

Collaborative Development of a Shared Framework for Competency-Based Veterinary Education

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ABSTRACT

Competency-based medical education is an educational innovation implemented in health professions worldwide as a means to ensure graduates meet patient and societal needs. The focus on student-centered education and programmatic outcomes offers a series of benefits to learners, institutions and society. However, efforts to establish a shared, comprehensive competency-based framework in veterinary education have lagged. This article reports on the development and outcome of a competency-based veterinary education (CBVE) framework created through multi-institutional collaboration with international input from veterinary educators and veterinary educational leaders. The CBVE Framework is designed to reflect the competencies expected of new graduates from member institutions of the Association of American Veterinary Medical Colleges (AAVMC). The CBVE Framework consists of nine domains of competence and 32 competencies, each supplemented with illustrative sub-competencies to guide veterinary schools in implementing competency-based education in their local context. The nine domains of competence are: clinical reasoning and decision-making; individual animal care and management; animal population care and management; public health; communication; collaboration; professionalism and professional identity; financial and practice management; and scholarship. Developed through diverse input to facilitate broad adoption, the CBVE Framework provides the foundation for competency-based curricula and outcomes assessment in veterinary education internationally. We believe that other groups seeking to design a collective product for broad adoption might find useful the methods used to develop the CBVE Framework, including establishing expertise diversity within a small-to-medium size working group, soliciting progressive input and feedback from stakeholders, and engaging in consensus building and critical reflection throughout the development process.

Key words: competency-based veterinary education, competency-based medical education, competency-based education, competency framework, graduate outcomes, international collaboration, inter-institutional collaboration

INTRODUCTION

Competency-based medical education (CBME) was first introduced to the healthcare professions in 1978 by the World Health Organization,¹ and gained momentum in the mid-1990s as a way of defining and shaping medical curricula.² In contrast to traditional curricula that focus on subjects taught (inputs) rather than outcomes, the goal of CBME is to develop “. . . a health professional who can practise medicine at a defined level of proficiency, in accord with local conditions, to meet local needs.”^{1(p.18)} Central to this focus is aligning education with patient care requirements and stakeholder expectations for workplace performance.³

The core components of CBME have been described as (1) clearly articulated outcome competencies required for practice, (2) sequenced progression of these competencies and their developmental markers, (3) tailored learning experiences that facilitate the acquisition of competencies, (4) competency-focused instruction that promotes

the acquisition of competencies, and (5) programmatic assessment that supports and documents the acquisition of competencies.⁴ The learner-centered nature of competency-based curricula supports active engagement by students in their learning as they progress toward the standards defined for graduation.^{5,6} This progress can be guided by formative and summative assessment that occurs in authentic learning environments.^{6,7} Sequential development of competencies within a structured framework allows learners to be entrusted with increasing levels of responsibility that enable them to meet post-graduation performance expectations.^{8,9}

The first phase in creating a competency-based educational system is to develop a shared language and establish definitions that articulate key components.¹⁰ Next, domains of competence are developed to provide a general description of the spectrum of activities expected of a profession.¹¹ This is followed by a description of competencies expected of

graduates organized under each domain.¹² Each competency articulates an observable ability that integrates attributes of a healthcare professional, including knowledge, skills and attitudes.¹¹ Competencies may be supplemented by illustrative sub-competencies, or nested sub-competencies, to offer guidance in applying the framework to educational programs.¹³ As a whole, a competency framework should comprise a well-structured set of interrelated competencies that encompass the key behaviors of effective practice.¹⁴ Well-defined and documented competency frameworks can then be used to guide curricular development, assessment and program evaluation.⁸

Initially, several CBME frameworks were developed as professional organizations sought to define expectations of new graduate physicians. More recently, a group of international experts have come together to advance CBME in a collaborative manner.^{5,15} One of the first frameworks developed was the CanMEDS framework in Canada.^{16,17} Subsequent frameworks in the US included the Accreditation Council for Graduate Medical Education (ACGME) Outcomes Project¹⁸ and the General Physician Competencies.¹¹ In Europe, they included Good Medical Practice,¹⁹ the revised Tomorrow's Doctors framework,²⁰ the Scottish Doctor Project,¹³ and the Framework for Undergraduate Medical Education.²¹ In Australasia, the Nine Competencies of the Royal Australasian College of Surgeons were published.²² These competency frameworks collectively focus on requirements for professional practice and elucidate the broad range of professional knowledge, skills, abilities and attitudes needed for effective contemporary practice, including "non-technical" professional skills, such as collaboration and communication. There is a growing consensus that the responsibilities of medical education training programs extend beyond traditional instruction of medical knowledge and skills to include comprehensive training that prepares graduates for the complex roles of today's healthcare professionals.^{13,20,22,23}

Veterinary medical education shares similarities with human medical education in that it focuses on patient and client outcomes as its goal and learner-centered educational processes as its method. However, unlike human medical education, veterinarians typically enter practice immediately after graduation from the professional program, following 12 to 18 months of clinical placements. In this way, veterinary education is more similar to undergraduate medical education than the post-graduate residency context for which CBME was originally developed.² In contrast, though, veterinarians can be licensed upon graduation from their professional program to perform sophisticated professional procedures independently, such as anesthesia and surgery. Due to the need for general practitioners in large or mixed animal practice to routinely treat herds of animals, population medicine tends to be a greater focus in veterinary medicine than in human medicine. Also, unlike medicine, veterinarians often treat multiple species in different settings with varying goals ranging from individual animal care to safe food supply. Conversely, human medical programs demonstrate a greater focus on clinical audit, inter-professional collaboration, working within large institutional healthcare systems, and faculty development than that found in veterinary medical programs.

