

Perspectives in Professional Education

Defining the attributes expected of graduating veterinary medical students

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There is increasing recognition that colleges and schools of veterinary medicine need to more explicitly define the attributes expected of graduates of their veterinary degree programs. This need was first highlighted in a report¹ published by the PEW National Veterinary Education Program entitled “Future Directions for Veterinary Medicine” and more recently was brought into particular prominence by results of the KPMG-LLP study² on the current and future market for veterinarians and veterinary medical services in the United States. The latter, jointly commissioned by the AVMA, the American Animal Hospital Association, and the Association of American Veterinary Medical Colleges, provides an alert to all those in veterinary medicine of the changes that will need to occur for the profession to meet the expectations of it and the potential of which it is capable. Dr. Lonnie King, vice chair of the National Commission on Veterinary Economic Issues (NCVEI), stated in a follow-up to the KPMG-LLP study that “increasingly, the critical success factors for veterinarians in our rapidly changing world are seemingly less about our scientific and technical skills and more about life skills, including interpersonal competence and entrepreneurship; ability to adapt, leverage technology, create and take advantage of new opportunities, and work in teams; and high self-confidence and a desire to improve and continuously learn. The acquisition of these skills will produce new graduates who are better equipped to raise incomes, meet societal needs, and truly reach our profession’s potential.”³

For the veterinary profession to reach the goals outlined by the KPMG-LLP study and the NCVEI, colleges and schools of veterinary medicine must define the complement of professional characteristics, as well as the knowledge and skills, required of their graduates by the time their veterinary degree training has been completed. 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 the members of the veterinary profession and be able to successfully compete in the existing and expected marketplace.

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A well-defined curriculum is critical for the success of any educational program. A curriculum, however, is only a course of study,⁴ and although the term is frequently supposed by some to have a broader connotation, the curriculum does not itself define the overall set of attributes that those enrolled in that course of study will or should have attained upon its completion. Educational programs, especially those in the health professions, have most often been designed from the bottom up. The faculty of each veterinary college and school expends extensive efforts delineating the set of courses and clinical rotations that make up the professional curriculum, precisely defining the timing of courses within the veterinary professional degree program and the amount of time and assumed student effort required for each of the component parts. Similarly, the faculty dedicates extensive effort to structure each course and clinical rotation within the curriculum and to describe its objectives and content. Substantial effort is then applied to course delivery and clinical instruction and to assessing whether students meet the established course criteria and objectives. Much faculty effort is also directed towards establishing the criteria for admission that are deemed essential for student success and selecting the candidates that best meet these criteria.

In stark contrast, however, relatively little faculty effort has been devoted in veterinary medical education 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.

Three steps are essential to ensuring that the attributes attained by graduates of veterinary degree programs will allow them to meet the expectations placed on them as members of the veterinary profession and the needs of society. 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 or school. 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 feed-

back that can then be used to further develop the veterinary degree program and refine the attributes expected of its graduates.

Increasingly, educational programs are being required to perform outcomes assessments to obtain and retain accreditation. The US Department of Education spearheaded a movement in the 1980s aimed at more extensive inclusion of outcomes assessment in accreditation processes,³ and outcomes assessment is now deemed essential by the Council for Accreditation of Counseling and Related Educational Programs⁶ and the Council for Higher Education Accreditation.⁷ Outcomes assessment is also becoming a key component in the accreditation of the educational programs of schools of medicine^{8,9} and dentistry¹⁰ and for residency programs for physicians.¹¹ It would appear likely, therefore, especially with the recent institution of a pilot program by the AVMA, that outcomes assessment will also become part of the accreditation process of veterinary education programs.

It is not possible to undertake a meaningful outcomes assessment of a program, however, without a clear definition of the expected credentials of the graduating students. For this reason, it is vital that colleges and schools of veterinary medicine define the attributes they expect their students to have attained during or before their veterinary school education. In addition, they must develop methods to ensure that students demonstrate these attributes during their veterinary school education. Such a statement of outcome objectives provides a template for judging whether the program can and is meeting its goals. The purpose of the present report was to describe the method used by the University of California, Davis, to create a comprehensive listing of the attributes expected of graduates of its School of Veterinary Medicine. It is hoped that this method and the resulting listing of attributes can serve as a template from which other colleges and schools of veterinary medicine may create their own listings of the expectations of the graduates of their veterinary degree programs.

Methods

Development of a statement of the attributes expected of veterinary graduates—As a starting point, a small group of faculty members from the University of California, Davis, School of Veterinary Medicine developed a draft of the expected attributes of graduates of the school's veterinary degree program. The draft was based on the structure and definition of learning objectives recently created for medical student education by the **Medical Schools Objectives Project (MSOP)** of the Association of American Medical Colleges.¹² This comprehensive and well-reasoned set of objectives for medical student education represents the culmination of a 3-year project (1996 through 1999) that incorporated contributions from some of the most accomplished and knowledgeable medical educators in the United States and Canada.

