Efficacy of training in theriogenology as determined by a survey of veterinarians

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Objective—To determine whether veterinarians perceive that theriogenology training at veterinary medical schools in North America and the Caribbean is adequate for achievement of theriogenology skills commonly used in private practice.

Procedures—A survey was mailed to members of the veterinary medical associations of Alabama, Kansas, Pennsylvania, and Washington. With regard to reproductive procedures in bovine, equine, porcine, small ruminant, camelid, and small animal species, veterinarians (predominantly practitioners) were asked to rate the importance of that procedure in their job and to assess their own degree of competency in that procedure at the time of their graduation from veterinary school.

Results—Procedures considered most valuable in practice were those that represent basic theriogenology education and training, such as transrectal palpation of cows and mares and interpretation of vaginal cytologic specimens in bitches. Dystocia management was a high priority in all species. Correlations between rankings for value in practice and competency at graduation were good, varying from 0.75 in cattle and 0.78 in horses to 0.98 in dogs and 1.0 in cats, small ruminants, and pigs.

Conclusions—Analysis of these data suggests that appropriate theriogenology procedures are being taught in veterinary medical schools but perhaps not to the extent required to achieve adequate competency immediately at graduation. Issues requiring further investigation include the effect of tracking in the veterinary curriculum on theriogenology training, methods by which more students could receive greater practical exposure during theriogenology training, and the apparent relative lack of theriogenology training (including contraception) in small animals and exotic animals. (*J Am Vet Med Assoc* 2006;229: 514–521)

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An important factor during accreditation of each veterinary medical school by the AVMA is evidence of efficacy of training by use of outcomes assessment of graduates of that school. This is achieved via a mail survey of alumni who have completed formal training. An unanswered question remains: what are the competencies required at graduation? This is a concern of the Royal College of Veterinary Surgeons, which drafted an education policy in 2001 that suggested creation of 2 tiers of competencies.[1] In that report, day 1 skills were those competencies expected of new graduates by members of both the veterinary profession and animal-owning public. In contrast, year 1 skills were those competencies developed during a professional training phase, in a broad but defined area of veterinary medicine, under the guidance of a veterinary mentor, and certified by qualifications and experience.

Definition of competencies required for practice within specific disciplines has been undertaken in several areas of veterinary medicine, including bovine–food animal practice,[2-4] internal medicine,[5] complementary and alternative medicine,[6] public health,[7] and practice management.[8,9] Surveys or focus groups have been used to define general areas of competency within veterinary medicine further broken down into specific activities, knowledge, or skills that must be accomplished to achieve competency.[10]

Faculty members of veterinary schools and veterinary practitioners have been included in surveys. Concerns about the inclusion of faculty are that many may never have been employed in private practice or they are so enmeshed in their specialty that they have lost focus of the broad requirements for veterinarians in general practice. However, faculty are in the best position to ensure uniform teaching among schools, which should allow graduates of any veterinary school to function globally.[11] Furthermore, a survey[12] (which was created by veterinary school faculty and completed by practitioners) on the frequency of use of various procedures in small animal practice revealed 67% agreement between faculty and practitioners with regard to the procedures that are performed commonly and should be considered day 1 skills.

Concerns about the use of practitioners to assist in defining duty bands and tasks include lack of understanding of curriculum development in veterinary

medical schools and the narrow focus within the species or industry in which those practitioners are employed. In addition, frequency of procedures and perception of importance of those procedures in practice vary[13] between practitioners in small and large animal hospitals and between practitioners in large and small towns. This suggests that any survey of practitioners must be sufficiently broad to minimize such sources of variability.

Theriogenology is a broad-based discipline concerning reproduction of all nonhuman species. It encompasses many fields, including embryology, physiology, endocrinology, surgery, medicine, pathology, toxicology, and behavior. A survey[14] of the veterinary schools in North America and the Caribbean revealed a lack of uniformity among schools with regard to didactic, laboratory, and clinical training in theriogenology. Didactic training in at least 1 species was required at all 24 schools that responded to the survey, but laboratory training was required by only 18 of 24 (75.0%), and clinical theriogenology training was required by only 16 of 22 (72.7%). Number of theriogenology faculty

Table 1—Number of respondents to a survey on theriogenology training, by type of employment and geographic location.

