived local veterinarians to be very knowledgeable concerning diagnostics, treatment, and reproduction, moderately knowledgeable in areas of herd management and nutrition, and the least knowledgeable in agribusiness and economics.
- * □ Producers perceive veterinarians to be highly cost effective concerning reproduction, diagnostics and treatment, but less cost effective than producers themselves concerning herd management, nutrition, and agribusiness and economics. **The producers surveyed in 1994 perceived local veterinarians as less knowledgeable and less cost effective in reproduction, diagnosis, and treatment than producers surveyed in 1985.** These results suggest underlying factors that could have negative impacts on future growth of demand for the services of veterinarians.
- * □ Veterinarians are considered first, second, or third contacts in all areas except agribusiness and economics. Livestock producers believe local veterinarians are important to their livestock operations. They have a high regard for, and a high level of satisfaction with the abilities of veterinarians.
- * □ Veterinarians rated themselves or consultative veterinarians as the most knowledgeable individuals in all aspects of livestock production. The ratings of veterinarians and producers were consistent regarding reproduction, diagnostics, and treatment but inconsistent concerning herd management, nutrition, and economics.

- *□ Veterinarians feel that they are important to most aspects of their clients operations.
- *□ Veterinarians do not believe that producers consider them herd management consultants, contrary to the belief of producers. Therefore veterinarians may be missing opportunities to expand their practices.

Implications of Opportunities for Veterinary Education. Consideration of the U.S. livestock market for veterinary medical services described in the previous section indicates that preparing the new graduate to meet those needs is a major task which cannot be accomplished with the generalist undergraduate education system of the past. There is a need to design an educational system and a practice model for the future based primarily on the dynamics of integrated animal health and production for the production of food and not on individual animal medicine. Unfortunately, for livestock veterinary medicine, most students who enter veterinary medicine to become animal medical doctors to treat sick animals. Many veterinary students are simply not interested in production-oriented veterinary medicine.

Factory Farming. The industrialization of food animal agriculture, or sometimes now called factory farming is a major topic which must be addressed by veterinary educators and food animal practitioners. Consumer advocates, animal rights and welfare activists are busily campaigning against intensified agriculture because of what they perceive as animal suffering. Veterinary educators and the organized veterinary profession cannot ignore the potential animal welfare, animal health, environmental, sociological, and human health consequences, of intensified food animal agriculture. It is a major and very complex multifactorial subject, and veterinary science and veterinary medicine, in concert with our colleagues in agrology, must become proactive. If that means that if veterinary science has reservations about the extent of intensified food animal agriculture, then it should be in the forefront of integrated animal health and production management. At the undergraduate level in veterinary college, it means appropriate instruction in a food animal program during at least the last two years of a four-year program.

PRIVATE FOOD ANIMAL PRACTICE

Over a period of about 45 years (1945 to 1990), the percentage of veterinary practitioners engaged in a single-species such as small animals and horses, increased, and continues to increase, while the percentage in mixed animal practice declined (Pritchard 1993).

Mixed Animal Practice

Historically, mixed animal practitioners in North America provided veterinary service to owners of dairy and beef cattle, sheep and goats, swine, horses, and small animals. In certain areas other species such as camelids and alternative livestock such as elk, bison and farmed deer were included. Most mixed animal practices,

doing predominantly large animals, have usually depended on small animal practice as a source of income when the large animal part of the practice is relatively inactive.

There are many opportunities available for new veterinary graduates in mixed animal practice on a worldwide basis. Students and new graduates commonly say that they want to experience mixed animal practice because they are unsure of what career path they want to pursue.

Mixed animal practice in rural communities is gradually becoming limited to cattle and small animals, and horses. The majority of the veterinary activity is in cattle practice but characteristically, these practices gradually do more and more small animals. Small swine herds have been replaced by larger herds which are being served by swine veterinary specialists.

The emphasis in mixed animal practice has been on individual animal medicine, emergency service, some herd investigations, and task-oriented herd health work such as pregnancy diagnosis, breeding soundness examination of bulls, and recommendations on health management such as vaccination schedules.

Sales of drugs and vaccines constitute a significant portion of income. The number of veterinarians in mixed animal practices varies from one to several with and several and there is a tendency for each veterinarian to develop a special interest in certain aspects of a species or a discipline.

Single-person rural veterinary practice (mixed animal practice with emphasis on large animals) in small rural communities is no longer attractive to new graduates. Only a small number of new graduates want to enter such practices in small isolated rural communities which demands long days and little time off.

Historically, food animal practitioners entered mixed animal practice in rural communities, were motivated and dedicated, and became pillars of the community. They raised families successfully. Inevitably many such practitioners shifted to do more small animal practice as it became available. But now these practitioners are finding it difficult to recruit new graduates into these rural areas and cannot sell their practices.

Over time, as the profession divides itself into career tracks, the mixed animal practitioner might eventually disappear. The current model in which every community has a mixed practice might not survive for reasons of public protection and assurance of competency and level of service (Prescott et al. 2002).

Why are new graduates more interested in mixed animal practice than a single species or class of animal practice such as dairy cattle, beef cow-calf, beef feedlot, or swine, or veterinary public health? Is there a realistic future in being a mixed animal practitioner who provides adequate veterinary service to all the domestic animal species?

Specialty Food Animal Practice

In food-animal practice, specialization is gradually developing in a species or class of livestock such as dairy cattle, beef breeding herds, beef feedlot, swine herds,

and small ruminants. There are opportunities for specialty food animal practice in Canada and the United States and livestock producers are willing to pay well for competent veterinary service. However, specialty practice requires a certain concentration of farms and animals which will support the establishment and continuation of a specialty practice in a certain area. Mixed animal rural practitioners consistently point this out when they claim that there are limited opportunities in most rural areas for a species specialist. But farms continue to increase in size and decrease in numbers. The larger they are the more need there is for advanced health and production management.

Food animal veterinary medicine serves producers and must respond to the forces that influence the clientele it serves (Leman 1988). The ultimate business of the livestock industries is to produce food for human consumption. The viability of these industries is therefore dependent on raising disease free animals and the efficient production of wholesome and nutritious meat, eggs, poultry, milk and other animal based food products. Practitioners who deal exclusively with dairy cattle, beef cow-calf herds, beef feedlots, or swine herds are health and production management oriented which is very complex. However, food animal veterinary education at the undergraduate level has not become as advanced as necessary because colleges have not applied the resources to the task.

"The knowledge and the technology are available to provide a cost-effective comprehensive health management veterinary service to production-oriented livestock producers. The delivery of the service by veterinarians is the greatest challenge facing large animal practitioners."

At the undergraduate level our greatest challenge is to teach those students who are interested, how to deliver a comprehensive health management and production veterinary service to the modern livestock producer.

Dairy Cattle Practice

There are many opportunities in general or specialty dairy cattle practice. The spectrum of the dairy cattle practitioner in North America varies from the generalist who provides routine emergency individual animal medicine and some basic herd health activities for herds from 50 to 200 cows, to the specialist who provides a specialty service for dairy herds ranging in size from 200 to 1,000 or more lactating cows. The nature of dairy cattle practice is highly variable depending on the needs and expectations of the producers. In some large herds, resident veterinarians are employed full time by the producer. ***Dairy cattle practitioners in this survey said there are many excellent opportunities to practice first class dairy cattle health management and production veterinary medicine.***

A dairy cattle veterinary specialist provides comprehensive health and production management veterinary service which could include evaluation of reproductive performance, mastitis control and milk quality including milking machine evaluation, calf health management, nutritional status of the herd and feeds and feeding consultation, infectious disease control and vaccination recommendations, advice on culling and breeding programs, biosecurity strategies for purchasing

breeding stock, evaluation of animal health and production records, and the economics of milk production. Veterinarians make regularly scheduled visits to the farms and may spend several hours to a full day on health and production management.

There are opportunities for postgraduate specialization in dairy cattle such as the Dairy Production Medicine offered at the College of Veterinary Medicine in California. The residency focuses on the skills and approaches to provide production medicine services to large commercial dairy operations, with training in dairy production medicine, nutrition, animal health economics, diagnostic pathology, computer analysis, and udder health surveillance. During the residency, the candidate will: 1. be involved in faculty-directed research; 2. participate in teaching 4th year veterinary students; 3. learn to structure and analyze farm-based research; 4. develop skills in communicating with dairy producers and employees; 5. participate in dairy employee training programs; 6. develop quantitative skills to analyze dairy records; and 7. develop skills in epidemiology and interpreting population-based research. The residency teaches the candidate quantitative skills that can be utilized in the interest of controlling and preventing economically important diseases and improving the efficiency of dairy cattle production.

There are also Dairy Health Management Certificate Programs which have been offered by the Ontario Veterinary College, and the Pennsylvania Dairy Production Medicine Certificate Program.

Beef Cow-Calf Herd Practice

There are many opportunities in beef cattle practice, either in a mixed multiple-person practice, or as a beef cow-calf specialist. Beef herds in North America vary considerably in size. In the US in 1998, 80% of the beef herds had 1-49 cows, 12% 50-99 cows, 7.7% 100-499 cows and 0.6% had more than 500 cows. The needs of beef cattle producers vary from individual animal medicine, to basic herd health procedures such as pregnancy diagnosis, breeding soundness examinations, and providing advice on disease control and vaccination recommendations. The caseload is typically seasonal. Pregnancy diagnosis in the fall season, breeding soundness of bulls examination in the spring, and weaned calf diseases in the fall. During calving season, emergency services consist primarily of obstetrical assistance including caesareans as necessary, and the treatment of calves with neonatal disease. As herds become larger, and as owners become more knowledgeable, veterinarians provide more animal health and production integrated veterinary service which includes evaluation of reproductive performance and evaluation of the feeds and feeding program for the winter months, evaluation of production records, prebreeding evaluation of the female part of the herd, biosecurity strategies, and the provision of advice on calving management, weaning procedures, heifer replacements selection, and consultation on the economics of production. The veterinarian may make several scheduled herd visits annually to make observations, collect animal health and production data, perform procedures such as pregnancy diagnosis and breeding soundness examinations and evaluate the nutritional program.

