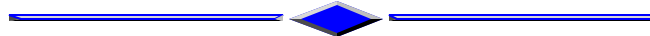




***DEVELOPMENT OF THE FRAMEWORK FOR AN
ALBERTA-BASED FOOD ANIMAL VETERINARY
EDUCATION PROGRAM***



**SUBMITTED BY:
FEEDLOT HEALTH MANAGEMENT SERVICES**

P. Timothy Guichon, D.V.M.

Calvin W. Booker, D.V.M., M.Vet.Sc.

G. Kee Jim, D.V.M.

Oliver C. Schunicht, D.V.M., B.Sc.

Brian K. Wildman, D.V.M.

Tom J. Pittman, B.Sc.Agr., D.V.M., P.Ag.

R. Kent Fenton, D.V.M.

Eugene D. Janzen, D.V.M., M.V.S.

In terms of the topic of food animal veterinary medicine and education requirements, extensive amounts of pontification, deliberation, and discussion have occurred, including the recent conferences held in October 2002 at Kansas State University and January 2003 at the Western Canadian Bovine Practitioners Annual Meeting in Calgary. Unfortunately, very little has been accomplished in terms of putting together a workable plan to solve the problems identified. This is likely due to the enormity of attempting to deal with all aspects of the issue at one time.

Veterinary medicine has a public responsibility to serve the needs of food animal industry and society. Veterinary students and new graduates are not participating in the broad scope and diverse sectors of the profession because there has been a major shift away from non-companion animal veterinary medical careers. As a result, 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 medicine.

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 in food-animal practice at graduation. The generalist paradigm of the current veterinary curriculum is unsatisfactory. There are concerns about the skills, knowledge, attitudes, and aptitudes of veterinary students and new graduates. The undergraduate veterinary curriculum needs to be changed to allow an in-depth clinical experience in a practice theme in the private or public sector in veterinary education. Extramural studies or practitioner externships must become an important and a necessary part of the education of veterinary students.

The food-producing animal industries in western Canada account for a major portion of gross national product. In Alberta alone, the gross farm livestock receipts in 2002 were just over \$5 billion. These industries are requesting leadership from the veterinary profession to provide profit-oriented, health and production management, as well as economical individual animal medicine. Provision of these services by qualified veterinary professionals to food animal agriculture industries in Alberta has the potential to substantially improve the health, productivity, and economic viability of livestock production in Alberta. These impacts could be substantial. More cost-effective food animal industry sectors is likely to directly help to foster increased long-term growth, employment, and competitiveness of Alberta's agriculture and agri-food industries. In addition, the development of an Alberta-based food animal veterinary education program could provide the veterinary manpower necessary to fill new and existing roles in food animal public practice, including food safety and inspection service, regulatory veterinary medicine, research and teaching, diagnostic support, and disease surveillance.

The development of an Alberta-based food animal veterinary education program will ultimately have benefits to all food animal sectors in the province. Using a beef feedlot financial impact example, every 1% improvement in feed efficiency alone in beef feedlot production lowers the cost of production by \$3.00 to \$6.00 CDN per animal. Based on an annual feedlot throughput in Alberta of 2.5 million animals, a 1% improvement in feed

efficiency would lower the cost of feedlot production in Alberta by \$7.5 to \$15.0 million CDN annually. Similarly, every reduction in the feedlot population morbidity rate of 5% results in cost savings of more than \$3 million CDN annually and every reduction in the feedlot population mortality rate of 0.25% results in cost of production savings of more than \$4 million CDN annually. Analogous calculations can be made for the other major food animal sectors, including dairy, beef cow/calf, poultry, and swine, to calculate direct sector benefits. In addition, indirect benefits will accrue to each sector as a result of improved public practice capabilities available to each sector.

Many observations on food animal veterinary education have been made in the last 15 years. In 1989, 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 future needs of society (Pritchard 1989). Two notable recommendations in the report included reorienting 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 requiring all students to obtain clinical experience with numerous species and focusing the education process and the practice of veterinary medicine on the ability to find and use information rather than on the accumulation of facts.