						Total	
Type of employment	**Ala**	**Kan**	**Pa**	**Wash**	**Other***	**No.**	**%**
Small animal practice	97	80	286	200	37	**700**	**66.7**
Dairy practice	2	0	28	10	7	**47**	**4.5**
Beef practice	3	0	0	1	0	**4**	**0.4**
Dairy and beef practice	0	12	0	1	0	**13**	**1.2**
Equine practice	6	0	23	22	8	**59**	**5.6**
Large animal practice	1	5	10	1	4	**21**	**2.0**
Mixed animal practice	21	47	40	31	11	**150**	**14.2**
Other†							
Camelid medicine	0	0	0	1	0	**1**	**0.1**
Laboratory animal medicine	1	0	2	3	0	**6**	**0.6**
Humane shelter	0	0	2	1	0	**3**	**0.3**
Avian medicine	0	0	0	2	0	**2**	**0.2**
Exotics medicine	0	0	1	3	1	**5**	**0.5**
Feline-only practice	0	0	2	3	0	**5**	**0.5**
Emergency-only practice	0	1	1	4	1	**7**	**0.7**
Zoo medicine	1	0	1	0	0	**2**	**0.2**
Postgraduate residency	1	0	0	0	0	**1**	**0.1**
Industry	1	1	0	0	0	**2**	**0.2**
Academician–administration	3	1	3	0	0	**7**	**0.7**
State diagnostic laboratory	1	0	1	0	0	**2**	**0.2**
Corporate swine veterinarian	0	2	1	0	0	**3**	**0.3**
Meat inspection	0	1	0	0	0	**1**	**0.1**
Small animal and equine practice	0	1	1	0	1	**3**	**0.3**
Regulatory veterinary medicine	0	1	0	0	1	**2**	**0.2**
Small ruminant practice	0	0	1	0	1	**2**	**0.2**
Veterinary technician educator	0	0	1	0	0	**1**	**0.1**
Food animal practice	0	0	1	0	0	**1**	**0.1**

*Represents members of the state veterinary medical associations of Alabama, Kansas, Pennsylvania, and Washington who resided outside those 4 states. †Represents types of employment other than traditional private practice.

Table 2—Number of respondents to a survey on theriogenology training, by size of practice and geographic location.

						Total	
Size of practice	**Ala**	**Kan**	**Pa**	**Wash**	**Other***	**No.**	**%**
1 veterinarian							
Provide emergency service	30	37	38	42	10	**157**	**15.2**
Outsource emergency service	17	9	43	32	7	**108**	**10.5**
2 to 5 veterinarians							
Provide emergency service	46	70	122	52	27	**317**	**30.7**
Outsource emergency service	32	23	118	96	11	**280**	**27.1**
> 5 veterinarians							
Provide emergency service	7	4	60	38	12	**121**	**11.7**
Outsource emergency service	1	7	19	12	2	**40**	**3.9**
Other†	1	0	0	6	2	**9**	**0.9**

†Represents results for veterinarians who are employed as relief practitioners at various-sized practices. *See* Table 1 for remainder of key.

decreased during the 10-year period prior to the survey at 12 of 21 (57.1%) schools that responded to the survey. To determine whether this amount of theriogenology training is adequate for achievement of day 1 skills in theriogenology, a survey of veterinarians (predominantly practitioners) in the United States was conducted.

Materials and Methods

Sample population—Four states (Alabama, Kansas, Pennsylvania, and Washington) were chosen to represent 4 broad regions of the United States and Canada. Surveys were sent to each member of the veterinary medical associations of those states.

Survey—The survey was created by the authors and reviewed and approved by the Board of Directors of the American College of Theriogenologists. It was not validated by an outside agency.

General information was solicited regarding veterinary school attended, state or states of licensure and practice, and type and size of clinic. For reproductive procedures in the bovine, equine, porcine, small ruminant, camelid, and small animal species, veterinarians were asked to rate the importance of that procedure in their job on a scale of 1 (not at all important) to 5 (very important) and to assess their own degree of competency in that procedure at the time of their graduation from veterinary school on a scale of 1 (not at all competent) to 5 (extremely competent). Reproductive procedures chosen were those most commonly taught at veterinary

Table 3—Mean ± SD scores for value in practice and competency at graduation for bovine reproductive procedures.