A certificate program is available in beef cattle health and production management. The Beef Cattle Production Management Series is conducted by the Great Plains Veterinary Education Center, University of Nebraska. This program aims to train veterinarians to use tools to evaluate and monitor production-management strategies and integrate the many factors involved in decision-making to optimize productivity and improve financial success for beef cattle producers. The program is multidisciplinary and interactive, consisting of seven 3-day sessions conducted at the Center over a 12- to 15-month period, with an emphasis on problem solving at whole-farm and industry levels. Topics include financial management, nutrition, preharvest food safety, epidemiology, data handling and analysis, and communication skills.

Beef Feedlot Practice

There are some opportunities for new graduates to enter beef feedlot practice. However, few graduates seem interested. Most feedlot veterinarians have been in large animal practice for a few years and circumstances provided the opportunity to pursue feedlot practice. In North America, feedlots vary in size from capacities of 500 to 30,000 to 50,000 animals.

The veterinarian is responsible for maintaining optimum animal health through the following activities:

Makes regularly scheduled visits to the feedlot, is punctual, and stays as long as necessary for adequate consultation. The frequency of visits depends on the size of the feedlot, the time of year, the expertise of the feedlot personnel, whether animals have recently arrived, and the degree to which the veterinarian is contractually responsible for the total animal health program.

Is available for emergency visits to the feedlot when disease epidemics occur unexpectedly.

Performs necropsies during the visit and trains feedlot personnel to do necropsies at other times.

Examines sick animals with the treatment crew to ensure that reasonably accurate diagnoses are being made and rational therapy is being given according to the previously provided treatment protocol.

Regularly examines, analyzes, and interprets animal health and production data and periodically makes recommendations in a written report. The effectiveness of detection of sick animals, based on response and relapse rates and case fatality rates, should be determined, and the effectiveness of the processing program for new arrivals, which includes the vaccines used and the medications given, should be examined and analyzed regularly. The veterinarian is responsible for selecting and prescribing all drugs used in the lot, giving specific advice about the use of drugs, and establishing a drug residue avoidance program in the lot.

Discusses overall animal health and production performance with the feedlot manager and other consultants. He or she coordinates the advice of other

specialists, sets animal health and production goals, and monitors achievement.

Performs benchmarking with other operations. Produces a monthly report that compares processing costs, treatment costs, and death loss by arrival weight and days on feed for clients in the consultants practice.

Takes an interest in all aspects of the feedlot operation and makes an effort to be aware of new developments in the feedlot industry.

Feedlot Health Management Services (Okotoks, Alberta)

This veterinary practice is an example of the highly advanced level of service which can be provided to the feedlot industry. It must be unique in the world.

Feedlot Health Management Services (FHMS) is a consulting company providing comprehensive herd health programs, veterinary consulting services, and computerized health recording systems to feedlots throughout western Canada and the United States.

The company is based in Okotoks, Alberta, Canada and currently employs 9 veterinary consultants and 18 administrative personnel. The practice has expanded over 18 years and presently provides production consulting services to beef feedlots with an annual throughput of greater than one million animals.

FHMS conducts over 25 research studies in feedlot and cow/calf operations every year. Studies are conducted for pharmaceutical companies, feed companies, government agencies, academic institutions, independent research firms, and client feedlots. The feedlot studies are conducted in both large, commercial feedlot pens (up to 600 animals per pen) and small, research feedlot pens (8-16 animals per pen). FHMS conducts various types of research studies:

1. Disease investigations
2. Product safety and efficacy studies
3. Commercial feedlot field trials
4. New technology assessments
5. Grain and forage production evaluations

The objective of these studies is to evaluate new and existing technologies and products to further enhance the efficiency of production and the quality and consistency of the beef produced in commercial feedlots. The results of these studies are incorporated into computerized economic models that assess the overall cost-benefit of the technology or product in question.

Currently, FHMS has authored or co-authored over 35 peer-reviewed scientific articles, completed more than 130 technical reports relevant to the academic field, and presented technical material at more than 200 conferences and meetings throughout the world. All studies are designed and conducted to a standard that would allow for publication in peer-reviewed scientific journals.

FHMS provides feedlot clients with a computerized individual animal record keeping system called FHARM[®] (Feedlot Health Animal Record Management). The system is designed to meet the requirements of feedlot administrative and animal health personnel, production consultants, legislative/legal responsibilities, and national identification program compliance.

FHARM[®] is designed for multi-user, multi-site functionality in a user familiar Windows environment. The program has the ability to handle large amounts of data with an automated dial-up feature that allows data transfer between the feedlot and Feedlot Health Management Services. The system is based on unique individual identification of all animals, assignment of individual animals to financial entities called lots, and recording and tracking of all individual animal level events (processing, diagnosis and treatment, production strategy, weight capture, animal movement, marketing, death, etc.). All processing and treatment protocols are provided on-line. There is also an extensive help document that provides program help as well as production and management guidelines. The program also generates both animal health and administrative reports.

FHARM[®] also interfaces with a serial concentrator called AWACS (Animal Weighing and Controlled Sampling, Mix-Weigh Inc.). This system allows for automated input of scale weight, GLA thermometer temperature reading, electronic animal ID, and national electronic ID into FHARM.

Individual animal data are collected and stored centrally at FHMS. Records are analyzed and used for benchmarking, forecasting, and tracking all animal health events. Epidemiological data are generated that aid in the data-based decision making process.

FHMS provides education and training for feedlot personnel, digital necropsy imaging service, disease surveillance and monitoring, production management strategies, development of feedlot policies and standard operating procedures, as well as other administrative services including pharmaceutical procurement.

Swine Practice

There are opportunities for new graduates to pursue swine specialty practice in

North America. In the swine industry, the small herds are gone and large herds of thousands of breeding sows dominate the industry in which the integration of health and production, disease control, waste control, applied nutrition, epidemiology and high biosecurity measures are commonplace. The emphasis is on intensified production, economic viability, and the veterinarian being paid for healthy animals. The swine veterinary specialist does almost no traditional individual animal emergency medicine such as obstetrical assistance for farrowing sows and treating mastitis. Determining and modifying or eliminating the factors which account for the spread of infectious disease is an important veterinary activity.

The veterinarian in the swine industry has three main roles: advice on the diagnosis and treatment of individual animals; the diagnosis and treatment of groups of animals or herds; and the provision of advisory services to the farm to improve production, health, and productivity. The first role is diminishing and the third role is increasing.

The changing roles are a reflection of the ever-changing swine industry. The number of herds is decreasing, and the size of herds is increasing. One view is that the general practitioner can handle most problems in herds with up to 150 sows. In herds larger than this size, a specialist's knowledge of the swine industry and herd is

necessary. The very large swine producer or farming company with herds of 500 to 1000 sows requires the services of a veterinarian who can deal with the complex interrelationships that exist in such large herds. The characteristics of the large swine producer of the 1990s include the following: they produce over 500 litters per year; it is a family farm; the second-generation members of the family have college degrees; the family is hard working, conservative, quite wealthy, and has several employees; the

farm is also involved in the production of crops; and the producer takes risks.

Veterinarians can also have an economically viable practice from these large swine farms through the sale of drugs, vaccines, other animal health supplies, and premixes; veterinary services; and consultation. Because of competition from other sources, the revenue from the sale of drugs and vaccines will be limited. Veterinary services include the routine diagnosis of disease, writing prescriptions, government regulatory work, acute disease drug therapy, and specialized surgery. The consultation services will consist of helping producers with intermediate and long-term decisions regarding disease management, cost-benefit nutrition, genetic program evaluation, environmental management, and the logistics of production flow of pigs.

In the study of the US livestock market for veterinary medical services in 1995, swine practitioners generated the highest individual practitioner revenue and the highest percentage revenue from sales of animal health products.

Sheep and Goat Practice (Small Ruminants)

There currently approximately 900 U.S. and 95 international veterinarians, not specifically categorized by specialty and mixed practices, 80% see all small ruminant groups: sheep, goat, camelids & deer/elk. Percentages in these categories vary for each practitioner and some do not see all species. There are vacancies and opportunities in the small ruminant field and the American Association of Small Ruminant Practitioners (AASRP) encourages interest for upcoming veterinarians. Many of these practitioners that take 4th year veterinary students on externship programs and have AASRP chapters at many colleges in the U.S. and a few in Canada. AASRP also offers grants to students for programs they may need or want to attend in their 4th year.

Poultry Practice

There are approximately 500 members of the American Association of Avian Pathologists which are members of the AVMA. The poultry veterinarian is either a diagnostic laboratory employee or an employee of a poultry company or a technical consultant employed by a pharmaceutical company. Postgraduate studies are increasingly required because the field is so highly specialized; some would say as specialized as any of the clinical disciplines in a veterinary college. There are undergraduate courses in poultry science including diseases of poultry. These poultry science graduates become production managers for poultry companies and become assistants to the poultry veterinary practitioner. Poultry practitioners are becoming more involved in the corporate decisions in companies. This is accelerating as food

safety and antibiotic usage become issues. Poultry veterinarians are perfectly situated for HACCP/Food Safety program trainers and auditors. In the US it is estimated that annually there about 10 new positions for new veterinary graduates to pursue poultry practice.

Teaching and Research

There are many highly satisfying career opportunities in teaching and research careers in food animal veterinary medicine in veterinary colleges worldwide. This includes undergraduate and postgraduate teaching, and continuing veterinary educational programs many of which are presented by veterinary clinicians. Currently there are, and will be, major shortages of qualified veterinarians for faculty positions in veterinary colleges who have the necessary postgraduate education and training. Veterinarians with postgraduate qualifications and clinical experience are needed to teach and do research in large animal internal medicine, surgery, and theriogenology of food animal practice. In ambulatory clinics of veterinary colleges there is a need for clinicians to teach individual animal medicine, reproduction and surgery of the food animal species, and health and production management of dairy herds, beef cow-calf herds, swine herds, beef feedlots, small ruminants (sheep and goats) including camelids, wildlife and specialized livestock including farmed deer, elk and bison, and poultry production. Such teaching responsibilities require a group of clinicians who are species specialists.

The development and maintenance of a critical number of qualified clinicians who can teach undergraduate and postgraduate students how to deliver leading edge comprehensive health and production programs to livestock producers in the vicinity of a college has always been a major challenge. Such clinicians must be the first line leaders because they have the opportunity and the time to motivate students to pursue a career and become competent and confident in food animals. All aspects must be taught including the collection and analysis of animal health data and preparing reports to be sent to the producer. The opportunity for the student to learn about food animals must begin at the college where the student has the time and faculty and library resources to assimilate the knowledge and apply problem-solving skills. This can be combined with practitioner externships where the student has the opportunity to apply the principles and hone their skills.