In 1998, a Task Force of the Canadian Veterinary Medical Association (CVMA) published a report on the future of the veterinary profession in Canada, “Veterinary Medicine in Canada: Opportunity for Renewal” (CVMA 1998). It was noted in the report that changing veterinary education and making it relevant to industry and societal changes was required. Canadian veterinary colleges were 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. Also, the final 12 months of pre-graduate veterinary education 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.

In 2001, veterinary surgeons in the UK were consulted about the education needs of the profession from 2010 to 2020 (RCVS 2001). The terms of reference were to undertake a review of the key issues facing veterinary education and training in the veterinary profession, and to formulate a draft veterinary education strategy to meet those challenges over the next ten years. An extensive list of recommendations and position statements emanated from the review, including recommendations for extra-mural studies in appropriate veterinary practices or other institutions.

In 2002, a CVMA Task Force on “Education, Licensing, and the Expanding Scope of Veterinary Practice” was convened (Prescott et al. 2002). In defining the problem facing veterinary medical education the Task Force said: “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)...”. Weaknesses of the current veterinary education system related to food animal medicine included an

inadequate caseload in food animals, a lack of students with a background in agriculture, and a lack of encouragement and mentoring of interested capable students.

In spite of all of these recommendations, very little has been done in western Canada to substantially address the issues identified in these various studies as they pertain to food animal veterinary education. Nonetheless, there appears to be an ever increasing demand for veterinarians in production animal health and food safety in North America and it seems obvious that changes are needed in the veterinary curriculum, postgraduate training, and licensing in order to meet the requirements of society in the 21st Century. There is clearly a need to design a food animal veterinary education system and practice model for the future to meet the needs of the food animal industries and consumers. The purpose of this project was to review the massive amount of information that has been accumulated on this topic, consult with relevant stakeholders, and put together the framework to deal with one specific component of the issue (clinical food animal veterinary education) so that an Alberta-based food animal veterinary education program can be developed to enhance the general veterinary education that is provided by the Western College of Veterinary Medicine (WCVM), Saskatoon, Saskatchewan (and other veterinary colleges).

As noted above, a review of the literature on the topic of food animal veterinary education revealed a striking consistency in the observations noted and the general ideas/recommendations put forth to address the concerns identified. That is, the model for food animal veterinary education needs to change to meet the times. In addition, it becomes very obvious from the literature on this topic that the issues related to food animal veterinary education are consistent and widespread throughout Canada, the United States, and other first world countries. Moreover, although representatives from veterinary colleges around the world have been involved in discussions on the topic of food animal veterinary education going back over 15 years, there has been very little initiative from those institutions to invoke any sort of substantial change. In the case of the WCVM, the situation is of direct concern to livestock industries in western Canada. Although the Alberta government announced funding in January 2001 for a new Academic Chair in Beef Cattle Health Management at the WCVM (the Alberta Beef Chair) to allow for "...expanded research and student specializations in agricultural veterinary practice and to provide greater support to the needs of the beef cattle industry in Alberta and across the west", the position has remained unfilled since its inception. In addition, industry and government representatives have expressed frustration with the lack of genuine interest and action at the WCVM in dealing with food animal veterinary education issues.

There are likely several underlying reasons for the apparent disconnect by veterinary colleges between the described **need** for change to food animal veterinary education and concrete actions to **invoke** change. First, the process of fundamental change requires influential, visionary individuals within veterinary institutions to lead the process. Second, in order for fundamental change to occur, the current veterinary education paradigm needs to change. Third, directly related to changing the current veterinary education paradigm, there is a tremendous amount of inertia within public institutions

(and most government and private organizations as well) associated with any kind of substantive change. All too often, the process of change gets so side-tracked on trying to work out the details of how things will happen and identifying all the reasons why the new idea can't work that the process gets bogged down before the actual framework for the concept gets defined. Finally, changes to food animal veterinary education programs will undoubtedly be associated with changes to/incremental budgetary requirements and many veterinary colleges are already limited in this regard. As a result, it appears that efforts to step back and evaluate food animal veterinary education with an objective of developing the framework for meaningful, appropriate change are more likely to be successful and overcome the issues identified above if they are directed by stakeholders from outside veterinary colleges.