Procedure	No. of recent graduates*	No. of long-term veterinarians†	Value in practice‡	Competency at graduation§
Transrectal palpation||	111	197	4.4 ± 1.1	3.5 ± 1.2
Dystocia management||	114	201	4.3 ± 1.1	3.4 ± 1.1
Herd health management||	109	197	4.1 ± 1.2	3.3 ± 1.0
Treatment of reproductive tract disease||	109	194	3.8 ± 1.2	3.3 ± 1.0
Cesarean section||	112	195	3.7 ± 1.2	3.1 ± 1.2
Treatment of infertility||	109	191	3.6 ± 1.3	3.0 ± 1.1
Breeding soundness examination of males	108	188	3.0 ± 1.6	3.4 ± 1.2
Reproductive tract surgery	106	189	2.6 ± 1.3	2.6 ± 1.1¶
Ultrasonography of reproductive tract||	104	137	2.5 ± 1.3	1.8 ± 1.0#
Artificial insemination	100	172	2.3 ± 1.3	2.4 ± 1.2
Embryo transfer||	92	132	1.9 ± 1.2	1.6 ± 1.0

Correlation coefficient for ranked comparison between value in practice and competency at graduation was 0.75.

*Defined as those who graduated from a veterinary medical school from 1995 through 2005. †Defined as those who graduated from a veterinary medical school before 1995. ‡Scored on a scale of 1 (not at all important) to 5 (very important). §Scored on a scale of 1 (not at all competent) to 5 (extremely competent). ||Mean perceived competency at graduation was significantly ($P \leq 0.01$) lower than mean perceived value in practice. ¶Scores for recent graduates were significantly ($P \leq 0.01$) lower than scores for long-term veterinarians. #Scores for long-term veterinarians were significantly ($P \leq 0.01$) lower than scores for recent graduates.

Table 4—Mean ± SD scores for value in practice and competency at graduation for equine reproductive procedures.

Procedure	No. of recent graduates*	No. of long-term veterinarians†	Value in practice‡	Competency at graduation§
Transrectal palpation||	100	192	3.9 ± 1.3#	3.1 ± 1.2
Ultrasonography of reproductive tract||	92	140	3.7 ± 1.5#	2.7 ± 1.4#
Estrus manipulation||	94	173	3.5 ± 1.4	3.0 ± 1.2
Dystocia management||	95	188	3.4 ± 1.3	2.6 ± 1.2
Artificial insemination||	88	159	3.4 ± 1.5#	2.7 ± 1.3#
Treatment of reproductive tract disease||	94	172	3.3 ± 1.3	2.8 ± 1.1
Treatment of infertility||	92	170	3.1 ± 1.4	2.7 ± 1.3
Neonatology	96	173	3.0 ± 1.4	3.1 ± 1.2#
Breeding soundness examination of males	91	172	2.7 ± 1.4	2.8 ± 1.3
Manipulation of semen for freezing and transport||	90	142	2.7 ± 1.6	2.1 ± 1.2#
High-risk pregnancy management||	89	164	2.7 ± 1.4	2.2 ± 1.1
Reproductive tract surgery	85	159	2.4 ± 1.3	2.1 ± 1.1
Embryo transfer||	79	122	1.9 ± 1.2	1.5 ± 0.9
Cesarean section	77	140	1.7 ± 1.1	1.6 ± 0.9

Correlation coefficient for ranked comparison between value in practice and competency at graduation was 0.77.

See Table 3 for remainder of key.

schools and routinely requested as continuing education topics by veterinarians. Terms used were appropriate for each species in the discipline of theriogenology. A category of "other" was used to solicit information about species or types of employment outside those commonly taught at veterinary schools (eg, treatment of exotic animal species and employment in public health or other nontraditional services).

Surveys were excluded from analysis when general information was not completed, a respondent was professionally educated at a veterinary school located outside North America or the Caribbean, or a respondent considered that their professional experience was not that of a typical veterinarian.

For analysis of the reproductive procedures in each species, surveys were included when scores were provided for both value in practice and competency at graduation for a specific variable. Data were included for a given species only from those respondents who designated that species as a major source of revenue for their practice (eg, opinions of practitioners who performed exclusively small animal practice were not included in analysis of bovine procedures).

Data analysis—For each procedure, a mean score for value in practice and a mean score for competency at graduation were calculated. Values were compared between recent graduates (defined as those who graduated from a veterinary medical school from 1995 through 2005) and long-term veterinarians (defined as those who graduated from a veterinary medical school before 1995) by use of a Student *t* test. Significance was established at values of $P \leq 0.01$.