Veterinary epidemiology has become a vital center of activity in teaching and research in food animals. Likewise, veterinary ethology has become an integral part of a teaching and research programs in food animals.

Industrial Veterinary Medicine

Industrial veterinary medicine deals with the manufacture and sales of animal health products such as pharmaceuticals, biologics and veterinary diets. Veterinarians in these companies provide veterinary advice and consultation to both internal (sales, marketing, training) and external customers (practicing veterinarians and other end users). These veterinarians are involved in the research, development, field testing and interfacing with regulatory authorities for the approval of new products, and any technical issues which may occur following approval and use in the

field. Qualifications following the DVM degree range from three to five years of practice experience, postgraduate education in disciplines such as epidemiology, and an increasing number with MBA degrees.

PUBLIC VETERINARY MEDICINE

There are many opportunities for veterinarians to practice veterinary medicine in federal and state government organizations such as the United States Department of Agriculture, and state or provincial diagnostic laboratories. The US Federal Government is the single largest employer of veterinarians; approximately 2000 as of 2002. The future of veterinarians in government has been reviewed (King 2000b). Consideration of the list below of events and situations associated with infectious diseases of food-producing animals makes it clear that both public and private practice sectors of veterinary medicine have a major obligation to ensure the production of wholesome and safe meat and milk. Biosecurity has now become a major activity. In a recent publication of *Veterinary Clinics of North America, Food Animal Practice*, a series of papers dealt with Biosecurity of Cattle Operations (Dargatz 2002; Dargatz et al. 2002).

Importance of Infectious Diseases of Food-producing Animals. The infectious diseases of food-producing animals, some of which are **zoonoses**, assume major importance to the livestock producer because of the economic losses associated with illness, deaths, treatment, and control procedures. In the last few decades, and especially in the last 10 years, various other aspects of infectious diseases of food-producing animals have assumed major importance to both the livestock producer, national economies, world trade organizations, import and export regulations, and public health aspects. The recent epidemics of bovine spongiform encephalopathy and foot-and-mouth disease illustrate the complexity of the diseases themselves, the enormous economic losses to the nation, and the adverse effects of the epidemics on the emotions of the human population. Those two diseases alone have had immense effects on the perception which society has on animal agriculture, particularly the cattle industries, both dairy and beef.

On a worldwide basis, livestock producer groups, governmental agencies, and veterinarians, have introduced a variety of biosecurity programs designed to produce wholesome and safe meat and milk and other animal products for human consumption.

Some examples of occurrences, activities, and actions taken related to the control of infectious diseases in food-producing animals and their public health aspects are as follows:

In October 2002, The Center for Disease Control and Prevention announced, along with several State Health Departments, the identification of an "outbreak" strain of listeria found in a poultry processing plant, and in 46 affected persons. There were 10 deaths, and a number of miscarriages or stillbirths.

Foot and mouth disease outbreak in the U. K. 2001. (Source of infection- illegally imported meat uncertain) and rapid spread occurred because of uncontrolled movement of sheep across the country. Cost of eradication and economic losses to the country approximately 20 billion dollars.

Walkerton, Ontario, town drinking water tragedy, E.coli 0157H:7. Several people died and hundreds ill.

Frequent recalls of millions of pounds of ground beef contaminated with E. coli 0157H:7 in North America. Economic losses very high.

Cattle Identification Program. Canadian Cattle Identification Agency. Trace cattle back to herd of origin

Food Safety and Food Quality. Consumers are raising the bar for food safety and quality

Bovine spongiform encephalopathy and variant Creutzfeldt-Jakob disease. UK The BSE Inquiry (A publication of thousands of pages). Affects consumer beef consumption.

Cysticercosis in a feedlot (Ontario 1996-1998). Due to feeding human food wastes?

Outbreaks of Salmonellosis in cattle which had been treated in a large animal clinic in Saskatchewan and subsequently spread to farms using the clinic.

Jeopardizes future of large animal clinics.

Cryptosporidia in water supplies (North Battleford, Saskatchewan, 2001). Did the parasite originate from cattle?

Does *Mycobacterium avium* subspecies paratuberculosis cause Crohn's disease in man? Does pasteurization inactivate the organism?

Tuberculosis occurs in cattle herds in Manitoba and Ontario 2002. Canada eradicated tuberculosis in cattle many years ago.

Healthy People 2010. Healthy People 2010 is the health promotion and disease prevention initiative for the next decade in the United States (Hendrix et al. 2002). As veterinarians we must educate our human counterparts and the public at large regarding our profession's contributions in key areas such as food safety, the human-animal bond, and intervention in the event of bio-or agriterrorism. The food safety objectives are the primary topics which link the discipline of veterinary medicine to Healthy People 2010.

United States Federal Food Safety and Inspection Service

The United States Department of Agriculture's Food Safety and Inspection Service has described the *Future of FSIS Veterinarians: Public Health Professionals For the 21st Century* (FSIS-USDA 2000). Approximately 2,000 veterinarians are employed in the US Federal Service. In 1996, FSIS issued the Pathogen Reduction; Hazard Analysis and Critical Control Point (HACCP) systems final rule to control and reduce pathogens (harmful bacteria) on meat and poultry. Federal and State meat and poultry plants must adopt HACCP, a system based on hazard prevention, with performance standards set by FSIS. Effective implementation of HACCP by industry will ensure safe food and should alter relationships with FSIS. Astute utilization of

veterinary resources enhances farm-to-table food safety. FSIS employees increasingly make science-based judgments that impact a broad range of entities.

FSIS believes its food safety goal should be to reduce the risk of foodborne illness associated with the consumption of meat and poultry products to the maximum extent possible by ensuring that appropriate and feasible measures are taken at each step in the food production process where hazards can enter and where procedures and technologies exist or can be developed to prevent the hazard or reduce the likelihood it will occur.

Veterinarians are the predominant internationally-recognized authority to audit and inspect foreign establishments that export animal foods to the United States. They assess the safety of animal products from foreign sources, including freedom from unsafe levels of chemical residues, exotic pathogens, and emerging agents of public health importance. Veterinarians are recognized internationally for possessing the scientific competence and integrity to sign certification for animal products attesting that the products were produced within a system of controls which meet both food safety and disease freedom requirements of importing countries. They help ensure public and international confidence in the safety of the animal-based food supply.

Veterinarians have an in-depth understanding of production practices and animal disease and the linkages between them. They can identify and scientifically evaluate the potential human and/or animal health significance of the wide variety of clinical signs in animals submitted for slaughter (antemortem inspection). These skills help veterinarians make individual animal disposition judgments and target animals that may need more intensive inspection and/or diagnostic work. Examples include: (1) surveillance for exotic or notifiable diseases (e.g., bovine spongiform encephalopathy, brucellosis and tuberculosis); (2) monitoring for disease or physiological states which can increase the potential for, or significance of, contamination occurring during processing (e.g., severely stressed animals tend to be high shedders of *Salmonella*); (3) assessing suitability for entering slaughter of non-ambulatory animals (downer animals), injured animals or animals approaching parturition, and then examining them after slaughter; (4) checking for signs indicating likely recent drug treatment or exposure to contaminants; and (5) monitoring for disease or physiological states which make the animals unsuitable for slaughter for human consumption. While other specialists may be able to evaluate animals as "normal" or "not normal," a veterinarian should make a specific diagnosis and interpret the significance of the findings. This information is increasingly important in ensuring reliability of producer and processor quality assurance programs in the farm-to-table continuum.

Veterinarians have a strong foundation upon which they can build capabilities to supervise, train, and interact with others. This includes knowledge and professional experiences in record keeping, systems analysis, administrative skills, and client education. Veterinarians have skills in developing, implementing, and analyzing public and animal health policies, correlating and analyzing information systems, managing and leading complex and extensive government programs and personnel, and building national and international partnerships for food safety systems.

Veterinarians can train food inspectors, laboratory personnel, and sanitarians. These skills will be especially important in helping educate very small plant operators to meet pathogen reduction and HACCP requirements.

Veterinarians are well-trained and experienced in animal welfare during production and in humane handling as animals are transported, unloaded, stunned, and handled at plants. They are well able to evaluate compliance with the Humane Slaughter Act, especially proper stunning, bleeding, rail insensibility, pen maintenance and handling, truck unloading procedures, and handling of non-ambulatory animals.

FSIS Veterinary Student Employment Program. This program provides experience that is directly related to the student's educational program and career goals. It provides a schedule of periods of alternating attendance at an accredited veterinary school combined with periods of career-related work in a Federal Agency.

Students work directly under the supervision of a FSIS veterinarian acquiring knowledge of what veterinarians do throughout the Agency. Students learn what in-plant veterinarians do to ensure the meat, poultry, and egg products that reach the consuming public are safe, wholesome and correctly labeled.

First and second year students benefit most from the program because the goal of the program is to complete 16 weeks of employment prior to obtaining their DVM degree. Those completing 16 weeks of employment will be eligible for noncompetitive placement into a career position upon graduation. Completing 16 weeks of employment can be accomplished during school breaks (i.e., summer and holiday breaks) prior to graduation. At a minimum, students will be asked to commit to 8-10 weeks of full-time employment during the summer beginning in May or June 2003, depending on the student's schedule.

United States Department of Agriculture. Animal and Plant Health Inspection Service

Veterinary Services (VS) a part of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) is responsible for protecting and improving the health, quality, and marketability of the Nation's agricultural animals, animal products, and veterinary biologics. VS practices preventive veterinary medicine on a broad scale, dealing with animal health problems of statewide, regional, national, and international importance. These broad responsibilities can have a profound effect on many aspects of American agriculture and animal health, especially the success of U.S. agricultural exports in world trade.

VS supports the livestock industry in the prevention and control of animal diseases that could otherwise be devastating. VS activities have international significance through import export and emergency response programs. VS employees also ascertain that all licensed animal biological products distributed interstate, like vaccines, are pure, safe, potent, and effective.

As a regulatory agency, APHIS uses a collaborative rulemaking process that enables it to adapt to industry needs in a changing environment. The VS program is moving to a more broad-based public service role in order to better serve

stakeholders and constituents and meet the demand for increased services. VS plays an important role in safeguarding America's animal health. And the best way that VS can stay on the cutting edge of veterinary science is to recruit and hire professionals with the best credentials and experience people like you.