The process for proceeding moved forward in an ever-evolving manner. As the leader of the project, Dr. Tim Guichon held extensive consultative discussions over the last year with Drs. Eugene Janzen and Calvin Booker from Feedlot Health Management Services (FHMS) and Dr. Otto Radostits, Professor Emeritus, WCVM to gain a clear understanding of the work that had been done previously in this area and to put together a plan for proceeding. Subsequently, informal discussions with representatives from the Alberta government indicated that development of an Alberta-based food animal veterinary education program would fit very well with current agriculture and education objectives in Alberta. However, it was also clearly indicated in these discussions that the process should be initiated/directed by the veterinary profession, with support from industry. As a result, Dr. Tim Guichon contacted the Registrar (Dr. Duane Landals) and the Deputy Registrar (Dr. Clay Gellhaus) of the Alberta Veterinary Medical Association (AVMA) to discuss food animal veterinary education in Alberta. Under the guidance of Drs. Guichon, Landals, and Gellhaus, extensive discussions were held with key stakeholders within the AVMA to identify methods and strategies for proceeding. Subsequently, these individuals from the AVMA convened a meeting with the Alberta Minister of Agriculture (Honorable Shirley McClellan) to gain a clearer understanding of current agriculture and education objectives in Alberta, to present the AVMA-based ideas for development, and to discuss appropriate approaches for proceeding. The ideas and concepts for an Alberta-based food animal veterinary curriculum program presented by the AVMA were very favorably received by Minister McClellan. In these discussions, the group clearly agreed that the food animal veterinary program to be developed was not intended to compete or interfere with the veterinary programs currently offered at WCVM, but to augment the curriculum taught at WCVM and fill a void in food animal veterinary education that is not currently being addressed. Further, the group agreed that these ideas would form the basis for a proposal to develop a food animal veterinary college in Alberta. Subsequently, the Alberta Ministry of Learning became involved and introduced the idea/plan to the Provost and Vice President (Academic) (Carl Amrhein) and the Dean of the College of Agriculture, Forestry and Home Economics (Ian Morrison) at the University of Alberta, Edmonton, Alberta. As a result, Dean Morrison, with input from key College of Agriculture, Forestry, and Home Economics personnel, drafted a confidential response document entitled "Establishment of a Veterinary Program at the University of Alberta" (attached as Appendix A). In his response document, Dean Morrison addresses the rationale for the proposal, the objectives of the

program, the outline for developing a non-traditional approach to curriculum development, and the existing University of Alberta assets that compliment the program. The proposal was forwarded to Vice President Amrhein for consideration and review with government officials. The time line for proceeding further at this juncture has not yet been clearly stated. However, both the University of Alberta and the Government of Alberta have indicated that the proposal will be reviewed in a timely manner.

Clearly, the process of laying a framework for a food animal veterinary program in Alberta has been moved forward in fairly dramatic fashion. Dr. Guichon and the team at FHMS identified an appropriate course of action for proceeding and provided the initial catalyst to get the process started. In addition, Dr. Guichon was instrumental in keeping the process moving through the AVMA, the Alberta Government, and the University of Alberta to develop the framework for an Alberta-based food animal veterinary education program. The process has undoubtedly been successful in developing a concrete plan for moving forward. At this point in time, the proposal is in the hands of the University of Alberta and the Government of Alberta for consideration and the responsibility for moving forward with finalizing the details (including funding) of how the proposal can come to fruition have shifted from Dr. Guichon and the team at FHMS to the AVMA, the University of Alberta, and the Government of Alberta.