The draft proposal was then reviewed by a board of external advisors^a consisting of 17 veterinarians. Members of this board were broadly representative of various areas of veterinary medicine throughout

California; several had leadership roles in the California Veterinary Medical Association, the AVMA, or regulatory agencies, and many were in private practice. Board members were a mixture of ages, reflecting different times since completion of their own veterinary school training, and 7 of the 17 had received their training at institutions other than the University of California.

For each attribute listed in the initial draft, board members were asked to indicate whether they strongly agreed, agreed, disagreed, or strongly disagreed with the statement that a graduate of a veterinary degree program should have demonstrated the defined attribute by the time of graduation. Board members were then individually interviewed to expand the scope of their assessments and were asked to provide an overall evaluation of the set of defined attributes and make suggestions for modifications, additions, and deletions.

Following this review, the attributes statement was comprehensively revised and expanded. The revised statement was then reviewed by a group of veterinary school faculty with special interest in curriculum objectives and distributed to department chairs and faculty for further review and comment. The final statement was subsequently endorsed by the Executive Committee of the Faculty Senate of the School of Veterinary Medicine, University of California, and by the school's Academic Council.

Assessment of the attributes statement by veterinary students and residents—Following creation of the attributes statement, fourth-year students in the doctor of veterinary medicine degree program of the University of California and residents of the University of California Veterinary Medical Teaching Hospital were surveyed to obtain their assessments of the defined set of attributes. A questionnaire was developed, requesting that respondents evaluate the importance of each attribute and indicate whether they believed the entire set of defined attributes should be required as a criterion for graduation. Questionnaires were distributed by e-mail to fourth-year students during the middle of the fall academic quarter and to residents during the summer and fall. Sixty-eight of 110 (62%) students and 49 of 75 (65%) residents responded. Students who responded represented all of the clinical tracks offered at the University of California; residents who responded represented 18 specialties. Sixteen of the residents who responded had graduated from the University of California School of Veterinary Medicine; the remaining 33 had graduated from the veterinary degree programs at Auburn University, Cornell University, the University of Georgia, the University of Illinois, Iowa State University, Michigan State University, the University of Minnesota, Oregon State University, the University of Pennsylvania, Purdue University, Texas A&M University, Tufts University, Virginia-Maryland Regional College of Veterinary Medicine, the University of Wisconsin, Ontario Veterinary College (Canada), the University of Liège (Belgium), Tierärztliche Hochschule Hannover (Germany), the University of Utrecht (Netherlands),

the University of Las Palmas de Gran Canaria (Spain), the Swedish University of Agriculture and Science, the University of Bern (Switzerland), the University of São Paulo (Brazil), the University of Melbourne (Australia), and the University of Sydney (Australia).

For each of the attributes defined in the final attributes statement, respondents were asked to assign a grade from 0 to 5, with 5 = absolutely essential for every graduate to have demonstrated, 4 = very essential for almost every graduate, 3 = a very valuable attribute for most graduates to have attained, 2 = a useful attribute for most graduates to have attained, 1 = only of modest value for most graduating students, and 0 = should definitely not be expected. Data were analyzed for the entire cohort of students and residents (n = 117) and for the 2 groups individually. In addition, responses were evaluated for combinations of students and residents based on intended (students) or current (residents) type of veterinary practice (large animal practice, n = 36; small animal practice, 63). Intended practice type for students was based on self-identification or their fourth-year clinical track selection, with those in the mixed-animal clinical track categorized on the basis of predominance of large or small animal rotations. Students in the companion and exotic animal clinical track were included with students in the small animal clinical track. Six students who intended to pursue careers in public health or pathology or who were pursuing individualized fourth-year clinical tracks were excluded from analyses based on practice type. Residents were included in analyses based on practice type only if they had exclusive or nearly exclusive responsibility during their residency for either small or large animals. Twelve residents who were pursuing training in anesthesiology, pathology, or radiology were excluded.

Statistical evaluation—Responses were compared among groups by use of Student *t*-tests, assuming unequal variances and 2-tailed distributions; analyses were performed with statistical software.^b Values for responses to individual attributes were expressed as

mean ± the margin of error at a 95% confidence interval (ie, standard error × 1.96).

Results

Description of the attributes statement—The final attributes statement, “Expected attributes of the graduates of a veterinary degree program,” defined 62 attributes divided into 3 fundamental areas: professional characteristics (including compassion, altruism, and duty), knowledge and understanding, and skills (Appendix). Attributes in each fundamental area were prefaced by a definition of the general expectations of practicing veterinarians.