Although the data were intended to be descriptive, it may be assumed that at graduation, veterinary students should believe they are at least somewhat competent (value of 3) for techniques of average value (value of 3) in practice and should believe they are extremely competent (value of 5) for those techniques perceived to be of great value (value of 5) in practice. Analysis by use of the Student *t* test was used to evaluate differences in overall perception of value of a given procedure in practice and degree of competence in training. Significance was established at values of $P \leq 0.01$.

Finally, procedures for each species were ranked on the basis of mean scores for value in practice and competence at graduation. A correlation coefficient was generated to determine whether those procedures of most value in practice were those in which students believed they were most competent at graduation.

Results

Sample population—A total of 5,907 surveys were mailed to veterinarians, and 1,107 were returned for a return rate of 18.7%. The percentage of veterinarians working in a particular state that had graduated from a veterinary medical school in that state was high (mean, 70.0%). Consequently, no additional comparisons were made on a regional basis in an effort to minimize a potential focus on quality of education for any specific school. At least 1 respondent had graduated from every veterinary school in the United States, except Western University of Health Sciences (which had not yet had a graduating class), and 2 of the 4 Canadian veterinary schools. Ross University was the only Caribbean veterinary school that respondents had attended. Year of

Table 5—Mean ± SD scores for value in practice and competency at graduation for small ruminant reproductive procedures.

Procedure	No. of recent graduates*	No. of long-term veterinarians†	Value in practice‡	Competency at graduation§
Dystocia management‖	100	173	3.1 ± 1.2	2.8 ± 1.2
Abortion	95	162	2.6 ± 1.3	2.5 ± 1.2
Neonatology	95	160	2.5 ± 1.2	2.3 ± 1.2
Treatment of reproductive tract disease	93	160	2.3 ± 1.3	2.3 ± 1.1
Estrus manipulation	90	146	2.1 ± 1.3	2.3 ± 1.2
Breeding soundness examination of males	88	154	2.1 ± 1.2	2.3 ± 1.2
Artificial insemination	79	122	1.5 ± 0.9	1.5 ± 0.9

Correlation coefficient for ranked comparison between value in practice and competency at graduation was 1.0.
See Table 3 for remainder of key.

Table 6—Mean ± SD scores for value in practice and competency at graduation for porcine reproductive procedures.

Procedure	No. of recent graduates*	No. of long-term veterinarians†	Value in practice‡	Competency at graduation§
Dystocia management	63	122	2.2 ± 1.3	2.2 ± 1.1
Abortion	61	116	2.0 ± 1.3	2.3 ± 1.1
Neonatology	64	117	1.9 ± 1.2	2.1 ± 1.1
Treatment of reproductive tract disease	63	115	1.8 ± 1.2	2.1 ± 1.1
Estrus manipulation	61	107	1.7 ± 1.2	1.9 ± 1.0
Artificial insemination	58	98	1.7 ± 1.2	1.8 ± 1.0
Breeding soundness examination of males	54	98	1.6 ± 1.1	1.9 ± 1.0

Correlation coefficient for ranked comparison between value in practice and competency at graduation was 1.0.
See Table 3 for remainder of key.

graduation varied from 1959 to 2005, with 395 (35.7%) respondents graduating from 1995 through 2005.

At least 1 veterinarian was licensed to practice in every state of the United States, except Rhode Island, Utah, and Wyoming. Most respondents designated small animal as the primary source of income for their practice. Practitioners in Kansas were much more likely than those in Pennsylvania or Washington to designate themselves as employed in mixed animal practice (**Table 1**). Most practitioners worked in clinics that employed 2 to 5 veterinarians; about half of the responding veterinarians provided their own emergency services (**Table 2**).

Tabulated responses—For each species, reproductive procedures were listed on the basis of perceived value in practice (**Tables 3–10**). Correlation coefficients for ranked comparison between value in practice and competency at graduation varied from 0.75 to 1.0; in general, scores were lower for common large animal species and higher for small animal species.

For all species, diagnosis and management of dystocia were perceived to be procedures of great value in practice. Transrectal palpation was perceived to be of great value to bovine and equine practitioners (Tables 3 and 4). As might be expected, long-term veterinarians believed that they had been less well trained in the use of ultrasonography in horses and cows; some respondents mentioned the inability of this survey to determine whether training in some technologies was available for all respondents at the time they were in veterinary school.