APPENDIX A

Establishment of a Veterinary Program at the University of Alberta

A response document prepared by
I.N. Morrison, Dean, Faculty of Agriculture, Forestry and Home Economics
for Carl Amrhein, Provost and Vice President (Academic), U of A
18 February, 2004

The University of Alberta (U of A) endorses the concept of establishing a veterinary medical program to train veterinary practitioners specializing in food animal production in Alberta.

Consultations with the Alberta Veterinary Medical Association (AVMA) as well as informal discussion with officials in the Ministry of Agriculture, Food and Rural Development (AAFRD) have pointed to an ongoing shortage of food animal veterinarians in Alberta and a severe limitation in Alberta's research capacity relating to animal health. Shortfalls in both areas could be met through establishment of a Veterinary Medicine program at the University of Alberta which already has substantial expertise in livestock sciences and has very recently committed over \$20 million toward construction of new facilities supporting world-class research in beef, swine, dairy and poultry production. These developments, coupled with the Province's intention to expand its research capacity in the area of veterinary pathology relating to BSE and other livestock diseases that threaten the viability of the province's livestock industry, and the emergence of the Institute of Food and Agricultural Science, Alberta (IFASA) which draws together the collective research expertise of the U of A, AAFRD and the Alberta Research Council (ARC), are a timely convergence with the proposal to establish a veterinary medical program in this Province.

The strengths of the University of Alberta's animal science programs are in the areas of livestock production, nutrition, metabolism, endocrinology, immunology, molecular biology, reproductive physiology and genetics/genomics. Courses offered in these areas constitute the foundations of our current Pre-Vet program and animal science majors in our B.Sc. Agriculture degree program. Development of a new program in Veterinary Medicine could build effectively on our existing expertise and address the Province's dual concerns about an inadequate supply of food animal veterinarians on the one hand, and a need to bolster animal health related research on the other. The latter would also support advanced training of specialist experts with M.Sc. or Ph.D. degrees in areas such as epidemiology, toxicology, veterinary microbiology, etc. who are also in extremely short supply.

In short, the rationale for establishing a Veterinary Medicine program with a focus on food animal production at the University of Alberta are compelling. By linking the

program closely with our current capacity in animal science three objectives could be met:

1. The number of DVM graduates with specialist knowledge in food animal production would increase. This, in turn, would address the current and projected constraints faced by Alberta's livestock industry.
2. Research on livestock production and health would be significantly enhanced such that it is commensurate with the importance of the livestock industry to Alberta's economy.
3. The recruitment and training of highly qualified specialists with advanced degree's (M.Sc.'s and Ph.D.'s) in veterinary science and related areas would strengthen Alberta's position as a world leader in agricultural and life sciences.

Feedback from the AVMA indicates that graduates of the Western College of Veterinary Medicine (WCVM) in Saskatoon are very skilled and well-trained to serve as mixed animal and small/companion animal practitioners. The proposal to develop a new program based in Alberta specializing in the training of food animal practitioners is predicated on the understanding that the need for mixed/companion animal practitioners will continue to be met by WCVM, and that Alberta will continue to support the training of students there.

Of several possible models for developing a food animal veterinary medicine program in Alberta, there is strong support from within the U of A and from the AVMA for a program that includes the following elements:

- Integration of the program into the Faculty of Agriculture, Forestry and Home Economics alongside the existing program in animal science which is recognized for both its teaching and research excellence (and which already has excellent production facilities, laboratories, and surgeries), while at the same time maintaining a separate and distinctive identity. Existing physical and human resources at the U of A, including experts in both the Faculties of Agriculture and Medicine, will support key components of both the undergraduate and graduate veterinary science programs.
- A formal linkage with the WCVM in Saskatoon, ideally through an affiliation agreement that provides for the program to be jointly offered by WCVM and the University of Alberta, with graduates being recognized by both institutions and the program meeting accreditation requirements. One option would be for students enrolled in the program to fulfill their pre-vet requirements in Alberta (as is the case already), undertake the first two years of their pre-clinical studies in Saskatoon, and then complete their specialization in food animal medicine in the new program in Alberta.
- A separate selection and admissions process that would draw from a pool of pre-vet students or animal science majors who have high academic standing and who are committed to completing a specialized program of food animal veterinary

medicine that would qualify them to practice in Alberta under restricted licensure as defined by the AVMA.