Assessment of the attributes statement by veterinary students and residents—Responses from the fourth-year veterinary students and the residents provided a strong endorsement for essentially all of the individual attributes included in the final attributes statement. Forty-five of the 62 (73%) individual attributes received a mean rating from the combined group of students and residents > 4 (ie, between a rating of “absolutely essential for every graduate to have demonstrated” and a rating of “very essential for almost every graduate”), and another 10 (16%) received mean ratings from the combined group between 3.7 and 4.0 (Tables 1, 2, and 3). The remaining 7 attributes all had mean ratings between 2.89 and 3.69. Fourth-year students and residents held similar opinions about the relative importance of most of the defined attributes, and mean rating given by the students was significantly ($P < 0.001$) different from mean rating given by the residents for only 7 attributes (for all 7, the difference between mean ratings was > 0.5).

The largest differences between mean ratings given by the students and the residents were for the 2 related educational objectives “knowledge of the appropriate tests for detecting animals or groups of animals at risk for specific diseases or in the early stage of disease and of strategies for responding appropriately” and “the competence to identify and suggest approaches to help prevent disease and trauma in individual and groups of

Table 1—Ratings of the importance of individual attributes related to professional characteristics for graduates of veterinary degree programs

Abbreviated attribute description*	Students	Residents
Character traits for responsible treatment of animals	4.91 ± 0.07	4.84 ± 0.11
Effective and appropriate client communication	4.46 ± 0.16	4.38 ± 0.19
Respect for other veterinary health care professionals	4.27 ± 0.19	4.06 ± 0.24
Respect for other veterinarians	4.49 ± 0.17	4.27 ± 0.24
Having a respect for the roles of animals	3.79 ± 0.23	3.92 ± 0.27
Being responsible to the community	3.99 ± 0.23	3.76 ± 0.30
Honesty in all interactions	4.84 ± 0.11	4.84 ± 0.12
Ethical principles that govern clinical decisions and appropriate care	4.51 ± 0.17	4.51 ± 0.19
Acceptance of limitations; self-motivation to improve	4.64 ± 0.17	4.51 ± 0.25
Placing patient benefits above one's own interests	4.25 ± 0.22	4.27 ± 0.29
Tolerance for conflicting ideas	4.25 ± 0.22	4.10 ± 0.30
Being an advocate for change	3.86 ± 0.21	3.51 ± 0.31

Ratings were assigned by 68 fourth-year veterinary students and 49 residents at the University of California who responded to a survey. Respondents were asked to assign a grade from 0 to 5, with 5 = absolutely essential for every graduate to have demonstrated, 4 = very essential for almost every graduate, 3 = a very valuable attribute for most graduates to have attained, 2 = a useful attribute for most graduates to have attained, 1 = only of modest value for most graduating students, and 0 = should definitely not be expected. Ratings are given as mean ± the margin of error at a 95% confidence interval. In each column, ratings that differ by > 0.5 are significantly ($P < 0.001$) different.

*Full descriptions of each attribute are given in the Appendix; the order of attributes in the table matches the order in the Appendix.

Table 2—Ratings of the importance of individual attributes related to knowledge and understanding for graduates of veterinary degree programs

Abbreviated attribute description*	Students	Residents
Knowledge of disease		
Normal structure and function of the body	4.78 ± 0.12	4.80 ± 0.13
Molecular, biochemical, and cellular mechanisms	4.04 ± 0.25	4.24 ± 0.22
Comprehension of disease from the molecular to the population level	3.91 ± 0.25	3.90 ± 0.29
Disease etiologies	4.58 ± 0.18	4.49 ± 0.20
Correlations of altered pathophysiology with disease	4.52 ± 0.18	4.47 ± 0.20
Disease transmission	4.60 ± 0.15	4.43 ± 0.21
Foundation principles of animal wellness and health maintenance		
Appropriate nutrition and patterns of eating	3.99 ± 0.23	3.63 ± 0.25
Immunization	4.66 ± 0.15†	4.13 ± 0.27†
Reproduction and animal husbandry	3.77 ± 0.23	3.58 ± 0.25
Normal growth patterns	3.57 ± 0.28	3.37 ± 0.26
Risk factors for disease	4.48 ± 0.17	4.06 ± 0.21
Population health and epidemiology	3.33 ± 0.23	3.20 ± 0.28
Testing for animals at risk or in early stages of disease	4.28 ± 0.21†	3.49 ± 0.28†
Principles of diagnosis, medical management, and treatment		
Clinical reasoning—finding and using medical knowledge	4.85 ± 0.09	4.71 ± 0.18
Clinical, radiographic, and pathologic manifestations of disease	4.67 ± 0.14	4.47 ± 0.22
Normal behavior and behavioral responses	3.84 ± 0.22	3.79 ± 0.24
Medications and pharmaceuticals	4.42 ± 0.20	4.35 ± 0.26
Surgical management procedures	4.53 ± 0.15	4.29 ± 0.20
Responses to injury, stress, and disease	4.38 ± 0.17	4.10 ± 0.23
Knowledge required for effective client communication		
Recognition of impact of successful communication	4.63 ± 0.19	4.43 ± 0.24
Knowledge of the roles and uses of animals	3.54 ± 0.20	3.43 ± 0.30
Nature of the human-animal bond	4.11 ± 0.21	4.01 ± 0.24
Breed recognition	3.52 ± 0.26	3.21 ± 0.33
Nontraditional therapies	3.12 ± 0.09	2.89 ± 0.09
Knowledge of public health		
Understanding of disease transmission	4.44 ± 0.16	4.40 ± 0.22
Control of disease transmission	4.45 ± 0.15	4.18 ± 0.24
Introductory knowledge of veterinary business practices		
Nature of private veterinary practice	3.38 ± 0.25	3.27 ± 0.29
Regulatory law	4.13 ± 0.21	3.76 ± 0.27