Thus, existing CBME frameworks are not easily or directly extrapolated to veterinary education.

Several initiatives in veterinary education reflect a transition toward competency-based education. In North America, in 2004, the American Veterinary Medical Association (AVMA) Council on Education identified nine areas of veterinary practice in which colleges are required to demonstrate satisfactory outcomes assessment for accreditation.²⁴ In 2011, the North American Veterinary Medical Education Consortium (NAVMEC) developed a framework for veterinary medical education in the twenty-first century.²⁵ In Europe, in 2001 the Royal College of Veterinary Surgeons (RCVS) articulated the Day One Competencies expected of veterinarians graduating from UK veterinary schools,²⁶ in 2011 Utrecht University in the Netherlands published the VetPro competency framework based on multinational research,^{27,28} and in 2012 the World Organisation for Animal Health (OIE) established the Competencies for Day One graduates.²⁹

These frameworks vary in their terminology, comprehensiveness and international acceptance. Some of the language of these earlier structures was developed before there was a full recognition of the nature of competencies. For example, the nine areas of veterinary practice identified for outcomes assessment by the AVMA Council on Education were a positive step toward outcomes-based education when first developed. These areas are more similar to disciplines than specific "competencies" as they are termed within the AVMA Council on Education Policies and Procedures,³⁰ vary in their breadth and specificity, and demonstrate a greater emphasis on clinical aspects of veterinary practice than the range of professional attributes now recognized as important for today's healthcare professionals. The NAVMEC framework²⁵ drew on the views of numerous stakeholders in a multi-phase development process to generate a framework that encompasses professional competencies as well as clinical competencies. While recognized as a significant development, this effort lacked a centrally driven implementation strategy and accompanying resources, such as milestones, entrustable professional activities (EPAs), and assessment tools, to aid schools in implementation.³¹ The VetPro competency framework,^{27,28} while based on multinational research and contemporary CBME theory, and published in the peer-reviewed literature, was not promoted at an organizational level for international distribution. In summary, while each of these frameworks represents important steps in the development of competency-based veterinary education (CBVE) worldwide, no unifying structure and shared language based on modern competencies has yet emerged.

To further advance veterinary education globally, a comprehensive competency framework is needed that reflects current expectations of new graduate veterinarians, forms a solid foundation for learner assessment, enables targeted curricular outcomes assessment, and provides guidance for individual schools in implementing competency-based education in their training programs.^{3,13} The latter can be achieved by providing example sub-competencies that schools can modify and supplement to create alignment between their existing new graduate attribute statements and the competencies of the shared framework.¹³ Achieving

these goals in veterinary education requires international collaboration and consensus building, consideration of current societal expectations, and understanding of the standards of competency-based education, within the broader context of varying requirements for accreditation and licensure around the world.^{32–35}

This article reports on the development of a competency framework for veterinary education designed through international collaboration to strengthen the potential for global application. The framework that is the outcome of this process articulates domains of competence and individual competencies expected of new graduate veterinarians from schools that are members of the Association of American Veterinary Medical Colleges (AAVMC). These veterinary schools span institutions in North America, Europe, Australasia, Asia and the West Indies.³⁶ A companion article in this issue reports the specific development process, and the outcome of the eight core EPAs linked to the CBVE Framework that were also developed by the multinational working group.

METHOD

The CBVE Working Group (the “Working Group”) was formed in December 2015 in response to a strong call by veterinary educational leaders and outcomes professionals at the June 2015 AAVMC Workshop on Assessment of Clinical Competencies for the development of shared workplace-based assessment tools. With the support of the AAVMC, a 10-person working group was established from leaders in veterinary education representing international AAVMC member institutions, with the goal of developing an internationally shared framework for CBVE and associated assessment tools. Diversity in the educational background and expertise of group members was desirable given the complexity of the anticipated work, and the extent of information processing and decision making involved.³⁷ Selection of the 10 Working Group members was based upon individuals’ breadth and depth of experience and expertise in veterinary education, as well as current and prior geographic distribution amongst AAVMC member institutions. Representatives were included from Canada (E. Read), the United Kingdom (S. May), the Netherlands (H. Bok), and the United States (K. Chaney, L. Molgaard, B. Rush, K. Salisbury), including three US-based members with prior experience in veterinary education in Australasia (J. Hodgson, J. Ilkiw, S. Matthew). An educational consultant and facilitator (J. Frost), provided procedural and conceptual guidance as the Working Group developed the CBVE Framework (“the Framework”).

The initial impetus for the Working Group was to develop shared workplace-based assessment tools; however, an investigation of the veterinary education literature, competency frameworks, and accreditation structures revealed that no common foundation existed upon which to build these tools. After reflecting upon, discussing and re-evaluating the group’s objectives and strategies,³⁸ the Working Group decided to focus first on building a shared, foundational framework for CBVE before proceeding on to develop associated assessment tools. A consensus-based decision-making approach among the group was used for this process, with incremental additional feedback from

a range of stakeholders as the Framework developed.³⁹ Consensus was determined as having been reached after all Working Group members agreed they could accept what had been proposed, as a result of a good-faith effort to meet all stakeholders’ interests.³⁹

As the first step in this process, the group examined existing structures in both veterinary and medical education to identify commonalities and explore possibilities for direct adoption of an existing framework for broad use in veterinary education. The examined structures included those identified previously in the introduction (AVMA Council on Education outcomes assessment areas,³⁰ NAVMEC framework,²⁵ RCVS Day One Competences,⁴⁰ VetPro,^{27,28} OIE Day One Competencies,²⁹ CanMEDS,⁴¹ AGCME Outcomes Project,¹⁸ Scottish Doctor Project¹³), as well as the graduate attribute statements of Working Group members’ veterinary schools and other veterinary schools (Colorado State University, Purdue University, Royal Veterinary College, Texas A&M University, The University of Sydney, University of California Davis, University of Calgary, Utrecht University). While each had value as part of the incremental development process for the Framework, none were found that met the Working Group’s goals to identify and establish an internationally shared framework for CBVE and associated assessment tools.