For small ruminants, management of dystocia was the only procedure for which there was a perceived mismatch of value in practice and competency at the time of graduation (Table 5). Porcine practitioners reported no disparities in value of procedures in practice and competency at graduation (Table 6). Conversely, for all procedures in llamas, alpacas, and other exotic species, perceived competency at the time of graduation was significantly lower than the perceived value in practice (Tables 7 and 10).

Regarding theriogenology procedures in dogs, more recent graduates believed that they were less well trained in the valuable procedures of vaginal cytologic interpretation, brucellosis testing, and performance of Cesarean sections, whereas long-term veterinarians believed they were less well trained in arti-

Table 7—Mean ± SD scores for value in practice and competency at graduation for llama and alpaca reproductive procedures.

Procedure	No. of recent graduates*	No. of long-term veterinarians†	Value in practice‡	Competency at graduation§
Dystocia management‖	81	107	2.4 ± 1.3	1.8 ± 1.1
Pregnancy diagnosis‖	80	104	2.4 ± 1.3	1.8 ± 1.1#
Neonatology‖	80	103	2.3 ± 1.3	1.7 ± 1.1#
Prepurchase examination‖	76	102	2.2 ± 1.2	1.7 ± 1.0
Treatment of infertility‖	79	101	2.1 ± 1.3	1.6 ± 1.0

Correlation coefficient for ranked comparison between value in practice and competency at graduation was 1.0.
See Table 3 for remainder of key.

Table 8—Mean ± SD scores for value in practice and competency at graduation for canine reproductive procedures.

Procedure	No. of recent graduates*	No. of long-term veterinarians†	Value in practice‡	Competency at graduation§
Cesarean section‖	341	517	4.2 ± 1.1#	3.3 ± 1.2¶
Vaginal cytologic interpretation‖	338	511	3.5 ± 1.2	3.3 ± 1.2¶
Treatment of reproductive tract disease‖	332	488	3.3 ± 1.2	2.9 ± 1.1
Reproductive tract surgery‖	334	486	3.1 ± 1.4	2.7 ± 1.3
Brucellosis testing	332	502	3.0 ± 1.3¶	3.1 ± 1.3¶
Breeding management‖	324	491	2.9 ± 1.3	2.7 ± 1.1
Breeding soundness examination of males	312	474	2.7 ± 1.2	2.7 ± 1.1
Pregnancy termination	326	499	2.7 ± 1.3¶	2.6 ± 1.2
Artificial insemination–vaginal‖	318	471	2.6 ± 1.4	2.4 ± 1.2#
Treatment of infertility‖	329	481	2.5 ± 1.3¶	2.3 ± 1.1
Artificial insemination–transcervical‖	295	417	2.0 ± 1.2	1.9 ± 1.1
Manipulation of chilled and frozen semen‖	296	395	1.9 ± 1.2	1.7 ± 1.0
Artificial insemination–surgical‖	291	388	1.7 ± 1.2¶	1.5 ± 0.9

Correlation coefficient for ranked comparison between value in practice and competency at graduation was 0.98.
See Table 3 for remainder of key.

Table 9—Mean ± SD scores for value in practice and competency at graduation for feline reproductive procedures.

Procedure	No. of recent graduates*	No. of long-term veterinarians†	Value in practice‡	Competency at graduation§
Dystocia management‖	319	505	3.3 ± 1.2	2.8 ± 1.2¶
Treatment of reproductive tract disease‖	316	459	2.4 ± 1.2	2.2 ± 1.2
Breeding soundness examination of males	292	428	1.8 ± 1.1	1.8 ± 1.1¶
Treatment of infertility	294	439	1.7 ± 1.0	1.7 ± 0.9¶
Artificial insemination	279	376	1.4 ± 0.8	1.4 ± 0.8

Correlation coefficient for ranked comparison between value in practice and competency at graduation was 1.0.
See Table 3 for remainder of key.

Table 10—Mean ± SD scores for value in practice and competency at graduation for reproductive procedures in other species.