A career in public veterinary health affords the opportunity to be involved with the health of major animal populations in many activity areas. Veterinarians have a responsibility for the health of the Nation's animals, and public health veterinarians can have a broad and lasting impact on animal health issues. Animal health technicians perform a variety of specialized duties that support our public health mission.

Army Veterinary Corps

The Corps anticipates the need for 30 to 40 veterinarians per year. It will continue to focus on public health, food safety, food science and technology, research and development, and operations of clinical services. The Corps will continue to need veterinarians with certain specialties and graduate degrees in pathology, pharmacology/toxicology, and laboratory animal medicine.

U. S. Agricultural Research Service

This agency needs veterinarians with specialties in microbiology, virology, pathology, parasitology, molecular biology, and epidemiology. Opportunities may also exist in microbial pathogens of animal-based food products, and pathogen and antibiotic resistance issues.

Canada Food Inspection Agency

The Canadian Food Inspection Agency (CFIA) is a Canadian federal government organization that works with consumers, industries and other government agencies to build one of the safest food systems in the world. The CFIA is committed to delivering effective and efficient federal inspection and related services for food safety, animal health and plant protection.

Veterinarians play a key role in food safety. They contribute to the healthy food and livestock industry in the areas of meat hygiene, animal health and within research and diagnostic laboratories. This is accomplished through frequent contact with the public and industry officials to help educate them to the potential hazards of importing products of animal origin, or through inspection of animals and meat products.

Veterinarians form the first line of defense against the spread of many diseases.

They work in laboratories performing research or diagnostic testing, controlling the authorization of veterinary pharmaceuticals, working in the field dealing with contagious disease outbreaks, testing animals for import and export and working in plants performing antemortem and postmortem inspections. They are a crucial player in the maintenance of human health through the meat inspections and control of foodborne and contagious diseases.

To be employed as a Veterinarian in the Agency the minimum requirement is graduation from a recognized school of Veterinary Medicine, as well as eligibility for

membership in a Canadian Veterinary Association. In Canada, at the time of the creation of the Canadian Food Inspection Agency in 1997, 491 veterinarians were employed in positions designated as veterinary medicine.

By 2002, that number had risen to 561. This does not include those staff with veterinary training who are employed in management positions which would add a further 18 to that number.

Of the 561 veterinary inspection staff, 441 work in Operations Branch providing front line delivery of activities at registered establishments (abattoirs and food processing sites), district offices and ports of entry. An additional 118 work in Programs Branch responsible for the regulatory and policy framework, program standards, laboratories, surveillance and risk assessment areas. In addition, there are two veterinary staff that work in public affairs and science evaluation. In terms of trends, approximately 20% of the current veterinary medical complement will be eligible to retire within the next five years, therefore, requiring a minimum of 110 to be hired over that time for renewal and it is hoped that further modest growth of perhaps an additional 40 positions will occur over that time.

Government Diagnostic Laboratory Services

Diagnostic laboratories and investigative centres are necessary for continued active and passive surveillance of diseases of food animals in a country. These laboratories are necessary for diagnostic pathology, clinical pathology, serological diagnosis and surveillance programs for infectious diseases.

In some jurisdictions these laboratories have been downsized or eliminated along with government regulatory veterinary services which have been reduced drastically in the last decade. As a result, crisis management rather than long term planning and visions of the future are common. Veterinary practitioners are very concerned about a lack of adequate veterinary diagnostic laboratory resources to investigate problems in the field. The recent outbreak of foot and mouth disease in the U. K. in February 2001, made regulatory veterinary authorities in many countries wonder about their level of readiness to handle such epidemics because of the reduction of veterinary manpower devoted to such potential epidemics.

A high percentage of currently employed veterinary laboratory diagnosticians in North America will retire in 10 to 15 years, and there are insufficient new graduates interested in such careers. This will seriously jeopardize animal disease surveillance programs.

Several emerging infectious diseases which affect both animals and man are not being adequately investigated because of lack of veterinarians in research careers devoted to such problems. Also, there seems to be a lack of veterinary interest in food safety and water quality and its relationship to the intensification of food animal production.

Environmental Toxicology and Ecosystem Health

Environmental toxicology encompasses the study of a wide array of chemical contaminants and toxic effects on species ranging from humans to other vertebrates, invertebrates, plants, protozoa, bacteria, fungi, and viruses (Beasley, 1993).

Ecotoxicology, a subdiscipline of environmental toxicology, is the science of toxicants in environments and their effects on living organisms, including interactions among organisms and with the environment.

Ecosystem health aims to provide a suitable environment to support human populations and maintain biological diversity. The goals of ecosystem health practitioners will be achieved through the equivalent of health management programs. Monitoring ecosystem health by using parameters currently used by classic ecologists, as well as those of conservation biologists, veterinarians, plant health specialists, geneticists, and others, will be essential to prevent problems before they become widespread. As in the production paradigm of food animal health management, conserving inputs and providing what is needed for optimum health is the ideal mode for ecosystem health management. It will also be necessary to include various types of emergency specialists able to deal with such problems as chemical spills, exotic species invasions, exotic diseases, and problems facing threatened and endangered species. Food animal practitioners are now becoming involved in improved productivity and wholesomeness of food of animal origin through better air and water quality, nutritious diets free from harmful contaminants, proper disposal of animal wastes, and specific disease-monitoring and prevention programs. Because food animal practitioners provide regular on-the-farm consultation, which increasingly involves management decisions, and because of their knowledge of infectious agents and toxic chemicals, they already assume a role in farm ecosystem protection. As agricultural policy becomes more attuned to environmental concerns, and as concerns with regard to urban, suburban, and home environments increase, at least some astute veterinarians will expand on their current expertise as knowledgeable environmental consultants for the animal-owning public. Concerns for environmental health may focus on the needs of the human population, domestic animals, and wildlife, and may involve recommendations to avoid contamination of air, soil, water, and food. Environmental assessments will be done performed on farm visits.

Veterinarians are now becoming involved in evaluating the potential adverse effects of environmental pollution on livestock and human health. Only recently have epidemiologic methods been used to study the potential effects of environmental contaminants from the oil and natural gas industry on livestock health and production (Waldner et al., 1998).

CHANGES REQUIRED IN PRIVATE FOOD ANIMAL PRACTICE TO MAKE IT ATTRACTIVE TO NEW VETERINARY GRADUATES TO ENTER AND PURSUE A CAREER

Gradually Change the Paradigm of Private Practice

It is the responsibility of the members of the practicing veterinary profession to take the lead in developing and implementing a best practice model for mixed animal practice and specialty food animal practice. Programmed animal health and production in food-producing animal herds continues to grow and expand and will continue to do so and last as long as animals are kept for food production, in contrast to individual animal medical practice which will be less important, and will be done by

owners, herdsman, and veterinary technicians in the future. Food animal species specialization will continue to expand. Herd health and all its related activities such as food supply, food safety and food quality, (veterinary public health) and protection of the environment from intensified animal agriculture is the way of the future and abounds with many different opportunities for veterinary graduates. Producers and herdsman must be educated about the economic benefits of integrated animal health and production total animal health care.

Cooperation rather than competition between practices would facilitate practice working conditions.

Multiple-Person Practice

Consolidation of small rural veterinary practices into larger multiple-person practices with several different species specialists will gradually occur. Almost all veterinarians surveyed indicated that multiple-person practice is necessary in food animal practice. Several veterinarians in a group can consult with each other, regularly review cases, roster night and weekend emergency service equitably, and, very importantly, provides the opportunity for each veterinarian to pursue certain areas of interest and become experienced and highly competent in a particular aspect of the practice. Every member of the practice can be encouraged to become good in some aspect of herd health management and eventually a multiskills practice will evolve. Practices must become centers of excellence in food animals. A group practice provides the time and the opportunity to develop more health and production-oriented services if the routine individual animal medicine is shared among the members of the practice, or as is commonly done, the most recent graduate will do most of the individual animal medicine and gradually develop the knowledge and skills necessary for herd health work. Time can be made for individual veterinarians to pursue certain specialized continuing education programs such as Certificate Programs which may lead ultimately to Board Certification. Effective supervision and mentorship can be provided in a multiple-person practice. With an adequate number of veterinarians in a practice, qualified support staff like veterinary technicians can be effectively employed. The experiences of veterinary students visiting such practices on externships will be enhanced because there will more likely be sufficient work to be done compared to the single person practice which may have very busy times or very little to do depending on the season.

Supervision and Mentorship

To improve satisfaction and experience, the new graduate needs adequate supervision and mentorship especially during the first year in practice. This means almost daily communication and discussion about cases, being available for surgical procedures and complex cases which the new graduate has not experienced. Constructive feedback and regular evaluation of performance are necessary. The new graduate must be empowered to excel. Communications must be effective and colleagues must listen carefully and attentively. Problems must be examined together. Owners of the practice must assure clients that the new graduate is conscientious and concerned about providing competent service. New graduates should be allowed to

do certain procedures their way unless evidence suggests it may be unsatisfactory. Graduates must come to feel satisfied about the work they are doing. Graduates must also appreciate that they need supervision and mentorship.

Professional and Business Development of Veterinary Practice

Private veterinary practice must become much more professional and business oriented. As presented earlier, the KPMG Mega Study , indicated that many veterinarians although clinically competent, may lack the crucial skills, knowledge, aptitudes, and attitudes that typically are correlated with , and may be essential for, their economic success. The detailed outline of the topics for a curriculum in Veterinary Professional Development and Career Success is provided in the paper by Lloyd and Walsh (Lloyd & Walsh 2002). One outstanding section deals with, The Art and knowledge for a successful veterinary practice . Items the section include: Business fundamentals; marketing and promotion; practice location; the fiscal enterprise, managing human resources; record keeping; essential legal knowledge; how to evaluate a practice for sale. Another section deals with Understanding Leadership.

In order to attract new veterinary graduates into food animal practice, it must be appealing, attractive, interesting, exciting, motivating, and progressive. The new graduate must become empowered to excel in his or her work and be given opportunity to be innovative. This requires a critical mass of veterinarians, technicians, and excellent receptionists and secretarial assistance. If the practice will not sustain such a critical mass, it is questionable that it should be maintained.

The National Commission on Veterinary Economic Issues (NCVEI) has introduced benchmarking of excellent practices which can be compared with other practices to determine what may be done to improve the professional and economical status of the practice. Anything worth doing, is worth doing right .