†Mean ratings assigned by students and residents were significantly ($P < 0.001$) different.
See Table 1 for remainder of key.

Table 3—Ratings of the importance of individual attributes related to skills for graduates of veterinary degree programs

Abbreviated attribute description*	Students	Residents
Deductive reasoning and problem solving skills		
Ability to articulate and communicate	4.73 ± 0.12	4.61 ± 0.20
Eliciting a full patient history	4.38 ± 0.22	4.22 ± 0.21
Humane and safe animal restraint	4.52 ± 0.15	4.41 ± 0.21
Complete and organ system-specific physical diagnosis	4.62 ± 0.15	4.46 ± 0.22
Performing core clinical procedures	4.67 ± 0.13	4.58 ± 0.19
Selecting and interpreting common diagnostic procedures	4.51 ± 0.15	4.19 ± 0.25
Developing problem solving lists	4.64 ± 0.14	4.19 ± 0.24
Developing clinical management and therapeutic strategies		
Recognition and appropriate institution of therapy in life-threatening conditions	4.69 ± 0.13	4.58 ± 0.19
Developing clinical management and therapeutic strategies	4.65 ± 0.14	4.38 ± 0.21
Recognition and appropriate institution of therapy in life-threatening conditions	4.87 ± 0.09	4.75 ± 0.15
Proficiency with standard surgical procedures	4.68 ± 0.14†	4.13 ± 0.27†
Appropriate therapeutic administration	4.85 ± 0.09	4.56 ± 0.19
Competencies in animal reproduction and neonatal care	3.63 ± 0.22	3.33 ± 0.29
Monitoring progress and adjusting therapy	4.61 ± 0.15	4.25 ± 0.20
Recognition of limiting knowledge and skills		
Recognition and relief of pain and suffering	4.84 ± 0.13	4.73 ± 0.14
Appropriate recognition for need and implementation of euthanasia	4.73 ± 0.12	4.54 ± 0.18
Competency in disease and trauma prevention	4.76 ± 0.13	4.63 ± 0.19
Medical record keeping	4.09 ± 0.21†	3.39 ± 0.27†
Competence in information technology	4.55 ± 0.16	4.40 ± 0.09
Skill to remain current with emerging knowledge	4.01 ± 0.20†	3.24 ± 0.32†
Ability to critically examine new knowledge	4.46 ± 0.16†	3.91 ± 0.25†
	4.39 ± 0.11†	3.89 ± 0.25†

See Tables 1 and 2 for key.

animals, including the ability to conduct an environmental assessment for hazards including toxic chemicals and plants.” Students rated these as more impor-

tant than did residents by 0.79 and 0.70 points, respectively, which may reflect some component of the University of California curriculum. Students also

rated the attribute "competence in information technology to be able to access and retrieve from electronic databases and other resources accurate biomedical information, diagnostic strategies, and medical records" higher than did residents (difference, 0.77 points). This difference likely reflected the enormous change that has occurred in the past several years in the amount of reliable material that can be easily accessed electronically. On average, residents had started their residency program 3.5 years after completing their veterinary degree program; therefore, their veterinary degree education almost certainly provided them with less experience with electronically accessed data than current students receive.

Analysis of responses on the basis of type of veterinary practice (ie, small vs large animal) indicated that these 2 groups also ranked attributes similarly. For these two groups, there were no significant differences in mean ratings, with a mean (\pm margin of error) difference between ratings by individuals in or preparing for large vs small animal practice of 0.14 ± 0.12 .

Analysis of responses on the basis of gender (76 females and 41 males) did not reveal any significant differences between ratings. The mean difference between ratings by males and females (\pm margin of error) was 0.07 ± 0.11 .

Residents and students also were asked whether they thought the entire set of attributes should be adopted as a criterion for graduation. Of the 61 students, 21 (35%) responded definitely yes, 35 (57%) responded probably yes, 3 (5%) responded probably no, and 2 (3%) responded definitely no. Of the 48 residents, 18 (38%) responded definitely yes, 26 (54%) responded probably yes, and 4 (8%) responded probably no; none responded definitely no.