After collective reflection and discussion about the outcomes of this search, the Working Group decided that establishing common definitions for CBVE should be the next step in the development process. The Working Group investigated various sources in medical, veterinary and general education to discover whether unique definitions of “competencies,” “domains of competence,” and “competency framework” were needed. Sources investigated included the draft CanMEDS 2015 framework,⁴⁰ Frank et al.,⁴² Englander et al.,¹¹ Association of American Medical Colleges Core Entrustable Professional Activities for Entering Residency Faculty and Learners’ Guide,⁴³ ten Cate,⁴⁴ Welsh et al.,⁴⁵ Vandeweerdt et al.,⁴⁶ and the Oxford English Dictionary.⁴⁷ After discussing the relevance and applicability of these definitions to veterinary medicine, the Working Group decided to align the definitions used for the Framework with those published in CBME to minimize confusion, emphasize the inherent commonalities and provide a foundation for future research and development, whilst also adapting some of the components for relevance and ease of communication within the veterinary community.

Domains of competence were then developed by the group with incremental input from stakeholders. Draft domains of competence were identified by reviewing existing competency frameworks published in medical^{13,18,41} and veterinary education,^{25,27,29,40} as well as the graduate attribute statements of various veterinary schools as listed previously. Domains of competence and their descriptors were developed first through individual writing, then refined through collective editing that occurred online using a wiki and during video conference discussions by the group. The developing domains were merged, rearranged and unmerged in this process as the group discussed the similarities and differences between them. Feedback was sought from associate deans and educators at AAVMC member veterinary schools in March 2016 through an

online survey investigating the extent to which the draft domains of competence were understandable, comprehensive and relevant to veterinary medical education. The group discussed this feedback and established that no significant changes were required. The final draft domains of competence were presented, and additional feedback solicited at a workshop on competency-based education attended by educators from AAVMC member institutions in June 2016. After reviewing this feedback, the Working Group reached consensus on the domains of competence for the Framework.

The definitive competency statements that comprised each domain were then identified and refined, together with their illustrative example sub-competencies. Multiple rounds of revision by the Working Group refined initial drafts prepared by individual members and pairs to a draft set of competencies and illustrative sub-competencies. An important ground rule during this process was to allocate each competency to only one domain. Furthermore, each competency was allocated to the domain that was most pragmatic for communicating the Framework and applying it in teaching and assessment.

Progressive feedback was sought from stakeholders on the developing Framework through presentations and solicitations at meetings across 2016–2018 attended by veterinary educators, administrators and educational leaders from across the AAVMC member institutions internationally (deans, associate deans and outcomes professionals), as well as webinars and surveys administered to these stakeholders. This included surveys before, during and after webinars explaining the Framework, sharing information and gathering direct feedback at a variety of conferences where we knew that relevant stakeholders would be present; and circulating documents via the AAVMC associate and assistant deans' email list for open comment. Authors of frameworks, some of whom were members of the CBVE Working Group, were also consulted to gather feedback (CanMEDS,¹⁶ General Physician Competencies,⁹ RCVS Day One Competencies,⁴⁰ VetPro framework²⁷ and VetSet2Go framework for veterinary employability⁴⁸). Employer, new graduate and student perspectives on new graduate veterinarian competencies were drawn from the literature^{27,49,50} and data gathered previously by the International Council on Veterinary Assessment and at the Working Group members' institutions (unpublished). This input was discussed by the group and integrated into the iterative development process until consensus was reached on the final outcome.

The Working Group developed and refined the CBVE Framework over approximately 2 years through collaborative work, including use of asynchronous technologies, bi-monthly video conferences (1–2 hours each) and five face-to-face working sessions (1–2 days each), sometimes scheduled before and/or after veterinary educator conferences that many of the group members would be attending. Asynchronous collaborative editing of the draft competencies using a Moodle^a platform and then Google Docs enabled the group to make progress in developing the Framework and working toward consensus between face-to-face meetings.^{39,51} Polls were used for the bi-monthly video conferences to find times that worked

for the maximum number of group members, given the different time zones and conflicting schedules across the group. The intensive face-to-face sessions were found to be critical to work through difficult decisions, engage in collective analysis and reflection, and challenge each other to work toward consensus on the outcomes resulting from prior work by individuals and small groups within the Working Group.^{52–54} This facilitated the group's conceptual development and accelerated progress in developing the Framework and associated materials.

Informational updates on the progress of the Working Group were provided to relevant professional organizations, including the AAVMC Board of Directors, the AVMA Council on Education, International Council for Veterinary Assessment, AAVMC Academic Affairs Committee, individual veterinary schools and attendees at the AAVMC Annual Conference, the AAVMC Primary Care Veterinary Educators Symposium and the AAVMC Veterinary Educator Collaborative Symposium.