Value for Veterinary Service

Many veterinarians say that a major problem with food animal practice, especially those in mixed practice, is that we undervalue our veterinary services. If that is true then we must reform veterinary medicine and make our services more valuable by improving our competence.

Food animal practice as part of a mixed animal practice may no longer be economically viable. In order to compete with other opportunities in veterinary medicine, food animal veterinarians must become much more competent in order to add value to livestock operations. The U. S. Livestock Market for Veterinary Medical Services and Products (1995) indicated that The fundamental task for food animal veterinarians is to shift from a fee-for-service or task oriented business relationship to fee-for-advice or information oriented business relationship that is focused on the financial performance of the livestock enterprise .

If the food animal practitioner desires more income compared to other opportunities, then they will have to increase the value of their veterinary services. This means that veterinary services must account for a greater part of the costs of

livestock production than they have been in the past. This means that routine tasks must be done by veterinary technicians at a lower cost to the producer.

If veterinarians provide valuable service to any sector of society, and if that service is deemed to be valuable, the client will pay for services rendered.

Veterinarian s Salary

Recent graduates commonly say that inadequate salary is a major deterrent to enter and remain in food animal practice. However, many successful food animal practitioners, particularly those in single species practice (dairy cattle, swine, beef cow-calf, beef feedlot, poultry practice and others) claim that financial income is not the problem. Adequate compensation can be assured if the recent graduate becomes a partner in the practice and assumes some of the responsibility for the success of the practice, and shares in the subsequent increase in total net income and equity of the practice. Thus, associates in the practice must be encouraged to become partners in the practice.

Net income depends gross income and expenses. Many practitioners feel that we do not charge adequately for our services because we do not adequately value of our services. We should also be changing the paradigm of practice to being paid for health and production management in addition to individual animal medicine.

It is possible that food animal veterinarians are not paid enough because of not being sufficiently competent. Those who are highly competent as species specialists are well paid and among the highest paid in the profession. **Is there a lesson to be learned?** High income follows high competence.

Emergency Veterinary Service

The provision of emergency veterinary service after regular day hours and during the weekends and holidays is an issue, particularly for recent graduates.

Possible solutions to mitigate the onus of such service work include the following:

- Educate producers to request service during regular hours. This requires close surveillance of animals and the early detection of those which require veterinary assistance. An after hours call charge may motivate producers to minimize the number of unnecessary out of hours calls

- Gradually educate and instruct producers how to do routine procedures on their own. Provide a manual for standard operating procedures for the detection, diagnosis and treatment of the common diseases.

- Employ veterinary technicians to assist with many of the common technical procedures encountered in routine and emergency service. The incorporation of veterinary technicians into food animal practice has the potential to improve the working conditions.

- Develop and maintain a multiple person practice which allows for equitable distribution of the entire workload. Provide time off to the veterinarian who has been busy providing veterinary service throughout the night and weekend.

- Where possible, establish cooperative networking between adjacent practices to share the emergency veterinary service.

- Encourage telephone consultation with producers and provide advice.

Do not schedule herd health visits if on duty night before.
Provide veterinarians a portion of the professional fees earned while doing after hours emergency work.

Notwithstanding the above comments about after hours emergency service, the new graduate must accept that a food animal practitioner is providing a service to the livestock industry and that a certain amount of after hours emergency work is inevitable as it is many other professions and occupations such as operating room nurses, physicians, police, firefighters, and the like. As food animal practitioners we are not unique in our obligation to provide emergency service after regular hours. .

Veterinary Technicians

As food animal veterinary practices change from primarily an emergency based practice to more production-oriented health management services, the veterinarian will be relied on for more and more information and problem-solving. Veterinarians are becoming involved in nutrition and feeding systems, breeding and culling programs, records and records analysis, and infectious disease control. Veterinary technicians can be employed as assistants in many different common tasks both in traditional veterinary practice and in herd health programs. Up until very recently veterinary technicians have not been employed in large animal practices to the same extent as they are in small animal practice where they are deemed to be indispensable.

Technicians can be an invaluable asset to a food animal practice. Working with the practitioner on the farm they can increase the quantity and quality of services provided by the practice by developing standard operating procedures and treatment protocols, implementing and monitoring programs such as mastitis control, conducting field trials, planning the details of herd health visits in advance, identifying cows for examination, assisting with breeding soundness examination of bulls, body condition scoring of cows, trimming feet, collecting samples (blood, milk, feed and water), assisting with vaccination procedures, collecting animal health and production records and entering the data into the computer, preparation of the data for the veterinarian, preparing herd health visit reports and regular newsletters, and helping to instruct herdsman and owners about injection sites (Stevenson 2002). The veterinarian-technician team working on the farm will increase output and efficiency of service and it will be cost-effective. Technicians can help to improve the working conditions of food animal practice on the farm and in large animal clinics and it will be a pleasure to provide the service (Day & Kral 2002). There may be different levels of technicians dependent on the procedures to be done and the levels of veterinary assistance required.

Graduates of accredited veterinary technician programs are trained to follow ethical and legal guidelines expected of a technician working under veterinary supervision. The employing veterinarian has the ultimate responsibility for utilizing technicians in an appropriate manner consistent with all laws, regulations and ethical codes applicable to a state or province (Stevenson 2002).

Continuing Professional Development and Postgraduate Specialization

To study the phenomena of disease without books, is to sail an uncharted sea, while to study books without patients, is not to go to sea at all .

Sir William Osler. 1901. Books and Men. Opening of Boston Medical Library. January 12, 1901.

Continuous professional development is closely related to the undergraduate program. Much has been said about the importance of students being self-directed life-long learners. However, at the undergraduate level, in my experience, students are not formally taught how to be life-long learners, how to develop an effective personal library, how to read the literature critically and how to develop a personal professional development program during one's career. It has been assumed that veterinary students will learn those tasks on their own. Veterinary curricula need to consider how students should be taught life-long learning.

Having achieved a licence to practice, veterinarians should be encouraged to work towards higher qualifications as confirmation of their developing expertise. Historically, continuing veterinary education courses and workshops were offered by veterinary colleges and veterinary associations. Attendance and participation by practitioners was voluntary. Many veterinary licensing authorities now require that veterinarians declare evidence of attendance at continuing education courses for a certain number of hours per year as a requisite for continued licensure. Such mandatory continuing education will continue and probably expand. It is easy to document that a veterinarian has registered for a conference and has attended a certain number of hours of lectures.

Continuing veterinary medical education can motivate practitioners to change the way they practice. If continuing veterinary medical education is to improve practice and patient care, it should be integrated into a practice's strategic planning and considered a legitimate business expense. Decisions about continuing veterinary medical education are made easier if program objectives are clearly outlined (Moore et al. 2000).

Opportunities for Intellectual Challenge. At its annual conference, the American Association of Bovine Practitioners now offers about 20 preconvention seminars on all aspects of health and production management of dairy cattle, beef cattle herds, and beef feedlots, including clinical epidemiology and quantitative methods for veterinary practitioners. Because the emphasis in these seminars is on small group teaching, enrollment is limited and they are usually oversubscribed, which indicates that practitioners recognize the need for specialized knowledge and skills. The American Association of Swine Practitioners also has an annual continuing education program for swine practitioners. The Royal Veterinary College of Veterinary Surgeons in the United Kingdom certifies practitioners by examination in swine medicine and production. The American Board of Veterinary Practitioners offers certification by examination within a food-producing animal species. The objective of the board is to promote species-oriented clinical practice as a specialty in the veterinary profession. It encourages excellence and advanced certification among practitioners, which should raise the standards of practice. The examination requires that the candidate

have a multidisciplinary understanding of the health and production of a particular species, which fits well with the knowledge and skills required for a food animal veterinary specialist.

Certificate programs are a developing area of continuing education that will become much more important in the future as a means of ensuring continued or improved competency for practitioners. In general, certificate programs are structured, intensive continuing education programs designed to meet specific needs for a particular audience (Chenoweth, 1996). These programs attract individuals who are not necessarily interested in graduate degree programs, yet desire more intense training than that usually provided through conventional continuing education programs. Certificate programs focus on a specific area or need and are designed for individuals with at least 2 years of experience in clinical practice.

In 1990, at the Ontario Veterinary College in Guelph, Ontario, the Dairy Health Management Certificate Program was begun for dairy practitioners. It is a postgraduate program for dairy practitioners who desire to increase their expertise in dairy health management. The first program extended over a period of 2 years and consisted of 13 modules, each 3 days in length, during which lectures and seminars were presented. Small- group problem-solving exercises based on actual dairy farm health and production problems were emphasized. Topics included monitoring animal health and production, clinical epidemiology, nutrition, mastitis control, reproductive performance, control of infectious diseases, environmental management, rearing calves and herd replacements, genetics improvement programs, milk quality control and residue avoidance, economics of milk production, and implementation of health and management services. The participating veterinarians concluded that the program was successful and recommended it as a model for postgraduate education programs for veterinary practitioners wishing to specialize in a species or class of livestock.

The Pennsylvania Dairy Production Medicine Certificate Program began in 1991 and graduated its first class of dairy cattle practitioners in 1993. The curriculum consisted of 10 modules, each 2 to 3 days long, devoted to topics of dairy production medicine. The effect of participation by veterinarians on herd performance and management practice of the herds serviced by veterinarians indicated a positive effect of the program. At the end of the study, treatment herds were three times more likely to review herd performance with their veterinarian and monitor heifer growth, and two times more likely to set goals and conduct adequate estrus detection than were control herds. In dairy herds serviced by participating veterinarians, the mean age at first calving decreased and the prevalence of many good management practices increased compared with herds served by veterinarians who did not participate in the program. Management practices that require inputs of time or money, such as estrus detection, culturing for mastitis, tape-weighting heifers, and body condition scoring, are less amenable to change, and prevalence of these practices in control herds did not change over the course of the study.

Food-producing animal practitioners are now more business-oriented than veterinarians have been in the past even though most veterinary graduates do not

have any formal education or experience in the business management of a veterinary practice or a livestock farm.

American Board of Veterinary Practitioners. The ABVP was accredited by the AVMA in 1978 and is one of 19 specialty boards recognized by the Association as the first specialty board to recognize clinical practitioners. The purpose of the Board is to promote the highest standards in the art and science of veterinary practice. To accomplish this, it seeks to recognize veterinarians, qualified through examinations, who deliver superior comprehensive veterinary care. To become certified by the ABVP is to be recognized for outstanding performance in veterinary practice. It is to be acknowledged as an individual with the multidisciplinary skill needed to successfully operate a complex veterinary practice. It demonstrates a practitioner's dedication and commitment toward advanced studies over and above the attainment of a veterinary degree. The ABVP is also the only specialty board to require recertification by examination every 10 years.