Discussion

Colleges and schools of veterinary medicine have multiple stakeholders, each with a distinct perspective of what the educational programs of the colleges should accomplish. In addition, as stated by Dr. King,³ colleges and schools of veterinary medicine have "both the challenge and obligation to help resolve many of the issues that emerged from the KPMG study." One key step in determining how well the colleges and schools of veterinary medicine are fulfilling the needs of these stakeholders and, especially, the needs of society and the veterinary profession is to define the attributes they expect their students to have at the time of graduation. Explicit, rather than implicit, definition of these expectations is essential, and whether graduates possess these qualities and characteristics should be assessed, not presumed. The present report provides a template that colleges and schools can use to define the attributes they expect students in their veterinary degree programs to have attained by the time of graduation. Education is a combination of curriculum and assessment, and often, what a student accomplishes in an educational program is more determined by how the student is evaluated than by curriculum content. We incorporated this concept in the final attributes statement by specifying the expected outcomes in terms of their demonstration to the faculty, rather than

in terms of the curriculum. Some of the expected attributes of veterinary graduates are, and should be, part of the basis for admission. Even so, it remains essential that students demonstrate these attributes to the faculty during the course of their veterinary degree education.

Surveying the fourth-year students and residents yielded not only their assessments of the individual attributes but also a reassuring perspective of the values of this cohort, which represents the future leaders and providers of veterinary medicine in this country. However, even though ratings by the students and residents matched for most attributes, subtle but significant variations were evident. In addition, even though mean ratings for most of the attributes were high, there clearly was a graded importance attached by students and residents to attainment of given attributes. Similar results were obtained when the data were evaluated on the basis of practice type or gender. The similarity of ratings provided by these groups provides a validation to the overall evaluation.

Coupled to the need for a college or school to define the set of attributes expected of its graduates is the need to create a mechanism for students to demonstrate to the satisfaction of the faculty that they have attained these attributes by the time of graduation. The University of California School of Veterinary Medicine has begun to develop this type of internal assessment by producing a Web-based program for evaluation of fourth-year students during their clinical rotations. The expectation is that coupling this computer-based evaluation with evaluations provided by the faculty and residents in contact with the fourth-year students during their clinical rotations will provide a suitable avenue for determining whether students have attained the expected attributes.

A second fundamental reason why a college or school of veterinary medicine should define the attributes that it expects of its graduates is to provide a well-defined base for an external outcomes assessment. Colleges and schools should determine whether the expected outcomes of their veterinary degree program and their individual graduates are meeting external expectations. The University of California School of Veterinary Medicine is currently conducting an outcomes assessment study in partnership with the California Veterinary Medical Association, using the attributes statement as the basis for evaluation.

The initial structure of the University of California's attributes statement was based on the learning objectives for medical student education defined by the MSOP.¹² Although elements of the overall structure and the specific content of the statement of attributes expected of veterinary students remain similar to those of the MSOP, some important differences are also evident. The MSOP statement divided expectations for physicians into 4 major divisions and presented them in terms of a statement that physicians should be altruistic, knowledgeable, skillful, and dutiful, with dutiful including knowledgeable and skillful. Expectations for veterinary students, on the other hand, were classified into 3 categories (professional characteristics, knowledge and understanding, and

skills). In total, 62 attributes expected of veterinary graduates were defined, in comparison with the 30 attributes defined by the MSOP as expectations of medical school graduates. This expansion resulted from a clarification of certain attributes and specification of additional attributes, mostly as a consequence of the input from the practicing veterinarians who served on the advisory board for this project.

The attributes statement developed by the University of California was purposefully created to outline expectations for all students, independent of their subsequent career paths. The final set of attributes closely reflects the AVMA's requirement for accreditation of veterinary colleges that "the professional degree curriculum should emphasize the acquisition and development of skills, values, and attitudes at least as much as the acquisition of a core of veterinary knowledge."¹³

An alternative approach to defining outcome objectives that presents a valuable comparison to the statement provided in the present report is the report "Professional Competencies of Canadian Veterinarians," which was created by the Ontario Veterinary College¹⁴ on the basis of the Australian Veterinary Profession Competency Standards.¹⁵

^aMembers of the Board of External Advisors included Drs. Michael Andrews, Charles Boles, Nancy Collins, Kim Gill-Favier, Sara Ford, Douglas Herthel, Wesley Jones, Gerald Kugel, Nancy Martin, David McCrystle, James Peddie, Joan Samuels, Richard Schumacher, Richard Sullivan, Ronald Terra, Mimi Vishoot, and Peter Weinstein.

^bExcel 2000, Microsoft Corp, Bellevue, Wash.

References

1. Pritchard WR. *Future directions for veterinary medicine*. Durham, NC: PEW National Veterinary Medical Education Program, Duke University, 1989.

2. 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.