RESULTS

A review of the existing literature revealed that the terminology used in CBME was generally applicable to veterinary medical education. The Working Group reached consensus on a shared taxonomy for the CBVE Framework that contained minimal modifications for clarity:

Competency: An observable ability of a health professional related to a specific activity that integrates knowledge, skills, values, and attitudes (modified from Frank et al.)^{5(p.641)}

Domains of Competence: Broad distinguishable areas of competence that in the aggregate constitute a general descriptive framework for a profession (adopted directly from Englander et al.)^{11(p.1089)}

Competency Framework: An organized and structured representation of a set of interrelated and purposeful competencies (adopted directly from Englander et al.)^{11(p.1089)}

Review of the competency-based frameworks and related structures published in medical and veterinary education revealed that there was little consistency in the language used across these structures and variable overlap in their content. Feedback from stakeholders confirmed interest in developing a modern, shared competency framework for veterinary education applicable across AAVMC member schools.

The iterative development, feedback and refinement processes used to create the CBVE Framework resulted in the outcome of 32 competencies grouped into nine domains of competence (Tables 1–9). Illustrative sub-competencies were provided for each competency to guide schools in applying the Framework. Drafting, redrafting, and sense-checking, both within and outside the Working Group, resulted in consensus within the group on wording that firmly locates CBVE in the broader competencies literature, and is accurately descriptive and intelligible within the veterinary educational community. This Framework was published and released to AAVMC member institutions and the public in March 2018.⁵⁵

Table 1: CBVE Framework Domain I—Clinical Reasoning and Decision-Making**DOMAIN 1:** Clinical Reasoning and Decision-Making

The graduate demonstrates critical thinking and problem solving to arrive at evidence-based decisions that consider animal and client needs, available resources, and social context.

Competencies	Example Sub-competencies (non-comprehensive)
1.1 Gathers and assimilates relevant information about animals	<ul style="list-style-type: none"> a. Collects history b. Performs physical examination c. Interprets diagnostic test results d. Performs necropsy examination
1.2 Synthesizes and prioritizes problems to arrive at differential diagnoses	<ul style="list-style-type: none"> a. Identifies problems b. Creates refined problem list c. Prioritizes differential diagnoses
1.3 Creates and adjusts a diagnostic and/or treatment plan based on available evidence	<ul style="list-style-type: none"> a. Appraises available clinical information and acts accordingly despite uncertainty b. Explains justification for plan c. Re-evaluates animal or population in a timely manner to adjust plan d. Uses critical thinking to determine appropriate action when unexpected outcomes occur (e.g., complications, changed diagnosis)
1.4 Incorporates animal welfare, client expectations, and economic considerations into the diagnostic or treatment plan	<ul style="list-style-type: none"> a. Considers disease in context of the whole animal and client b. Presents a range of options to the client c. Considers euthanasia as a management option when appropriate
1.5 Prioritizes situational urgency and allocates resources	<ul style="list-style-type: none"> a. Triage cases to address most urgent and important problems first b. Recognizes emergent situation and directs action c. Recognizes and responds to reportable, transboundary, epizootic, and emerging/re-emerging diseases
1.6 Adapts knowledge to varied scenarios and contexts	<ul style="list-style-type: none"> a. Extrapolates knowledge to novel species or situations b. Adjusts existing protocol or procedure when standard measures are unavailable
1.7 Recognizes limitations of knowledge, skill and resources and consults as needed	<ul style="list-style-type: none"> a. Identifies situations in which referral is warranted b. Consults experts both within and outside the veterinary profession

Table 2: CBVE Framework Domain 2—Individual Animal Care and Management**DOMAIN 2:** Individual Animal Care and Management

The graduate performs preventive, diagnostic, medical, and surgical procedures for the health, wellness, and treatment of animals, appropriate to the context and life stage.

Competencies	Example Sub-competencies (non-comprehensive)
2.1 Performs veterinary procedures and post-procedural care	<ul style="list-style-type: none"> a. Performs elective procedures (e.g., castration) b. Performs routine therapeutic procedures (e.g., administer fluids) c. Performs emergency procedures (e.g., establish an airway) d. Provides analgesia and post-operative care e. Anesthetizes and recovers patients f. Manages patient comfort
2.2 Promotes comprehensive wellness and preventive care	<ul style="list-style-type: none"> a. Recommends disease prevention measures b. Provides nutritional counseling appropriate to life stage and health status c. Advises clients regarding routine dental care d. Educates clients on prevention of common behavioral problems e. Counsels clients about husbandry and welfare needs

Table 3: CBVE Framework Domain 3—Animal Population Care and Management**DOMAIN 3: Animal Population Care and Management**

The graduate designs and implements programs in herd health, disease prevention and control to improve the health, welfare and productivity of animal populations.

Competencies	Example Sub-competencies (non-comprehensive)
3.1 Applies population management principles in compliance with legal regulations and economic realities	<ul style="list-style-type: none"> a. Recommends disease prevention measures b. Advises on nutritional management c. Recommends housing and husbandry protocols d. Designs therapeutic plans for disease management
3.2 Recommends and evaluates protocols for biosecurity	<ul style="list-style-type: none"> a. Develops isolation protocols b. Selects disinfection protocols c. Recommends protocols for animal movement
3.3 Advises stakeholders on practices that promote animal welfare	<ul style="list-style-type: none"> a. Advocates for animal welfare through communication of the physical, affective, and natural needs of the animal b. Explains ethical and welfare-related aspects of production processes and slaughter c. Recognizes proper handling and/or adequate production facilities by interpretation of appropriate animal behaviors d. Advises on animal husbandry and transport

Table 4: CBVE Framework Domain 4—Public Health**DOMAIN 4: Public Health**

The graduate responds to issues at the interface of animals, humans, and the environment, utilizing a global perspective and sensitivity to local cultures.