The American Board of Veterinary Practitioners (AVBP) does not require post-graduate training such as an internship or residency but does require a series of tests that allow a veterinarian to become a specialist in certain species such as American Board of Veterinary Practitioners

- Food Animal Practice
- Dairy Cattle Practice
- Beef Cattle Practice
- Swine Health Management
- Equine Practice
- Canine and Feline Practice
- Feline Practice
- Avian Medicine

The AVBP seeks to promote the highest standards in contemporary veterinary clinical practice. To ensure that certification is accessible to active practitioners, the AVBP accreditation procedure relies upon high quality, practice-related experience, rather than veterinary college based, multi-year training programs. Formal postgraduate education is not required. Nevertheless, the credentialing process is rigorous and extremely demanding. Certification can only be achieved through demonstration of a thorough mastery of the field. The Board has an active mentoring program with many volunteer diplomates.

Certification by the AVBP needs to be promoted to all new veterinary graduates who plan to pursue a practice career.

Royal College of Veterinary Surgeons. The Royal College of Veterinary Surgeons is exemplary in the promotion of postgraduate qualifications for veterinary practitioners. It currently awards a wide range of postgraduate Certificates and Diplomas, as well as the Diploma of Fellowship, and maintains a list of RCVS Recognized Specialists. There is general recognition that the development of the RCVS Certificates has had a positive effect on the competence of veterinary practitioners. While the number of

Certificate and Diploma candidates as a percentage of the total practising membership is low, the average Certificate candidate is only about 30 years of age. As a proportion of the age groups, about one in four veterinary surgeons under the age of 31 is currently working towards certification. The RCVS has indicated that achievement of a certificate should be the norm for the future.

Need for Public Debate in the Veterinary Profession About Food Animal Veterinary Medicine

The veterinary profession must consider the future of all aspects food animal practice and develop a consensus about what it believes is required to meet the needs of the livestock industry and how those needs will be met by veterinarians, and how veterinarians should be educated and acquire the skills needed to provide the service. The profession should be informing the veterinary colleges about the veterinary educational needs for the future. There is a need for an alliance between the practicing profession, veterinary colleges, governments, and the livestock industry to discuss the animal health and production needs of the food producing animal industries which will meet the needs of the society and consumers.

Ingenuity Gap

Does veterinary medicine face an ingenuity gap? Is there a shortfall between our rapidly rising need for ingenuity and our inadequate supply: Has veterinary medicine adapted to the complexity, unpredictability and pace of events in our world? If we are to manage our affairs and improve our well being and meet the needs of society we will need more ingenuity more ideas for solving our problems and meeting our challenges.

In his brilliant book, *The Ingenuity Gap*, Homer-Dixon (2001) argues that the complexity, unpredictability, and pace of events in our world, and the severity of global environmental stress, are soaring. If our societies are to manage their affairs and improve their well being they will need more ingenuity that is, more ideas for solving our technical and social problems. However, societies, whether rich or poor cannot always supply the ingenuity they need at the right times and places. As a result, some face an *ingenuity gap*: a shortfall between their rapidly rising need for ingenuity and their inadequate supply.

The amount of ingenuity required to achieve a given goal depends critically on two factors: first, the intrinsic difficulty of achieving the goal and, second, the kinds and amounts of resources that we have available and that we can manipulate to achieve the goal. As the goal becomes harder to achieve and resources more scarce and inappropriate, the requirement for ingenuity rises.

We need both *technical* and *social ingenuity*. Technical ingenuity is the kind that creates new technologies. Social ingenuity, the more crucial kind, is used to reform old institutions and social arrangements, and build new ones, including efficient markets, competent and honest governments, and productive schools and universities.

A list of challenges and complex issues facing food animal veterinary medicine, selected from this paper is set out below. It illustrates the ingenuity gap in veterinary medicine as applied to the question: Are too few veterinary graduates choosing food animal practice? What is the problem?

Needs of Society

What are the veterinary needs of the progressive livestock producer?
 What do food animal practitioners expect in a new graduate entering food animal practice?
 Intensive livestock operations have created health and production problems which are difficult to understand and manage.
 Food safety is a major consumer concern

Recruitment of Students and Preveterinary Education

Small percentage of students with farm backgrounds
 Most students desire a career in small animal practice; few desire food animal practice.
 Admissions procedures are controversial. Is there a best method of selecting students?
 Content of preveterinary education?
 Effect of high percentage of female students on the future of the profession to meet the needs of food animal veterinary medicine.

Veterinary curriculum.

What is a core curriculum in today's world?
 The knowledge explosion and overcrowded curriculum.
 A generalist education (omnicompetence) or tracking in a practice theme?
 The nature and size and location of an adequate clinical caseload in food animals.
 Clinical competencies outcomes assessment. How should it be done?
 The NAVLE examination. Does it meet the needs of the profession?
 Biosecurity measures are now a major concern in food animal practice.
 Insufficient clinical research in food animals constrains evidence-based practice.
 High costs of veterinary education and limited economic resources, limits opportunities to develop new initiatives.
 Mandatory internship. Is it necessary? Who will supervise and evaluate competency?
 Continuing veterinary education. Are the current models satisfactory for the future? How do we teach students to be lifelong learners?

Private and Public Practice

Inadequate promotion of food animal veterinary medicine to young people.
 Undesirable working conditions of farm animal practice.
 The problems of out-of-hours emergency veterinary service in rural practice.

Role of veterinary technicians in rural practice.

Inadequate salary in rural practice.

Rural lifestyle may be undesirable. The effects of spousal occupation.

Herd health has not developed to the extent predicted 30 years ago. Veterinary medicine has not done the on-farm research necessary for the basis of a herd health programs.

Veterinary public health has not been an attractive career for veterinary students perhaps because they do not appreciate the opportunities

There is a gap between the needs of society and our ability to deliver the ideas and skills effectively and economically. Because we don't know how or don't have the resources, is veterinary medicine at risk if we don't close the gap?

The challenges we face converge, intertwine, and often remain largely beyond our understanding. This is the ingenuity gap, the critical gap between our need for ideas to solve complex problems and our actual supply of those ideas.

Is our world becoming too complex, too fast-paced to manage? There is a critical gap between our need for practical, innovative ideas to solve complex problems and our actual supply of those ideas. We need practical solutions for complex problems.

General Discussion

Veterinary medicine faces an exciting challenge to meet the needs of society in food animal veterinary medicine. The challenge should be put on top of the agenda of veterinary colleges, veterinary associations, livestock producers and government agencies. There is a need to design a veterinary education system and practice model for the future. ***Food animal veterinary medicine has a huge and incredibly complex responsibility to meet the needs of society.***

Studies of the Veterinary Profession. Many observations of the veterinary profession and suggestions for change and improvement have been made in the last 15 years. Changes are needed in the veterinary curriculum, postgraduate training and licensing in order to meet the needs of society in the 21st Century. There has been a major shift of student interest to small animal practice and away from non-companion animal veterinary medical careers. Animal agriculture is not being well served by veterinary medicine. Because of the overcrowded curriculum, and the many clinical skills to be acquired, students find it impossible to learn and become competent and confident at graduation. The generalist paradigm of the curriculum is unsatisfactory. Practitioner externships are will become important and a necessary part of the education of veterinary students. The consequences on the profession of the high percentage (75 to 90%) of women entering profession are uncertain. Females work part time and do not want to invest financially in private practices. Postgraduate professional training phase (Mandatory internship) and competencies at the end of Year 1 may be desirable. There is a declining interest in veterinary research careers. The vital importance of postgraduate continuing education and lifelong learning has

been emphasized. The income of veterinarians is considered by some to be inadequate

Veterinary Employment Demographics.

Remarkable demographic, economic and sociological changes are occurring in society which are profoundly affecting veterinary education and the veterinary profession at large. Society expects competent veterinary service.

Shift to Small Animal Practice. There has been a major shift of veterinarians into small animal practice. A high percentage of veterinary students have chosen a career in small animal practice on admission into veterinary college. Small animal practices are becoming diagnostically and therapeutically sophisticated, and hence attractive to new veterinary graduates. Veterinary colleges have diverted more resources into companion animal medicine, especially individual animal medicine.

In the last 45 years, there has been a gradual shift from mixed animal practice to single animal species or class of animal practice.

Shortage of Veterinarians in Food Animal Practice. There has been a declining interest in food animal practice and an erosion of resources in food animal veterinary education at the very time when the food animal industries are becoming larger and intensified and need veterinarians competent in providing health and production management. There is a major shortage of large animal practitioners for species specific food animal practice (dairy cattle, beef cattle herds, beef cattle feedlots, swine). There is a need to identify, recruit and adequately prepare new veterinary graduates for productive and fulfilling careers within the production animal industries. Single-person rural veterinary practice is no longer attractive to most veterinary graduates because of the rural lifestyle and the working conditions. Such practices will be uncommon and replaced by a multiple-person practice in a larger community.

Veterinarians in food animal practice will progressively provide more health and production management services to livestock farms and much less individual animal medical care.

There is a shortage of trained veterinarians for public health and diagnostic veterinary services. The small number of graduate veterinarians entering research careers is also a major concern and may be due to the low income of graduate students.

Potential Implications of the Shortage. The lack of participation in both private and public food animal veterinary medicine are increased vulnerability of livestock industries to exotic diseases, increased public health risks from food safety and quality problems, lowered public confidence in animal agriculture, threats to the national economy and standards of living, and loss of opportunities for veterinarians to meet the needs of society. The lack of veterinarians to serve in the various sectors of food animal veterinary medicine will lead to a loss of veterinary expertise and skills necessary to educate the next generation.

Issues and Opportunities

1. Needs and Expectations of Society and Animal Agriculture

The needs and expectations of society for food animal veterinary services, both in private and public practice are large, ever changing and complex. All sectors of food animal agriculture are intensified and the integration of animal health and production is a major challenge for veterinary education and practitioners. Consumers are concerned about food safety and food quality which means an increased role for food animal veterinary education.