- A non-traditional approach to curriculum design that incorporates both formal course work with experiential learning through clinical rotations in practices in Alberta focused on food animal production. In developing the curriculum, experienced gained at other Colleges with ‘non-traditional’ programs would be taken into account, including, for example, Edinburgh University Royal School of Veterinary Medicine; Murdoch University (of Western Australia) Veterinary School, and Purdue University School of Veterinary Medicine. (A current assessment by representatives of the AVMA is that the externship program currently offered by WCVM does not provide students with the necessary educational qualifications and competencies in food animal production).
- Provision for graduates of the program to obtain the necessary additional credentials for ‘unrestricted’ practice, i.e. to remove licensure restrictions, through a program of professional upgrading, possibly offered in collaboration with WCVM.
- Coordination with provincial programs that would provide incentives for graduates to serve the interests of the primary livestock producers across all regions of the Province. For example, in Wisconsin, the State has enacted a “Veterinary Medical Services Act” that provides for repayment of educational loans to veterinarians willing to locate their practice in areas that are underserved.

With respect to research, the creation of a veterinary school would align Alberta’s scientific strengths with the evolving (and at times unpredictable) needs and opportunities associated with Alberta’s multi-billion dollar livestock sector. The province is currently under-resourced in terms of scientific capacity serving the livestock industry, particularly relating to animal health. The concept of a Food Animal Centre of Excellence as part of the new veterinary program is consistent with current thinking relating to the Institute for Food and Agricultural Sciences, Alberta (IFASA). IFASA can provide the means by which current and new animal health initiatives are coordinated and will provide new veterinary medical staff and students access to existing resources, including over \$100 million worth of equipment, facilities, and animals currently situated at the U of A’s main campus, on South Campus, and at Kinsella and Ellerslie, as well as additional provincial resources housed in the O.S. Longman Building and the soon-to-be-built \$15 million BSE testing and research facility.

The goals of IFASA are 1) to reduce fragmentation and duplication of effort among agricultural research providers, 2) to build research and commercialization capacity in areas that are unique and critical to Alberta, and 3) to enhance the training/education of highly qualified scientists, technical and industry personnel. The development of a veterinary medicine program and the associated strengthening of Alberta’s animal health research capacity are entirely consistent with the mission of IFASA and the direction set by the University, AAFRD and ARC.

Notionally, estimates of the human resources required to deliver a food animal specialization at U of A are that a minimum of 25 to 35 new academic staff members

would be required plus administrative and support staff, allowing for the fact that considerable expertise, e.g. in nutrition, and support services are already in place. New academic staff would be hired across four major disciplinary areas or sections: Epidemiology; Laboratory Sciences; Environmental Sciences and Clinical Sciences. These are rough estimates only and both the disciplinary specialty and numbers will need considerable refinement as planning proceeds.

Based on the foregoing, it is estimated that the food animal veterinary program could accommodate an intake of approximately 15 undergraduate students annually once it is fully up and running. This compares with a quota of 20 students that are currently admitted to WCVM from Alberta each year. On the assumption that each academic staff member would also supervise no fewer than 4 post-graduate students/post-doctoral fellows, an additional 100 -120 spaces for post-graduate training would be created. As it is anticipated that academic staff would attract funding from both the National Sciences and Engineering Research Council (NSERC) and the Canadian Institutes of Health Research (CIHR), as well as other federal and provincial agencies, the private sector, and commodity associations, a new veterinary science program could well be expected to spawn an additional \$5 - \$10 million worth of research activity related to animal health and production each year. This, in turn, would pay major dividends to Alberta's livestock industry and the provincial economy.