Competencies	Example Sub-competencies (non-comprehensive)
4.1 Recognizes zoonotic diseases and responds accordingly	<ul style="list-style-type: none"> a. Identifies the clinical signs, clinical course, transmission potential and pathogen(s) associated with zoonotic diseases b. Responds to zoonotic disease diagnosis through owner education, reporting, quarantine, and disinfection
4.2 Promotes the health and safety of people and the environment	<ul style="list-style-type: none"> a. Makes recommendations for management of animal waste, carcasses, and by-products b. Implements safety and infection control practices c. Advises on disaster/emergency preparedness and response d. Practices responsible use of antimicrobial agents e. Describes the role of the veterinarian in assuring food safety

DISCUSSION

This article reports the process and outcomes of the collaborative, multinational effort that led to the creation of the AAVMC CBVE Framework. This was initiated by the inter-institutional CBVE Working Group and incorporated broad and iterative input from veterinary educators at AAVMC member institutions internationally, as well as other stakeholders. We believe that other groups seeking to design a collective product for broad adoption might find useful the methods used by the Working Group to develop the CBVE Framework, including establishing

expertise diversity and psychological safety within the group from the outset, inviting progressive input from stakeholders to refine the developing Framework, and engaging in consensus building and critical reflection throughout the development process.^{38,39} We also propose that AAVMC member institutions and other veterinary schools can use the CBVE Framework as a shared, inter-institutional foundation to guide ongoing curricular and assessment development in alignment with principles of competency-based education and mutual expectations for new graduate veterinarian performance.

Table 5: CBVE Framework Domain 5—Communication**DOMAIN 5: Communication**

The graduate communicates effectively with diverse clients, colleagues, other healthcare professionals and the public to promote animal, human and environmental health and well-being.

Competencies	Example Sub-competencies (non-comprehensive)
5.1 Listens attentively and communicates professionally	<ul style="list-style-type: none"> a. Communicates with diverse stakeholders (e.g., demonstrates empathy, uses terminology appropriate to listener) b. Utilizes a variety of communication platforms (e.g., email)
5.2 Adapts communication style to colleagues and clients	<ul style="list-style-type: none"> a. Demonstrates client-centered communication b. Elicits client goals, expectations, perspectives and constraints, considering the human–animal bond c. Engages clients in difficult conversations such as financial decisions and end-of-life care (e.g., palliative care and euthanasia)
5.3 Prepares documentation appropriate for the intended audience	<ul style="list-style-type: none"> a. Documents care and communication using professional terminology b. Ensures documentation fulfills professional and legal requirements

Table 6: CBVE Framework Domain 6—Collaboration**DOMAIN 6: Collaboration**

The graduate collaborates with diverse colleagues, clients and other stakeholders and demonstrates skills as a leader and inter-professional team member to improve outcomes and reduce error.

Competencies	Example Sub-competencies (non-comprehensive)
6.1 Solicits, respects and integrates contributions from others	<ul style="list-style-type: none"> a. Invites input from others irrespective of role, hierarchy, or background b. Acknowledges input and incorporates into ongoing plan of action c. Leverages own role and roles of others to achieve shared goals
6.2 Functions as leader or team member based on experience, skills and context	<ul style="list-style-type: none"> a. Applies principles of teamwork b. Bases action on collaborative input c. Manages conflict
6.3 Maintains ongoing relationship to provide continuity of collaborative effort	<ul style="list-style-type: none"> a. Follows up to determine if collaborator can implement the plan b. Provides support through encouragement, education, or redirection to refine the plan of action
6.4 Demonstrates inclusivity and cultural competence	<ul style="list-style-type: none"> a. Demonstrates respect for diversity b. Encourages diverse contributions within the workplace

Inter-Institutional Collaboration

The inter-institutional, multinational collaborative effort upon which the CBVE Framework is based generated benefits and challenges. Strategic selection of Working Group members was not only by geographic regions but also for recognized educational leadership and expertise in veterinary medicine, which helped to foster trust among

educators for the work of the group and their outputs. The consistency of group membership, existing collegial relationships between many group members, and small-to-medium group size of 10 members also fostered psychological safety among the group.⁵⁴ This facilitated honest and open communication, trust and constructive conflict among group members during the consensus-building process used

Table 7: CBVE Framework Domain 7—Professionalism and Professional Identity

DOMAIN 7: Professionalism and Professional Identity

The graduate demonstrates behaviors expected of the veterinarian, including ethical reasoning, reflective practice, self-regulation, professional development, and personal well-being.

Competencies	Example Sub-competencies (non-comprehensive)
7.1 Adopts an ethical approach to meeting professional obligations	a. Applies an ethical approach to professional decision-making b. Recognizes and responds to evidence of neglect and abuse
7.2 Practices time management	a. Recognizes impact of time management on stakeholders b. Prioritizes and completes tasks according to importance and urgency
7.3 Reflects on personal actions	a. Invites and responds to constructive feedback on performance b. Demonstrates self-awareness and self-regulation (e.g., evaluates personal strengths and limitations and acts accordingly)
7.4 Engages in self-directed learning and career planning	a. Engages in self-directed learning as a foundation for life-long learning b. Identifies and undertakes professional development to meet learning needs c. Uses appropriate resources for learning and decision making (e.g., information technology, consultation with colleagues) d. Compares career paths and weighs professional and personal rewards (e.g., financial implications)
7.5 Attends to well-being of self and others	a. Recognizes sources of workplace stress and acts to remedy adverse situations b. Recognizes signs of stress in self and colleagues, engages in self-care and recognizes when professional support is appropriate for self or others c. Manages expectations of client and self

to generate the Framework.^{39,54} Having consistent group members throughout the development process was also important for continuity and momentum of the initiative.