Animal agriculture. Livestock farms and herds continue to increase in size and decrease in numbers. The only factor restricting the size of these herds will be environmental regulations to control pollution. Livestock production will continue to intensify and the veterinary services provided to these herds are shifting to primarily health and production management advisory services. Animal attendants and animal health technicians will treat many of the common diseases and perform many of the emergency and elective procedures (obstetrics, foot trimming, vaccinations) traditionally done by veterinary practitioners.

Dichotomy Between Small Animal and Food Animal Practice

There is a dichotomy between companion animal and food animal veterinary medicine which influences decisions veterinary graduates make about entering which kind of practice. Small animal practice is devoted to the care of the companion animal with all its emotional aspects and willingness of the clients to pay for expensive veterinary care. In contrast, food animal practice is centered on the economics of health and production management. These differences also influence veterinary education.

2. Background and Selection of Students and Preveterinary Education

Most veterinary students are female, from urban backgrounds, with little or no understanding of animal agriculture. Only a very small percentage have had meaningful animal farm backgrounds.

Female graduates are less likely to work full-time compared to males, and less likely to invest financially in the ownership of a private practice. For them, veterinary medicine is a secondary source of income in the family where the male provides the primary source of income. Most female graduates enter small animal practice; only a small percentage enter food animal practice.

An equity gender program should be considered which would select 50% women and 50% men for a more equitable balance.

Veterinary colleges need to recruit students who have the *desire* to pursue a career in food animal veterinary medicine. This may necessitate the establishment of quotas for undergraduate programs for which students apply and remain in that program throughout the veterinary course. Animal science students who are capable academically and desire to be food animal veterinarian should be recruited.

Admissions. The criteria used for the selection of students should include equal emphasis on cognitive and non-cognitive attributes. Meritocratic tests do not evaluate skills considered important to be a successful veterinarian.

Preveterinary Education. The preveterinary curriculum should be reviewed for the relevancy of courses required and the length of time required. Rather than have a prolonged preveterinary curriculum, extra educational emphasis could be placed on career path of the student during the veterinary curriculum and immediately after graduation using mandatory internships in a species specialty.

3. Veterinary curriculum

Omnicompetence is Undesirable. The traditional paradigm of veterinary colleges to educate the omnicompetent veterinarian is changing. Veterinary students can no longer learn the large amount of knowledge and acquire the clinical skills required to be competent in all species of animals at graduation. In addition, the new graduate must become competent without a formal postgraduate professional training program. This results in highly variable levels of competence among practitioners.

Because of the problems with omnicompetence, and since a growing percentage of students have specific professional goals early in their course of studies, veterinary colleges have introduced core-elective programs in which the student selects species specific electives in the clinical years. This provides the student with the opportunity to focus on their personal professional goals before graduation.

Attempting to teach food animal veterinary medicine to meet the needs of the modern livestock industry cannot be done at the undergraduate level using the current system of teaching merely the basics. A much more concentrated curriculum focused on food animal practice is required to educate and train graduates with entry-level knowledge and skills.

Quota Undergraduate Tracking Programs. Quota undergraduate tracking programs would improve the competence of the new graduates in designated areas of veterinary medicine. Quotas should be established for major undergraduate programs including food animal practice which would ensure a reasonable supply of graduates choosing food animal practice. ***Some veterinary colleges could initiate a quota tracking program devoted to food animal veterinary medicine within a year.***

Engineering Model Undergraduate engineering education in Canada is an excellent model for consideration by the veterinary profession. It would provide ***flexibility*** and ***unlimited opportunities*** for veterinary colleges to educate veterinarians to meet the ever changing needs of society.

University-Practitioner Cooperative Programs. Because clinical caseloads for some species, such as food-producing animals, at veterinary colleges are insufficient, students will receive some of their clinical education in private veterinary practices. This will mean that practitioners would have to become seriously engaged in teaching by providing the time and resources necessary for effective teaching and learning. Veterinary students will acquire an increasing proportion of their clinical education in extramural rotations in licensed certified practices, some of which are now quite sophisticated and can provide comprehensive veterinary service.

Regional Centers of Excellence in Food Animal Veterinary Medicine. Because Colleges can no longer provide the necessary in-depth education and clinical

experiences in all species, the development of Regional Centers of Excellence in Food Animal Veterinary Medicine at certain veterinary colleges based on existing opportunities in various species specific specialties should be encouraged. These Centers would excel in their specialties and attract faculty, students, and research activities. The need for colleges to share expertise through consortia to enhance communications among educators and provide a network for students to learn from sources remote from their home colleges has also been recommended.

Undergraduate Clinical Education and Skills Experience. A major challenge in veterinary education is achievement of competent clinical skills in the new graduate. The nature and scope of activity in the clinical sciences have expanded multiplied far beyond anything imagined 25 years ago. The level of clinical competence on graduation is highly variable between students depending on preveterinary student background and animal and veterinary related experiences.

Bovine practitioners in the US have identified the entry-level skills and procedures which are expected of new graduates. Proficiency is expected in several frequently performed individual animal medical and surgical skills. Animal production skills were also deemed important and practitioners reported that new graduates were deficient in general production and herd health skills. (***This may be a reflection of the generalist paradigm of the curriculum.***)

Surveys of recent graduates and their employers in western Canada indicate that their major deficiencies include practice entry skills of the common diagnostic and surgical procedures done routinely by veterinary practitioners, practice management skills including business, personnel management and client relationships, knowledge of animal behaviour, and clinical nutrition.

Clinical Competencies Outcomes Assessment. Most graduates in Canada pass the NAVLE which is based on veterinary information and knowledge. It does not evaluate clinical skills which are a major concern of veterinary employers. Accreditation of veterinary colleges in North America is not based on any independent evaluation of the clinical skills of graduates.

The most obvious weakness of traditional veterinary education is the lack of a meaningful clinical competency outcomes assessment in which students are evaluated using an objective clinical examination before graduation. Until now it has not been possible logistically because of a lack of resources to evaluate students on their clinical, technical and professional skills in a generalist program involving several different species and disciplines. With undergraduate tracking, it should be possible for clinical faculty to rigorously evaluate students in their undergraduate programs. Faculty in the various tracks would be able to set standards which students would have to achieve.

Clinical Caseload. An adequate clinical caseload in veterinary colleges has become an issue especially for food animal practice. The clinical caseload is the lifeblood of a modern accredited veterinary college. This includes an adequate field service practice with **excellent clinical teachers whose primary responsibility is dedicated to teaching students production-oriented food animal practice on the farm.**

Student Externships in Practice. Most veterinary colleges in North America now allow students to elect during their clinical year, an off-campus experience usually in

private practice, commonly called externships. The mentor agrees to supervise the student's experience and to provide the coordinator with an evaluation of the student.

The expansion of elective options such as externships in both private and public practice settings, within the clinical phase of a curriculum provides a compromise to redefining the DVM curriculum. If students in the clinical phase of the curriculum have specialized needs, they need off-campus experiences to gain skills and knowledge which may not be available in traditional veterinary college clinics.

Education can take place where it most makes sense.

Undergraduates in all six veterinary colleges in the U. K. are required by the Royal College of Veterinary Surgeons (RCVS) to undertake 38 weeks of study in work placements in addition to the standard curriculum.

Professional and Business Development of Veterinary Students

Some real and excellent progress is being made in some veterinary colleges to address the educational needs of professional and business development of veterinary students. Veterinary practice is a small business enterprise, and if 75% of veterinary students expect to enter private practice, then it behooves veterinary colleges to consider the incorporation of formal course instruction on professional and business development in the undergraduate curriculum. If undergraduate programs were offered, as described earlier under quota tracking programs, it would be possible to add a significant component of veterinary practice management to the curriculum for all students regardless of their particular undergraduate program.

Budget. Veterinary college budgets have not kept pace with inflation and many have been reduced or remain static which impedes progress in the development of new techniques in teaching and learning. Faculty feel frustrated because of ever increased workloads of teaching, research and clinical service.

Universities and Colleges of Veterinary Medicine have not fully appreciated and supported the high costs of clinical teaching of food animal veterinary practice in the field, on the farm. Historically, it has been done superficially to satisfy superficial teaching and accreditation needs.

Using quota tracking programs, colleges could concentrate resources on those students who desire a career in food animal practice, both private and public.

Research. The percentage of graduate veterinarians entering research careers compared to 30 years ago is small. The emphasis in the veterinary curriculum on clinical practice does not expose the student to the roles of research in advancing veterinary science. Clinical faculty do not emphasize the importance of research to veterinary students. Stipends for veterinary graduate students cannot compete with the salaries offered in veterinary practice or other endeavours.

4. New Veterinary Graduate, Mandatory Internship and Designated Licensure

Confidence and Competence. Confidence and competence of the new graduates are major issues which need to be addressed. Repeatedly, recent graduates expressed sincere concerns about not being confident and competent which influenced their decisions about career paths. Many did not feel confident nor competent to enter food animal practice. New graduates need adequate supervision, mentorship and career guidance.

Mandatory internships. Internships in veterinary colleges and in specialty practices have been very successful. Mandatory internship or a certified postgraduate professional training phase may become necessary for licensure to practice in the future.

Licensure. The introduction of designated licensure to practice would be a logical consequence of undergraduate tracking. A certified postgraduate professional phase of training before licensure is also under consideration by some veterinary licensing authorities. Mandatory continuing education for continued licensure will be expected by veterinary licensing authorities.

5. Food Animal Practice (Private and Public)

Issues

Many issues influence whether or not new graduates choose to enter food animal practice. These include: the management expertise of livestock producers, the working conditions and lifestyle expectations of Generation X and Y, the expectations of the new graduate for supervision and mentorship, female graduates working part time and not investing financially in practices, the undesirable conditions of rural veterinary practice, undesirable rural lifestyle, difficulties encountered with getting spousal occupation in a rural community, undesirable working conditions including emergency work nights and weekends, inadequate intellectual challenge and inadequate salary.

Opportunities in Private Food Animal Practice

Food animal practice must be promoted as rewarding careers. There are many opportunities to provide veterinary service in mixed animal practice, dairy cattle herds, beef cow-calf herds, beef feedlots, swine herds, and small ruminants. Many of these opportunities are not being filled because of a lack of interest by new veterinary graduates.

Specialization is occurring in a species or class of livestock such dairy cattle, beef breeding herds, beef feedlot, swine herds, and small ruminants with emphasis on integration of health and production management which is complex. Livestock producers expect the service to be cost-effective and advisory. Poultry practice is highly specialized.