The concepts presented in this document encapsulate input from the following individuals:

AVMA

Duane Landals, Registrar
Clay Gellhaus, Deputy Registrar
Greg Andrews, Association Member
Tim Guichon, Association Member

U of A

Ian Morrison, Dean, Faculty of Agriculture, Forestry and Home Economics
Gary Kachanoski, V.P. Research
Andy Greenshaw, Assoc. V.P. Research
John Kennelly, Chair, Department of Agriculture, Food and Nutritional Science

REFERENCES

- Barnes JA, Taylor IR. Off-campus learning in the U.K. veterinary undergraduates: responding to changing learning needs. *J Vet Med Educ* 1999;26:16-22.
- Beasley, V. Ecotoxicology and ecosystem health: roles for veterinarians; goals of the Envirovet program. *J Am Vet Med Assoc* 1993;203:617-628.
- Black LS, Turnwald GH, Meldrum JB. Outcomes assessment in veterinary medical education. *J Vet Med Educ* 2002;29:(1)28-31.
- Black LS, Thatcher CD, Hueston WD. Outcomes assessment of the Center for Government and Corporate Veterinary Medicine at the Virginia-Maryland Regional College of Veterinary Medicine. *J Vet Med Educ* 2001;28:62-69.
- Blackwell MJ. Beyond philosophical differences: the future training of veterinarians. *J Vet Med Educ* 2001;3:149-152.
- Brown JP, Silverman JD. The current and future market for veterinarians and veterinary medical services in the United States. *J Am Vet Med Assoc* 1999;215:161-183.
- Campbell JS. Observations on perceived shortage of food animal veterinarians. Letters to the editor. *J Am Med Assoc* 2003;222:432.
- Canadian Engineering Accreditation Board. Accreditation Criteria and Procedures. Ottawa: Canadian Council of Professional Engineers. 2000:26 pp.
- Cardinet GH, Gourley IM, BonDurant RH, Cowgill LD, Stannard AA, McCapes RH, Smith BP, Rhode EA. Changing dimensions of veterinary medical education in pursuit of diversity and flexibility in service to society. *J Am Vet Med Assoc* 1992;201:1530-1539.
- Cattell MB. Rectal palpation associated with cumulative trauma disorders and acute traumatic injury affecting bovine practitioners. *Bovine Pract* 2000;34:1-5.
- Chenoweth PJ. Food animal veterinary education: Whither or Wither? *J Vet Med Educ* 1996;23:34-38.
- Collins GH. Veterinary education-the three-fold path to reform. *Aust Vet J* 1992;69:125.
- Dartt BA, Lloyd JW, Kaneene JB, Derksen FJ. The educational value of a practice-based ambulatory program in food animal medicine, surgery and herd health management. *J Am Vet Med Assoc* 1997;210:1590-1594.