Shared co-chairing of the group by two of the members (L. Molgaard, J. Hodgson) helped to build consensus among the group through participative leadership.⁵⁶ It also harnessed the strengths of the co-chairs in advancing and promoting the work of the group through collaboratively presenting and discussing the work and outputs of the group at stakeholder organizations such as the AAVMC and AVMA COE.^{39,57} On a logistical front, shared co-chairing of the group helped to record and maintain momentum in the activities of the Working Group among members' available time and schedules.³⁹ This was augmented by the facilitative leadership of an educational consultant to keep the group on task, utilize their collective resources, reflect on strategies and outcomes, and continue to make incremental forward progress among their other commitments.^{58,59} This progress was aided by the group having a compelling goal to guide and motivate their work^{54,60}—that of creating a shared clinical competency assessment tool

as they were originally tasked to do, which could not be achieved without the development of shared definitions for CBVE and an underpinning Framework, as reported in this article.

The creation of the CBVE Framework required a complex and collaborative development process to extend from existing resources, build consensus and achieve an innovative outcome. The Working Group engaged in critical reflection throughout the development process to achieve this,^{54,61} collectively reflecting upon and discussing the group's objectives, decision-making strategies, and processes to establish whether change was needed.⁶² An example of this is the group's decision to first identify a shared foundational framework for competency-based education before developing the associated workplace-based assessment tools that they were originally tasked to create. Another example is the group's decision, upon then finding that a common language did not exist across the existing structures and competency frameworks in veterinary education, to establish shared definitions for CBVE before creating the Framework. Both of these

Table 8: CBVE Framework Domain 8—Financial and Practice Management**DOMAIN 8: Financial and Practice Management**

The graduate utilizes business acumen to manage professional and personal decisions, complies with legal and regulatory requirements and ensures safety of the workplace.

Competencies	Example Sub-competencies (non-comprehensive)
8.1 Weighs economic factors in personal and business decision-making	<ul style="list-style-type: none"> a. Applies financial principles to professional decisions (e.g., debt repayment plan) b. Explains work-related insurance (e.g., personal, professional, patient) c. Describes relationship between revenue generation, expense categories, and compensation including benefits
8.2 Delivers veterinary services compliant with legal and regulatory requirements	<ul style="list-style-type: none"> a. Acts in accordance with codes of professional practice, veterinary practice acts and licensing board regulations (e.g., veterinarian-client-patient relationship) b. Acts in accordance with legal and regulatory requirements (e.g., reportable diseases, animal cruelty, waste disposal) c. Selects drugs in accordance with regulatory and legal requirements (e.g., controlled substances, extra-label, or off-label drug use)
8.3 Advocates for the health and safety of patients, clients, and members of the team within the workplace	<ul style="list-style-type: none"> a. Complies with workplace health and safety regulations (e.g., radiation safety, infection control) b. Applies safe practices for handling hazardous materials (e.g., administration of chemotherapeutic agents)

Table 9: CBVE Framework Domain 9—Scholarship**DOMAIN 9: Scholarship**

The graduate demonstrates the systematic identification, evaluation, integration and adaptation of evidence and experience to formulate questions and solutions, and educate others.

Competencies	Example Sub-competencies (non-comprehensive)
9.1 Evaluates health-related information	<ul style="list-style-type: none"> a. Retrieves and evaluates information based on research principles b. Analyses information for accuracy, reliability, validity, and applicability
9.2 Integrates, adapts and applies knowledge and skills	<ul style="list-style-type: none"> a. Formulates questions and customizes solutions, drawing on personal experience and available evidence b. Applies literature to solve clinical or scientific problems (e.g., evidence-based practice) c. Applies creativity to develop innovative solutions
9.3 Disseminates knowledge and practices to stakeholders	<ul style="list-style-type: none"> a. Develops and disseminates educational material b. Explains evidence-based recommendations

decisions involved the group engaging in critical reflection to identify and uphold the need to take a backward step in the development process from that which was anticipated. The psychological safety created within the group helped team members accept this course of action and rapidly redirect their efforts toward developing more foundational resources.⁵⁴

Each member of the Working Group brought a unique perspective to the developmental process based on their personal experience, geographical region, clinical education model, and specific institution. This expertise diversity enabled group members to work both individually and collectively to create a complex output.⁵⁴ All group members valued and respected the breadth of expertise

and educational perspectives brought by individual team members. Each member actively solicited the views of others in the group to surface and resolve differences of opinion, to create a stronger outcome. The high value placed on different diverse perspectives gave the group patience with the longer timeframe incurred by this extended communication process.⁵⁴

The group employed a number of strategies to overcome the challenges of managing the logistics of and reaching consensus among a 10-person volunteer working group situated across multiple time zones. These included the use of synchronous and asynchronous technologies for working as a team while dispersed at our local institutions. Regular scheduling of video conferences with structured agendas containing focused topics to be addressed in the 1- to 2-hour meetings was essential to maintain forward progress, as was setting goals and deadlines for incremental work products. Asynchronous collaboration online in between the Working Group's bi-monthly video conferences enabled the meetings to focus on items that required collective, contemporaneous thought and discussion. The group scheduled face-to-face working sessions before and/or after veterinary education conferences to maximize the number of Working Group members able to attend and minimize additional travel costs. Support from the deans of the Working Group members' veterinary schools was essential for ongoing participation in the Working Group as well as financial support for travel.