However, food animal veterinary education at the undergraduate level has not become as advanced as necessary because veterinary colleges have not applied the resources to the task.

Opportunities in Public Veterinary Medicine. There are many opportunities in public veterinary medicine including food safety and inspection service, animal health regulatory services, animal disease research laboratories, army veterinary corps, teaching and research in veterinary colleges, and diagnostic laboratories. These represent important public responsibilities in veterinary medicine and veterinarians need to be educated and trained for these areas. There is a need for partnerships between veterinary colleges and federal and state governments to find ways and means of encouraging veterinary students to consider these careers.

Changes Required in Private Food Animal (Or Rural) Practice

The provision of veterinary services to the food producing animal industries is a challenge to the veterinary profession now and in the future!

Paradigm of Practice. The paradigm of food animal practice is changing and adapting to meet the needs of the livestock industry towards more integrated health and production management. Veterinarians will be less involved directly with individual animal medicine and more on the economic viability achieved by integrated animal health and production management of the herd.

The knowledge and the technology are available to provide a cost-effective comprehensive health management veterinary service to production-oriented livestock producers. The delivery of the service by veterinarians is the greatest challenge facing food animal practitioners. The emphasis is changing from the treatment of disease to health and production management.

The excellent opportunities in food animal practice both private and public must be promoted by veterinary practitioners, veterinary educators, veterinary public health veterinarians and others who have a public responsibility to meet the needs of food animal veterinary medicine.

Multiple-Person Practice. Multiple person practice is necessary to allow sufficient time off, consultation and interaction, and time to develop specialty interests. The practice of the future will be located in a community near an urban center and will provide a broad spectrum of service to both small producers and large intensified producers.

Professional and Business Development of Practice. Private veterinary practice must become much more professional and business oriented.

In order to attract new veterinary graduates into food animal practice, it must be appealing, attractive, interesting, exciting, motivating, and progressive.

The use of benchmarking of excellent practices to compare practices can improve the professional and economical status of a practice.

Value For Veterinary Service. Veterinary services must be reformed to make our services more valuable by improving our competence. If veterinarians provide valuable service to any sector of society, and if that service is deemed to be valuable, the client will pay for services rendered.

Supervision and Mentorship of New Graduates. The new graduate needs appropriate supervision, encouragement and mentorship. Effective communication about cases, work schedules, preparing bills for clients, and work being done is vital.

Veterinarians Salary. The salary and employment benefits of new veterinary graduates pursuing a career in food animal practice must be adequate to ensure that other opportunities are not more attractive.

Emergency Veterinary Medicine. The provision of emergency veterinary service after regular day hours and during the weekends and holidays is an issue. Solutions include:

Educating producers to request service during regular hours and educating producers how to do routine procedures on their own.

Employing veterinary technicians
 Develop and maintain a multiple person practice
 Establish cooperative networking between adjacent practices
 Provide veterinarians a portion of the professional fees earned while doing after hours emergency work.

Veterinary Technicians. Veterinary technicians can do a wide variety of procedures and planning in a food animal practice which would allow veterinarians to expand health and production management services to the herds. Veterinary nurses and technicians will be doing more veterinary procedures which now are done almost exclusively by veterinarians.

Support Staff. Food animal practices need to be large enough to be able to employ sufficient support staff for operation of the practice. This would include excellent secretarial assistance to assist with records analysis and the preparation of excellent reports to producers. This may include a practice manager whose sole responsibility is daily operation of the practice, and personnel management.

Continuing Professional Development. Certified continuing professional education will be mandatory for licensure to practice. Board certified specialists in private veterinary practice will become more common and should be promoted beginning in veterinary college.

Summary

1. There are many excellent opportunities in food animal veterinary medicine which has a huge and complex responsibility to meet the needs of society. The future is in animal health and production management of herds for the production of wholesome and safe food.

2. There is a worsening shortage of food animal veterinarians (public, private, academic, industry) in North America.

Food animal agriculture in its broadest perspective is being underserved by the veterinary profession, and, society's needs are not being served.

It is ironic that this trend is occurring at a time of greatly increased public concern about catastrophic food animal pandemics, food safety breakdowns and animal health risks associated with rapidly increasing globalization.

Food animal veterinary medicine is only one aspect of a much larger perspective which the veterinary profession must address and make the necessary changes. Veterinary students are not participating in several important sectors of the veterinary profession.

3. The reasons for the shortage are not clear but there are many probable causes.

Most veterinary students are an urban background; only a very small percentage have a meaningful farm animal backgrounds.

High percentage of female veterinary students who choose small animal practice in which they feel competent and competent, and find the working conditions satisfactory. Women do not invest financially in private practices as much as men do.

Agriculture seemingly is not as important to society as it was historically.

A veterinary curriculum which educates a generalist with growing emphasis on companion animal medicine which is attractive to urban students.

Food animal veterinary education is very complex and the traditional curriculum cannot produce a graduate with practice-entry knowledge and skills required to deliver an integrated health and production management veterinary service to modern livestock producers whose economic viability is a high priority.

The accreditation standards for licensing are general and do not encourage species specialization which is necessary in food animal veterinary medicine.

The working conditions of rural veterinary practice, and a rural lifestyle are not attractive to the current generation of veterinary graduates.

Other non-veterinary career opportunities may be more attractive to young people than veterinary careers.

Public veterinary medicine (governmental, teaching and research, diagnostic laboratories, ecosystem health) which is a vital component of public health, is an attractive career for only a small percentage of new veterinary graduates but the reasons are unclear.

Many contributing factors were discussed, including demographic and lifestyle changes, mismatched expectations, relative salaries and employment benefits and spousal employment opportunities in rural areas. Also, educational issues such as problems with food animal student recruitment and maintaining interest, lowered emphasis on food animal education, the proliferation of clinical specialties in companion animal veterinary medicine, and a lack of appropriate educational opportunities and role models, and lack of mentoring in food animal veterinary medicine.

It was considered that identifying major causes, and developing effective counter-strategies where possible, was a matter of national concern and urgency.

4. This situation is not in the best interests of the veterinary profession or society.

There is an urgent need to create awareness of the problem within the context of national economic and societal needs, as well as the future course of the veterinary profession.

5. Implications of its continuance include:

- a. Loss of rural veterinary services (food animal and/or mixed practice)
- b. Increased vulnerability of livestock industries to exotic disease (including acts of bio-terrorism).
- c. Increased public health risks from food safety problems
- d. Lowered public confidence in animal agriculture and its products

e. Resultant threats to the national economy and standards of living

Maintaining the status quo is no longer an option. Merely attempting to stay where we are inevitably invites decline (Eyre 2001)

Actions Required

1. Increase Level of Awareness. It is imperative to raise the level of awareness and a sense of urgency among those groups which have a public responsibility to meet societal veterinary needs (American Association of Veterinary Medical Colleges, American Veterinary Medical Association, Canadian Veterinary Medical Association, State and Provincial Veterinary Associations, and respective veterinary licensing authorities, American Association of Bovine Practitioners, American Association of Swine Veterinarians, United States Department of Agriculture Food Safety and Inspection Service, and the Canadian Food Inspection Agency. The veterinary groups and leaders which have a **public responsibility** to ensure that the needs of society are being met, and will be met in the future, should address these concerns.

2. Active Recruitment of Students and Reform Undergraduate Veterinary Education. An active recruitment program of students who desire a career in food animal veterinary medicine is necessary. Food animal practice experiences should begin in the early part of the curriculum to stimulate student interest. Undergraduate tracking programs in food animal veterinary medicine would graduate veterinarians much more competent and confident to enter food animal practice and likely pursue a career in that field.

3. Change the Paradigm of Food Animal Practice. Several changes need to be made in food animal practice, especially rural practice, to make it more attractive to new graduates as a career to pursue. Small rural practices need to consolidate into larger multiple-person practices with several veterinarians each with a species specialty interest. Food animal practice will progressively provide more health and production management services to livestock farms and much less individual animal medical care. Working conditions especially the expectations and demands of out of hours emergency services need to be improved. Veterinary technicians need to be employed to improve the quality and efficiency of food animal practice. New graduates need supervision, mentorship and career guidance.

Informed leadership is crucial at this critical time.

4. Industry Participation. The food producing animal industries, in the widest sense, must be informed and recruited as both stakeholders and allies.

5. Promotion of Food Animal Veterinary Medicine. A major emphasis needs to be made to market food animal veterinary medicine (in its widest sense) to potential and current students.

This should include positive messages in the many options and possibilities available, positive reinforcement and attentive, informed, encouraging mentoring.

Informed, positive mentoring is vital.

Here, it is suggested that a group of articulate, dynamic spokespersons be organized to address different student, professional and industry groups on related matters and issues.

- A. Consider establishment of Centers of Excellence in Food Animal Veterinary Medicine among North American Veterinary Colleges.
- B. Enlist industry support to enhance student training (e.g. scholarships, preceptorships, industry and academic internships).
- C. Enlist outstanding practitioners as adjunct teaching faculty.
- D. Encourage legislators to relieve student loans for those entering rural/food animal practice.

Conclusions

Food animal veterinarians are not an endangered species. There are many excellent and rewarding career opportunities in private and public food animal veterinary practice which provides animal health and production management veterinary services to animal agriculture whose primary objective is the production of wholesome and safe food. However, in recent years, an insufficient number of veterinary graduates have been choosing food animal practice for several probable reasons. Most students now have an urban background and are female, and the generalist veterinary curriculum makes them more comfortable in small animal practice than in a rural food animal veterinary practice. Increasing the the numbers of graduates who choose and pursue food animal practice as a career will require an active recruitment program at the youth level, and recruitment of students with a farm background who desire a career in food animal practice, introduction of undergraduate tracking programs which will improve the levels of competence and confidence of new graduates in food animal veterinary medicine, and major changes in food animal practice which are attractive to new graduates.

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Veterinarian's Oath

Being admitted to the profession of veterinary medicine, I solemnly swear to use my scientific knowledge and skills for the benefit of society through the protection of animal health, the relief of animal suffering, the conservation of animal resources, the promotion of public health and the advancement of medical knowledge.

I will practice my profession conscientiously, with dignity, and in keeping with the principles of veterinary medical ethics.

I accept as a lifelong obligation the continual improvement of my professional knowledge and competence.

Adopted by the AVMA in November, 1999