3. King LJ. It was the best of times, it was the worst of times. A perspective on the KMPG study. *J Am Vet Med Assoc* 2000;217:996-998.

4. *The shorter Oxford English dictionary*. Oxford, England: Oxford University Press, 1973.

5. National Institute of Education. *Involvement in learning: realizing the potential of American higher education*. Washington, DC: Government Printing Office, 1988.

6. US Department of Education. CACREP accreditation: assessment and evaluation in the standards and process. Available at: http://www.ed.gov/databases/ERIC_Digests/ed388884.html. Accessed Jul 20, 2001.

7. Council for Higher Education Accreditation. Recognition of accrediting organizations. Policy and procedures. Available at: <http://www.chea.org/About/Recognition.cfm>. Accessed Jul 20, 2001.

8. Liaison Committee on Medical Education. Accreditation standards. Available at: <http://www.lcme.org/standard.htm>. Accessed Jul 20, 2001.

9. Stevens DP. Three questions for the LCME. *Acad Med* 2000;75:960-961.

10. American Dental Association. Outcomes assessment. Available at: <http://www.ada.org/prof/ed/accred/>. Accessed Jul 20, 2001.

11. Accreditation Council for Graduate Medical Education. Outcome project. Available at: <http://www.acgme.org/>. Accessed Jul 20, 2001.

12. Learning objectives for medical student education—guidelines for medical schools. Report I of the Medical School Objectives Project. *Acad Med* 1999;74:13-18.

13. Essential requirements of an accredited or approved college of veterinary medicine. In: *Directory and resource manual*. Schaumburg, Ill: American Veterinary Medical Association, 2000;190-192.

14. *Professional competencies of Canadian veterinarians*. Guelph, Canada: Ontario Veterinary College, University of Guelph, 1996.

15. *The Australian veterinary professional competency standards*. Canberra, Australia: National Office of Overseas Skills Recognition, Australian Veterinary Association Competency Project, 1992.

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Appendix

Attributes expected of graduates of the University of California School of Veterinary Medicine

Expected Attributes of the Graduates of a Veterinary Program

VETERINARIANS MUST BE COMPASSIONATE, ALTRUISTIC, AND DUTIFUL

Veterinarians must bring to the study and practice of veterinary medicine those character traits, attitudes, and values that underpin beneficent and ethical veterinary care. They must be compassionate and empathetic in caring for animals. At all times, their treatment of animals must be humane. They should be advocates for the health needs and well-being of their patients.

Veterinarians must be compassionate and respectful in their interactions with animal caretakers and clients and be sensitive to their needs. They must humely serve and respect their clients without regard to the client's beliefs, values, ethnicity, gender, or economic status. They should have concern and be advocates for the welfare of their clients and the clients' communities in all aspects to which animals may contribute, including the public's health.

Veterinarians must be trustworthy and truthful in all professional dealings. They must be committed to the constant improvement of their own knowledge of veterinary care, be self-assessing and reflective of their knowledge and skill level, and be open to change and new ideas. They should be committed to working collaboratively with other veterinarians, other health care professionals, and community and regulatory agencies; they should be understanding of the value of professional interaction and sharing. They must accept and adopt the ethical precepts of the veterinary profession and their obligations under the law. Veterinarians should be advocates in all aspects of the veterinary profession that affect the well-being of animals and humans.

By the time of graduation, graduates of the School of Veterinary Medicine should have demonstrated the following professional characteristics to the satisfaction of the faculty:

- The character traits, attitudes, and values that result in the humane and responsible treatment of animals.
- The character traits, attitudes, and values that result in compassionate, courteous, and effective communication with clients and a respect for their dignity.
- A respect for and understanding of the roles of other veterinary health care professionals. They must be effective in communication with them in the care of individual and groups of animals.
- A respect for other veterinarians and recognition that they should collaborate with them when beneficial for the delivery of care.
- A respect for the roles of animals in society.
- A recognition that veterinarians have a responsibility for the welfare of the community that they serve, as may be affected by animal-related issues, including public health.
- Honesty and integrity in their interactions with clients, colleagues, teachers, other veterinary healthcare professionals, and others with whom they interact in their professional lives.
- A practical understanding of the ethical principles that govern clinical decision making and appropriate animal care and their application in the balance of humane treatment for animals and the interests and beliefs of their owners.
- A demonstrated intellectual honesty to recognize and accept limitations in their own knowledge and clinical skills, leading to a self-motivated commitment to continuously improve their knowledge and ability.
- The values and attitudes that place the benefit to the patient above their own personal interests and monetary gain.
- A tolerance for conflicting ideas and an openness and flexibility to accept change.
- A recognition that they must be an advocate for change to meet the goals of the profession and that they have a responsibility on behalf of the profession to the community that they serve.