Species	No. of recent graduates*	No. of long-term veterinarians†	Value in practice‡	Competency at graduation§
Companion avian‖	23	36	3.4 ± 1.2	1.8 ± 1.0
Reptiles‖	12	23	3.4 ± 1.1	1.9 ± 1.1
Rodents‖	24	34	3.3 ± 1.2	1.8 ± 1.0
Rabbits‖	17	30	3.2 ± 1.1	1.7 ± 1.0

Correlation coefficient for ranked comparison between value in practice and competency at graduation was not calculated.
See Table 3 for remainder of key.

ficial insemination techniques (Table 8). For cats, dystocia was perceived to be the most valuable procedure in practice, with a large number of veterinarians reporting this as the only feline reproductive procedure encountered in their practice. However, a larger number of recent graduates reported a perception of being less well trained in dystocia management in cats, compared with the perceptions for long-term veterinarians (Table 9).

Additional comments—Written comments were provided by 3 beef practitioners (all of whom were long-term veterinarians), 10 dairy practitioners (8 long-term veterinarians and 2 recent graduates), 13 equine practitioners (8 long-term veterinarians and 5 recent graduates), 1 large animal practitioner (a recent graduate), 22 mixed animal practitioners (11 long-term veterinarians and 11 recent graduates), 8 practitioners who listed themselves in the category of "other" (3 long-term veterinarians and 5 recent graduates), and 99 small animal practitioners (58 long-term veterinarians and 41 recent graduates). Comments were grouped to represent 5 broad questions and a set of representative written responses for each question.

Should we expect new graduates to feel competent?
- ➤ It is difficult to get hands-on experience in [veterinary] school; veterinary medicine is a license to learn.
- ➤ I was extremely happy with my equine theriogenology training. I was prepared for practice and have been told by other practitioners that I was more prepared than other new graduates.
- ➤ It's interesting how little absolute training [in theriogenology] I received during veterinary school. Most of my training came from the veterinarians I worked with early in my career, most of whom were extremely good.

What should be stressed during theriogenology training in veterinary school?
- ➤ I graduated [from veterinary school] never having performed a spay.
- ➤ I believe new graduates deserve more experience with Cesarean sections in [veterinary] school so practice owners and clients can be spared the new graduates' failures.
- ➤ Transrectal palpation is the single most important skill for survival in practice. I have yet to employ a veterinarian qualified [at the time of graduation] for large animal work.
- ➤ My new associates constantly tell me they have little knowledge of small animal reproduction.

Are limitations created by the veterinary school curriculum?
- ➤ Many of the courses that were more in-depth were offered at the same time, and choices had to be made.
- ➤ I had an interest in bovine reproduction, so I took extra rotations [at another institution].
- ➤ We had wonderful instruction in bovine theriogenology. Unfortunately, my practice is 95% equine.
- ➤ We only studied large animal [theriogenology] in veterinary school.

What do veterinarians believe about training in theriogenology?
- ➤ Our clinic refers breeding issues to veterinarians with specialty training [in theriogenology].

- One of the biggest disappointments in my veterinary education was the lack of theriogenology training.
- At our practice, new graduates are evaluated by clients on the basis of their abilities in theriogenology. It is the measuring stick by which they decide whether a veterinarian is competent. After 31 years of mixed animal practice and 8 associates, I must conclude that veterinary schools provide minimal training in [theriogenology] and leave the training to practitioners who are lucky enough to be able to pay them to train.
- My undergrad courses were nearly as good as my veterinary school training in regard to [reproductive] physiology.

Do practitioners consider theriogenologists simply to be breeding assistants, or are they professionals knowledgeable in all aspects of reproduction?

- I believe that with the state of dog and cat overpopulation [in the United States], it is irresponsible for veterinary schools to teach canine and feline theriogenology without directing equal amounts of time to ways to prevent pet overpopulation.
- Because most of our canine and feline patients are spayed or neutered, we don't practice a lot of reproductive medicine at our clinic.

Other topics included in the written comments included the lack of theriogenology involvement in poultry medicine; complete lack of training in exotic animals, including reptiles, ferrets, fish, cervids (deer or elk), primates, other zoo animals, sugar gliders, and squirrels; lack of training in neonatology, ultrasonography of all species, ergonomics and safety, ethics, and prebreeding examinations (including genetic testing); and abdication of many topics to internal medicine (eg, neonatology) or animal science (eg, artificial insemination and herd health management).

Discussion

In the survey reported here, a high percentage of respondents worked in or near the state of the veterinary school from which they graduated. This is in accord with earlier findings[15] and represents useful information for veterinary schools, state licensing boards, and state legislatures.