Development of the CBVE Framework was led collaboratively by the CBVE Working Group with progressive feedback sought from the associate deans and educators at AAVMC member schools as well as other stakeholders. This differs from the structured Delphi that has been used to create a group communication process and build consensus across entities involved in human healthcare education, research and practice.⁶³⁻⁶⁵ The structured Delphi process is based on soliciting contributions from a group of experts, compiling this input into a collective product that contains individuals' anonymized views, and engaging in further rounds of feedback and additional input from the group until either a pre-determined number of rounds has been completed or a pre-determined criterion has been met.^{63,65} The relatively small size of the veterinary educational community meant that the more flexible methods used by the Working Group were effective in reaching interested stakeholders and gathering feedback in the process of developing the Framework. Engagement in an iterative, open feedback process with progressive input from stakeholders facilitated the wordsmithing required to ensure the Framework was accurately descriptive and intelligible for its intended audience. Development of the CBVE Framework also benefited from earlier studies that had used a Delphi, such as the VetPro model.^{27,28} Engagement and feedback by the associate deans and veterinary educators at AAVMC member institutions was critical to the success of the effort. The Working Group refined the Framework to best meet the needs of AAVMC member institutions based on this feedback, which was gathered through multiple methods given the respondents' time commitments and limited availability. These included surveys, webinars and feedback gathered during and after conference presentations.

Organizational support by the AAVMC and their member institutions for the communication of the Working Group's process and outcomes has helped to disseminate the Framework among its intended constituents. Support by the AAVMC for communication of the Working Group's efforts meant that the progress and outcomes of the group were consistently shared with the AAVMC member institutions who were to benefit from their work. This support included periodic communication updates in AAVMC newsletters, printing of the CBVE Framework booklet, and hosting CBVE resources online. Ongoing support was also provided to the group for development of the linked core EPAs reported in the companion article in this issue, the development of milestones for learner development in the CBVE competencies,⁶⁶ and printing of these additional resources in companion booklets to the Framework. Additional support has also been provided for implementation workshops and meetings to assist veterinary educators in learning about and applying the CBVE Framework in their local context. This extended communication and organizational support for the efforts and outputs of the CBVE Working Group differs from that of previous collective efforts, such as NAVMEC,²⁵ to create a shared framework for veterinary education. In this way the AAVMC and CBVE Working Group hope to increase the breadth and long-term impact of the CBVE Framework compared with that of previous efforts.

A Framework for Competency-Based Veterinary Education

Competency-based education offers benefits for the health professions in its focus on the development of competent graduates who can provide quality patient care in alignment with stakeholder expectations for performance. However, it is not without its critics. In medical education, critical perspectives may reflect questions about the CBME approach,⁶⁷⁻⁶⁹ the work and resources involved in implementing CBME in financially-constrained environments,⁶⁸ and/or the challenges faced when implementing CBME within institutions accustomed to traditional subject-based curricula.⁷⁰ An example of the latter in veterinary education is seen in feedback received by the Working Group during the development of the Framework, which requested that items based on non-observable stages of knowledge development be included. While acknowledging the essential role of foundational knowledge in developing the capabilities required of the veterinary professional, the Working Group retained its focus on defining competencies that are observable and workplace-based. Foundational subject matter is embedded within these competencies and integral to workplace-based assessments. For instance, gathering and assimilating relevant information about animals (CBVE Competency 1.1) includes completing a physical examination, which is based on a working knowledge of physiology, anatomy, and pathology. Concern was also expressed by some faculty about the lack of specific technical skills in the Framework. The CBVE Framework competencies are overarching and require an array of technical skills for successful completion. For example, CBVE Competency 2.1—performs veterinary procedures and post-procedural care—encompasses many technical skills. The challenges

in communicating the intention and structure of the CBVE Framework do not diminish the value of incorporating competency-based approaches into veterinary curricula.³

The Working Group engaged in vigorous discussions and debate about the most effective, logical and communicable structure for the Framework, including the different domains of competence and the most appropriate location for some of the competencies. For example, debates occurred about whether Communication and Collaboration were separate domains of competence or should be combined. The allocation of competencies amongst CBVE Domains 1–3 (Clinical Reasoning and Decision-Making; Individual Animal Care and Management; Animal Population Care and Management) also engendered significant discussion amongst the Working Group. The group's decision to place "Advises stakeholders on practices that promote animal welfare" (CBVE Competency 3.3) under only Animal Population Care and Management (Domain 3) rather than also under Individual Animal Care and Management (Domain 2) generated similar debate. The group solicited each member's views to resolve these differences of opinion, keeping in mind the ground rules of placing each competency in only one domain of competence and allocating the competency to the domain of best pragmatic fit. Membership that spanned American, Canadian, British, and Australian English backgrounds, together with one non-native English speaker, meant that there was an additional challenge around precisely what was understood by different words, and gave confidence over the international acceptance of the terms ultimately selected.