VETERINARIANS MUST BE KNOWLEDGEABLE

Veterinarians must understand the scientific basis of veterinary medicine and apply that understanding to veterinary practice. They must comprehend disease at a molecular, cellular, systemic, individual, and population level. They must have a comprehensive knowledge of the body as an intact organism and of its major organ systems. They must understand the principles of homeostasis, the processes of aberrant growth, the modes of infection and infectious disease, and the responses to stress and injury. They must also have a sound foundation in nutrition, immunology, reproduction and development, pharmacology and toxicology, genetics, epidemiology, preventative medicine, and population health. They must have a comprehensive grounding in the comparative biology of animal species. They must be knowledgeable about animal behavior.

Veterinarians must expertly combine their understanding of these diverse biomedical areas into the effective medical management and treatment of sick animals, as compromised by disease, trauma, or other health-related issues. They must understand the etiology, pathogenesis, and time course of diseases and the clinical, laboratory, radiographic, and pathologic manifestations of diseases and injury. They must incorporate modern diagnostic and therapeutic modalities wisely into their practice. They must know how to find and use medical knowledge, and they must engage in lifelong learning to remain current in their understanding of the scientific basis of veterinary medicine. They must be knowledgeable about risk factors for disease and injury. They must use this diversity of knowledge to help maintain the wellness of individuals and populations of animals, and they must promote the health of animals through client and public education and action.

Veterinarians must be knowledgeable of the animal-human bond and the contributions that animals make to the well-being of humans. They must be knowledgeable of animal-related disease threats to human health, including environmental factors. All veterinarians should recognize the breadth of the discipline and especially understand the important and diverse roles that animals play in the health, economics, food-supply, recreation, and well-being of mankind.

By the time of graduation, graduates of the School of Veterinary Medicine should have demonstrated the following knowledge and understanding characteristics to the satisfaction of the faculty:

Knowledge of disease, which includes the following attributes:

- An understanding of the normal structure and function of the body as an intact organism and of each of the major organ systems for animals within their chosen specialty.
- A practical understanding of the molecular, biochemical, and cellular mechanisms important in maintaining the body's homeostasis and normal function.
- A fundamental comprehension of disease at the molecular, cellular, systemic, individual, and population level.
- An understanding of the various etiologies of disease, including metabolic, nutritional, traumatic, degenerative, toxic, infectious, parasitic, immune, neoplastic, genetic, and developmental; their causes; and the clinical reasoning that allows a distinction to be made among them.
- A knowledge and correlation of the altered pathology and pathophysiology of the body and its major organ systems with various disease conditions.
- An understanding of the processes of disease transmission for common diseases and of common environmental determinants of disease.

Knowledge of the foundation principles of animal wellness and health maintenance, which includes the following attributes:

- Knowledge of adequate nutrition and normal eating patterns and differences by age and disease state.
- Knowledge of common immunizations used within their chosen specialty.
- Knowledge of normal reproduction and animal husbandry.
- Knowledge of healthy growth patterns, especially as apply to food animals.
- An understanding of the risk factors for animal disease and injury and common practices for their prevention, especially as applicable for client education.
- An understanding of principles of population health and epidemiology, especially as they apply to multiple animal units and analysis.
- A knowledge of the appropriate tests for detecting animals or groups of animals at risk for specific diseases or in the early stage of disease and of strategies for responding appropriately.

Knowledge of the principles of diagnosis, medical management, and treatment, which includes the following attributes:

- An understanding of how to find and use medical knowledge and of the application of the scientific method to clinical reasoning, data evaluation, and diagnosis.
- Knowledge of the most frequent clinical, laboratory, radiographic, and pathologic manifestations of common animal diseases and the appropriate selective use of these and other diagnostic procedures in diagnosis strategies. The ability to interpret the results of commonly used diagnostic procedures. A knowledge of the correct collection, storing, and handling of diagnostic samples.
- Knowledge of normal animal behavior across species and of behavioral responses to disease and trauma.
- Knowledge of medications and pharmaceuticals commonly used in practice, including their contraindications, side effects, incompatibilities, and withdrawal times.
- Knowledge of routine surgical procedures, suture materials and suturing patterns, tissue handling techniques for surgical procedures and wound repair, and anesthesia, including techniques for anesthetic monitoring.
- An understanding of the responses to injury and stress and of the healing process following injury, surgery, or other invasive procedures.

A knowledge base for effective client communication, which includes the following attributes:

- Knowledge of communication and its impact on the successful functioning of a veterinarian.
- Knowledge of the use of animals in sport, recreation, agriculture, research, and industry, with a good awareness of animal ownership from the diversity of clients' perspectives.
- Understanding of the nature of the animal-human bond and the contributions that animals can make to human health and well-being and an appreciation of what being an animal owner entails.
- Ready recognition of common animal breeds within their area of specialty.
- Cognizance, with an open mind, of common nontraditional therapies.