- Day JD, Kral J. Increasing your practice's output and better serving your clients utilizing a veterinarian/technician team approach. *Proc Am Assoc Bov Pract* 2002;35:142-144.
- Dewey CE, Leyenaar JK, Straw B. The influence of swine-related work experience on career choice following graduation. *J Vet Med Educ* 2000;27:28-32.
- Draper DD, Uhlenhopp EK. A veterinary business curriculum model. *J Vet Med Educ* 2002;29:(2)73-80.
- Eyre, P. Professing change. *J Vet Med Educ* 2001;28:3-9.
- FSIS-USDA. The future of Food Safety Inspection Service (FSIS) veterinarians: public health professionals for the 21st Century. Task Force of USDA-FSIS. August 2000:1-41.
- Gilbert RO. Editorial: In-house caseload and education of veterinary students in production animal medicine. *J Vet Intern Med* 2002;16:5-6.
- Halliwell REW. Veterinary education: time to abandon the cult of coverage. *Vet Rec* 1999;144:129-130.
- Heath TJ. Career paths of Australian veterinarians. Brisbane, Queensland, Australia. 2001;ISBN1-875582-99-1
- Heath TJ, Niethel GE. Veterinary practitioners in rural Australia: a national survey. *Aust Vet J* 2001;79:464-469.
- Hendrix CM, McClelland CL, Kahn KL, Thompson I. Healthy People 2010-New opportunities for veterinary medicine in the 21st Century. *J Am Vet Med Assoc* 2002;221:951-956.
- Humble JA. Critical skills for future veterinarians. *J Vet Med Educ* 2001;28:50-53.
- Kaplan B. Call for marketing methods to promote veterinary medicine. Letters to the editor. *J Am Med Assoc* 2003;222:148.
- Karg M. Designated licensure-the case for speciation within the veterinary degree. *J Am Vet Med Assoc* 2000;217:1792-1796.
- King L. The future of veterinarians in government. *J Vet Med Educ* 2000b;27:23-30.
- King L. It was the best of times, it was the worst of times. A perspective on the KPMG study. *J Am Vet Med Assoc* 2000a;217:996-998.
- Kleine LJ, Terkla DG, Kimball G. Outcomes assessment at Tufts University School of Veterinary Medicine. *J Vet Med Educ* 2002;29:(1)32-35.

- Kogan LR, McConnell SL. Gaining acceptance into veterinary schools: a review of medical and veterinary admissions policies and practices. *J Vet Med Educ* 2001;3:101-110.
- Leman AD. Diagnosis and treatment of food animal educational diseases. *J Am Vet Med Assoc* 1988;193:1066-68.
- Lissemore K, Stowe J. Farm practice in a cross-fire. *Can Vet J* 1989;30:857-862.
- Lloyd JW, Walsh DA. Template for a recommended curriculum in "Veterinary professional development and career success. *J Vet Med Educ* 2002;29:(2)84-93.
- McConnell SL, Kogan LR. Subjective criteria as the sole method of selecting veterinary candidates at a US veterinary medical school. *J Vet Med Educ* 2001;3:131-145.
- Michell A. R. Clinical research at the crossroads. *Vet Rec* 1997;141:579-582.
- Moore, DA, Klingborg DJ, Brenner JS, Gotz AA. Motivations for and barriers to engaging in continuing veterinary medical education. *J Am Vet Med Assoc* 2000;217:1001-1006.
- Morin DE, Constable PD, Troutt HF, Johnson AL. Individual animal medicine and animal production skills expected of entry-level veterinarians in bovine practice. *J Am Vet Med Assoc* 2002a;221:959-968.
- Morin DE, Constable PD, Troutt HF, Johnson AL. Surgery, anaesthesia, and restraint skills expected of entry-level veterinarians in bovine practice. *J Am Vet Med Assoc* 2002b;221:969-974.
- Nielsen NO. A time for bold action. *Can Vet J* 1999;40:552-554.
- Nielsen NO. Is the veterinary profession losing its way? *Can Vet J* 2001;42:439-445.
- Ogilvie BM. Veterinary research: the need for a culture change. *Vet Rec* 1998;143:518-522.
- O'Rourke K. Food animal veterinarian shortage causing growing concern. News section. *J Am Med Assoc* 2002;222:127-128.
- Osborne, Darren. Demographic Survey Results and Demographic Survey Forecast. 2002
- Osborne CA. The veterinarian's oath: are you keeping your promise? *J Am Vet Med Assoc* 1991;198:1906-1908.
- Osler Sir William. Books and Men. Opening of Boston Medical Library. January 12, 1901.

Prescott J (Chair), Bailey J, Hagele WC, Leung D, Lofstedt J, Radostits OM, Sandals D. CVMA Task Force on “Education, Licensing, and the Expanding Scope of Veterinary Practice”. *Can Vet J* 2002;43:845-854.

Pritchard WR. Some implications of structural change in veterinary medicine and its impact on veterinary education. *J Am Vet Med Assoc* 1993;201:361-364.