We detected considerable variability by region regarding the types of practice in which most of the respondents worked. A much higher percentage of respondents from Kansas considered themselves mixed animal practitioners than did respondents from other regions, whereas most of the respondents in exclusively beef cattle practice were from Alabama. There were many more small animal practitioners represented overall than veterinarians in other categories or types of practice. However, the breadth of practice activities represented in this survey was important for decreasing regional variability in responses. Variability also was reduced by use of responses only from veterinarians that declared themselves or their practice to be involved in treatment of that species. All measures of significance were established at $P \leq 0.01$ instead of the more standard $P \leq 0.05$ in an effort to account for inherent variability.

Possible biases in the study include artificially positive responses because of school loyalty and inability to recall the degree of competency at the time of graduation, especially among veterinarians who had graduated many years before. The number of comments from respondents was approximately evenly divided between those who stated they had received a good veterinary education with regard to theriogenology and those who obviously considered their education in theriogenology to be inadequate. The inclusion of recent graduates (who may have had a better ability to remember perceived competency at the time of graduation) and more seasoned practitioners (who may have had a better idea of value of given procedures in practice) was considered to strengthen the validity of these findings.

Overall, those procedures considered most valuable in practice were those that represented basic theriogenology education and training, such as transrectal palpation of cows and mares and interpretation of vaginal cytologic specimens in bitches. Dystocia management was a high priority in all species. Correlations between rankings for value in practice and competency at graduation were good, varying from 0.75 in cattle and 0.78 in horses to 0.98 in dogs and 1.0 in cats, small ruminants, and pigs. This agrees with results of another study[16] in which investigators reported that overall proficiency of new veterinary graduates was considered adequate (as rated by their employers) for 3 of 9 procedures in horses, 5 of 9 procedures in cattle, and 8 of 9 procedures in small animals. This suggests that the appropriate procedures are being taught in veterinary medical schools but perhaps not to the extent required for adequate day 1 competence.

The information reported here will allow veterinary medical educators to better design courses within their species of interest and provides reinforcement for theriogenology educators to promote theriogenology education in all species. Faculty involved in instruction of theriogenology at veterinary medical schools require more resources, personnel (for teaching and support), and more teaching opportunities to adequately fulfill their obligations in educating and training veterinary students. New approaches must be investigated because live animals are expensive to maintain at veterinary schools and because of concerns about animal welfare. In this regard, computer-based surgery models have been used to adequately train veterinary students in small animal surgery,[17] and a simulator for bovine transrectal palpation improved students' abilities to quickly learn skills on live animals.[18] Faculty and administrators must recognize the students' need for additional opportunities to practice basic skills, such as transrectal palpation, and must provide financial support and personnel to help students achieve appropriate day 1 competence.

Comments from the veterinarians surveyed brought forth several broad, important questions, which must be addressed.

- How can we increase students' exposure so that they can achieve day 1 skills that they need to

perform reproductive procedures valuable in practice in all species?
- ➤ Can cooperative ventures with producers or practitioners be created to increase students' exposure to theriogenology in large animal species?
- ➤ Do current curricula, especially in veterinary schools with tracking, limit the students' ability to achieve day 1 skills in theriogenology?
- ➤ Why is there apparently so little small animal theriogenology training at veterinary schools, and how can we better promote the teaching of contraception and management of reproductive tract disease in neutered or sexually intact dogs and cats?
- ➤ Are theriogenologists the faculty members who should ensure training in exotic species for students with those interests? If not, who will provide them with that information?

Many practitioners stressed the importance of continuing education, informally within a practice as well as presentations at local, regional, or national meetings, to fulfill the tasks of consolidating and enhancing skills for which they believed they were less than competent at time of graduation and of learning new skills and techniques that have evolved since they graduated. In this regard, there is concern that a dwindling number of theriogenology educators will result in fewer opportunities for veterinarians to obtain appropriate continuing education in theriogenology in the future. This is happening at a time when technologies and techniques in theriogenology are proliferating commensurate with an increase in opportunities for practitioners and, hence, the need for relevant continuing education programs. This need cannot be appropriately or adequately met by representatives of other veterinary specialties, such as internal medicine. It is incumbent on veterinarians to commit to life-long learning and to ask program committees for continuing education venues to provide the training that is needed.

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