A knowledge base for public health, which includes the following attributes:

- An understanding of diseases transmissible between animals and humans and other animal disease threats to human health, including environmental-based and food-borne disease and drug residues. Associated with this is a responsibility to communicate these occupational hazards to clients and staff.
- Knowledge of approaches to the control of animal-animal and animal-human disease transmission and of emerging and foreign diseases that might threaten animal and human health.

Introductory knowledge of veterinary business practice, which includes the following attributes:

- A general understanding of the working environment of a typical veterinary practice, with an introductory level of knowledge of small business management and economics, including the economics of animal health and well-being and an understanding of the role of animal health in agriculture.
- A practical knowledge of regulatory law, especially as pertaining to the use of drugs.

VETERINARIANS MUST BE SKILLFUL

Veterinarians must be clinically and professionally skilled in providing care to both individuals and populations of animals. They must be able to obtain from their clients an accurate history, to safely and humanely handle and restrain animals for examination, and to perform complete, as well as limited, organ system-specific physical examinations. They must be skillful and knowledgeable to obtain the necessary diagnostic evaluations. They must be proficient in diagnostic reasoning, in developing problem lists and differential diagnoses, and in reasoning deductively and critically to solve clinical problems. They must be able from such analyses to develop appropriate clinical management and therapeutic strategies for a patient. They must be technically competent in common clinical and surgical procedures and in administration of anesthetics and therapeutics. They must be compassionate and skillful in the relief of pain and in the implementation of euthanasia.

Veterinarians must have the range of interpersonal skills necessary to communicate effectively and establish rapport with clients, colleagues, and staff. They must be able to discuss clinical options with their clients in an honest, compassionate, and objective manner. They must be able to recognize when their knowledge or skills are limiting, must know how to seek information, and must have the wisdom to seek referral when necessary. Veterinarians must have the skills and aptitude to seek out, critically evaluate, and appropriately use new knowledge. They must have the skills and commitment to remain current in their biomedical knowledge and clinical skills.

By the time of graduation, graduates of the School of Veterinary Medicine should have demonstrated the following skills to the satisfaction of the faculty:

- The ability to reason deductively and critically to solve problems.
- The interpersonal skills to communicate effectively both orally and in writing and to establish rapport with clients, colleagues, and staff.
- The ability to effectively listen to and elicit from a client the full history of the patient. This skill requires a good familiarity with lay terminology, expressions, and descriptions.
- The ability to safely, correctly, and humanely restrain animals for examination.
- The ability to perform both complete and organ system-specific physical examinations, including the assessment of behavioral manifestations of disease and trauma. This requires a good appreciation of when to avoid focusing the examination prematurely.
- The ability to perform routine technical procedures including venipuncture, intravenous catheterization, insertion of a nasogastric or orogastric tube, thoracocentesis, collection of cerebrospinal fluid, insertion of a urinary catheter, transrectal palpation, and aspiration of fluids and collection of other samples for laboratory testing.
- The ability to appropriately select and interpret results of common diagnostic procedures and to perform routine hematologic and microbiologic analyses, urinalysis, simple pathologic evaluations, semen analysis, and common radiographic and other imaging procedures.
- The ability to develop problem lists and differential diagnoses, to correlate clinical signs with appropriate organ systems, and to resolve clinical problems by logical reasoning and the application of the principles of evidence-based medicine.
- The ability to develop appropriate clinical management and therapeutic strategies for each patient from the thoughtful analysis of the full array of available information.
- The ability to recognize patients with immediately life-threatening conditions and to institute appropriate therapy.
- The ability to perform routine surgical procedures including handling and suturing wounds and lacerations, surgery to remove foreign bodies, spaying and neutering, and administering anesthetics.
- The skills essential for the administration of therapeutics by commonly used routes.
- The common clinical skills and competencies for animal reproduction and neonatal care.
- The clinical acumen to appropriately monitor progress as needed either by direct observation or client communication and to adjust therapy and diagnosis according to results.
- The ability to recognize when their veterinary knowledge and skill is limited and the wisdom and integrity to seek consultation and referral.
- The ability and knowledge to recognize and relieve pain and ameliorate the suffering of animals.
- The ability to identify the circumstances when euthanasia is an appropriate option, to effectively and compassionately communicate the range of options to a client, and, as appropriate, to implement euthanasia under compassionate conditions for the animal and client.
- The competence to identify and suggest approaches to help prevent disease and trauma in individual and groups of animals, including the ability to conduct an environmental assessment for hazards including toxic chemicals and plants.
- The ability to create, maintain, and use accurate, legible, and legal medical records.
- A competence in information technology to be able to access and retrieve accurate biomedical information, diagnostic strategies, and medical records from electronic databases and other resources.
- The skills to gain and appropriately use new information and to remain current with emerging biomedical knowledge and therapeutic options.
- The ability to critically examine new knowledge, with an understanding of the basic concepts and principles of scientific investigation in the biomedical sciences.