For the professional competencies articulated in CBVE Domains 5–9, the group discussed at length what was observable and measurable to guide the development of competencies in these areas. The group also debated what comprised new graduate performance expectations in these areas. For example, the group discussed what was reasonable to expect of new graduates in the Domains of Scholarship (Domain 9) and Financial and Practice Management (Domain 7), compared with expectations for those entering graduate research programs or involved in practice administration. Ultimately the group reached consensus in Domain 9 on competencies required for evidence-based practice and educating stakeholders, and in Domain 7 on competencies required for personal financial decisions, individual contributions to business decision making, compliance with legal and regulatory requirements, and advocating for workplace safety. The aim of these debates and discussions, together with reviewing feedback from stakeholders, was to create a CBVE Framework that was comprehensive and communicable, while also being flexible and attainable for application in teaching and assessment, with redundancy eliminated. Despite the consensus reached by the Working Group in these discussions, it is likely that these and other decisions will be revisited in the future.

Differences between the veterinary and medical educational systems pose unique challenges for the implementation of CBVE. Medical education systems are founded on years of post-graduate, workplace training following attainment of a medical degree, and CBME originated within this context.^{2,4} In contrast, veterinarians become eligible to apply

for licensure to practice veterinary medicine independently immediately upon graduation from veterinary school in some countries, and with additional completion of a written national qualifying examination in others. This impacts the level of performance desired for veterinarians prior to graduation. Furthermore, the requirement for direct and indirect supervision of veterinary students during clinical training impacts the structure of assessment programs, and so limits extrapolation from advanced training programs in medical education. These differences make the implementation of some features of CBME challenging in the veterinary education context. In the future, research into the challenges encountered and strategies used by individual veterinary schools in implementing CBVE would help to identify the areas where additional resources, explanations, and support would be helpful.

The Working Group convened and developed the CBVE Framework during a fortuitous period of growth in medical education. Since the CBVE Working Group was established in 2015, leaders in the CBME community have agreed that the collective integration of competencies, milestones, and EPAs, in the context of programmatic assessment, is optimal for learner progression.³ As such, the CBVE Working Group has now finalized these three components of competency-based education to support and inform student progression through the veterinary curriculum.^{55,66,71} Collectively, these integrated resources provide support for faculty development and implementation of CBVE across institutions. To that end, the CBVE Working Group hosted an implementation workshop in June 2019 that was attended by 90 participants from across North America, Europe, Australasia, and the West Indies. This provides evidence that the outputs of the Working Group have generated interest among AAVMC member institutions. Future research into the uptake and implementation of CBVE will determine the extent to which this initiative was successful.

Limitations

The CBVE Framework has been developed from a North American, Western European and Australasian perspective. While there is interest in applying the Framework to the needs of veterinary education in other regions,⁷² broader input may be needed to reflect the additional needs of veterinary education globally. The group felt compelled to develop a shared clinical competency tool in a relatively short timeframe in response to their stakeholders' requests. Doing so, however, required them to create an underpinning competency framework. To expedite the process, the CBVE Framework was developed using existing survey data from practitioners and students rather than gathering direct, contemporaneous feedback from all potential stakeholders. In future revisions, it would be useful to seek the views of all stakeholders to ensure they are represented.

The CBVE Framework offers a unifying structure and shared language based on modern competencies for veterinary practice that AAVMC member institutions and other institutions internationally may use to guide ongoing curricular and assessment development. It is expected to be periodically updated as the field of competency-based education advances, changes occur in the context of veterinary education, and feedback is received on the Framework

from faculty, students, employers and administrators as it is implemented in veterinary school curricula.

CONCLUSION

Competency-based education focuses on ensuring that learners achieve the competencies required to meet the needs of patients and other stakeholders in veterinary education and practice. While competency-based frameworks are well-established in medical education, veterinary education has yet to see widespread adoption. This article provides definitions and a CBVE Framework designed with collaborative, international input that articulates 32 competencies expected of new graduate veterinarians from AAVMC member institutions. These competencies are grouped under nine domains of competence with illustrative sub-competencies that schools may use as examples for applying the Framework in their local context. The nine domains of competence are: clinical reasoning and decision-making; individual animal care and management; animal population care and management; public health; communication; collaboration; professionalism and professional identity; financial and practice management; and scholarship. Incremental refinement of the CBVE Framework is expected with ongoing input from the veterinary profession to ensure the Framework reflects contemporary patient and societal needs.

The CBVE Framework forms the foundation for alignment and mapping of veterinary curricula to a shared taxonomy of competencies. Likewise, this Framework forms the foundation for development of linked milestones, EPAs and competency-based assessment tools that may be used to evaluate student progress toward achieving competence. A companion article in this issue reports the eight core EPAs linked to the CBVE Framework that were also developed by the multinational working group. Inter-institutional use of this Framework and their linked EPAs across institutions would facilitate benchmarking, feedback and collaborative development of competency-based curricula.

We believe that the processes and methods used by the Working Group to develop the CBVE Framework might benefit other multi-institutional groups seeking to create a collective product for broad adoption. These included the following: establishing expertise diversity within a small-to-medium size working group; soliciting progressive input and feedback from stakeholders to create and refine the developing Framework; and engaging in critical reflection to discuss and improve the group's process and outcomes. Shared co-chairing by two of the group members, together with facilitation by an educational consultant, helped to build consensus among the group and maintain forward momentum across the 2-year time frame of the project. Judicious use of synchronous and asynchronous technologies, plus periodic extended face-to-face meetings, enabled the collaborative efforts needed to create and reach consensus on the final Framework. Ongoing communication and dissemination of the Framework by the AAVMC and implementation by its member institutions will increase the breadth of adoption and long-term impact of this initiative.

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CONFLICT OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article. The AAVMC funded the involvement of Dr. Jody Frost as a consultant and facilitator for the group, as well as graphic design, publication, and some meeting expenses.

NOTE

- a Moodle open source software, Moodle Pty Ltd, West Perth, Australia, <https://moodle.org/>

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