Pritchard WR. *Future Directions for Veterinary Medicine*. Pew National Veterinary Education Program. North Carolina: Duke University. 1989;189 pp.

Radostits OM. *Herd Health. Food Animal Production Medicine*. Third Edition. WB Saunders Co. Philadelphia 2001;884 pp.

Randall DC. Elevating the role and status of food animal veterinarians. Letters to the editor. *J Am Med Assoc* 2003;222:580-582.

Royal College of Veterinary Surgeons. A survey of employment in the UK veterinary profession in 2002. The findings of a survey conducted by the Royal College of Veterinary Surgeons. September 2002a.

Royal College of Veterinary Surgeons. *Veterinary education and training: a framework for 2010 and beyond*. A consultation paper prepared by the RCVS Education Strategy Steering Group. Royal College of Veterinary Surgeons. London, England. July 2001.

Royal College of Veterinary Surgeons. *Veterinary education and training: a framework for 2010 and beyond*. Recommendations presented to the RCVS Council. 2002b

Selborne, Lord. Report of the committee of enquiry into veterinary research. The Wellcome Trust. London, England. November 1997

Sprecher DJ, Krehbiel JD, Hauptman JG. The demographics and evaluation of the externship experiences arranged by the Michigan State University Veterinary Medicine Students. *J Vet Med Educ* 2002;29:96-100.

Stevenson, D. Thinking outside the box: utilizing veterinary technicians in food animal practice. *Proc Am Assoc Bov Pract* 2002;35:139-141.

Sternberg RJ, Kaufman JC. Human abilities. *Annu Rev Psychol* 1998;49:479-502.

The CVMA Task Force on the Future of the Veterinary Profession in Canada. *Veterinary Medicine in Canada: opportunity for Renewal*. Ottawa. Canadian Veterinary Medical Association 1998;21 pp.

Tinga CE, Adams CL, Bonnett BN, Ribble CS. Survey of veterinary technical and professional skills in students and recent graduates of a veterinary college. *J Am Vet Med Assoc* 2001;219:924-931.

- Trent AM. Outcomes assessment planning: an overview with applications in health sciences. *J Vet Med Educ* 2002;29:(1):9-19.
- Turnwald GH, Spafford MM, Bohr JD. Veterinary school admission interviews, Part 2: survey of North American schools. *J Vet Med Educ* 2001a;3:122-130.
- Turnwald GH, Spafford MM, Edwards JC. Veterinary school admission interviews, Part 1: literature overview. *J Vet Med Educ* 2001b;3:111-121.
- Tyler JW, Miller R, Constable PD, Hostetler DE, Lakritz J, Hardin DK, Angel KL, Wolfe DF. Factors related to in-house agricultural animal caseloads in US veterinary teaching hospitals. *J Vet Int Med* 2002;16:7-11.
- Waldner CL, Ribble CS, Janzen ED. Evaluation of the impact of a natural gas leak from a pipeline on productivity of beef cattle. *J Amer Vet Med Assoc* 1998;212:41-48.
- Walsh DA, Osburn BI, Christopher MM. Defining the attributes expected of graduating veterinary medical students. *J Am Vet Med Assoc* 2001;219:1358-1363.
- Walsh DA, Osburn BI, Shumacher RL. Defining the attributes expected of graduating veterinary medical students, Part 2: External evaluation and outcomes assessment. *J Vet Med Educ* 2002;29:(1):36-42.
- Wise, JK. The U. S. livestock market for veterinary medical services and products. Center for Information Management. *J Am Vet Med Assoc* 1995:1-103.
- Wren, Geni. Tomorrows Practitioners. *Bovine Practitioners of Tomorrow. Bovine Veterinarian. Section B. A Supplement to Dairy Herd Management and Drivers for Bovine Veterinarians.* September 2002:3-13.
- Western College of Veterinary Medicine, University of Saskatchewan. Survey of Recent Graduates and Their Employees. A Guide for Curricular Development. March 2001.