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Creating the next generation of evidence-based veterinary practitioners and researchers:

What are the options for globally diverse veterinary curricula?

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ABSTRACT

Veterinary educators strive to prepare graduates for a variety of career options with the skills and knowledge to utilize, and contribute to, research as part of their lifelong practice of evidence-based veterinary medicine (EBVM). In the veterinary curriculum, students should receive a grounding in research and EBVM, as well as have the opportunity to consider research as a career. The lack of a cohesive body of information that identified the options and the challenges inherent to embedding such training in veterinary curricula led to the formation of an international group with the goal to synthesize evidence to help curriculum designers, course leaders and teachers implement educational approaches that will help inspire future researchers and create evidence-based practitioners. A literature review of the rationale, issues and options for research and EBVM in veterinary curricula was performed. Additionally, semi-structured interviews were undertaken with 11 key stakeholders across the eight Council for International Veterinary Medical Education (CIVME) regions. Emergent themes from the literature and interviews included societal need, career development and skills important for clinical professional life as reasons for including research and EBVM skills into the curriculum. Approaches included compulsory as well as optional learning opportunities. Barriers to incorporating these skills into the curriculum were grouped into student and faculty/staff related issues, including time in the curriculum and financial barriers. Having motivated faculty and contextualizing the teaching were considered important to engage students. The information has been summarized in an online 'toolbox' and is freely available for educators to inform curriculum development.

Key words: curriculum, research, research projects, evidence-based veterinary medicine, veterinary education, CIVME, international

INTRODUCTION

Whether a future clinician or researcher, veterinary students need to develop the skills and knowledge to utilize, and contribute to, research as part of their lifelong practice of evidence-based veterinary medicine (EBVM). Incorporating these skills into medical curricula is reported to have many benefits including enhancing students' ability for independent learning and critical thinking, increasing institutional published output, improving students' ability to practice clinical medicine, increasing student interest in a future academic career and making students aware of the health problems of the community and country.¹⁻³ Research is essential to guide improvements in health systems and to develop new initiatives.⁴

In the veterinary curriculum, students should receive a grounding in research and EBVM. Veterinary curricula should aim to provide students with the opportunities to experience research, consider research as a career and develop the knowledge and skills to utilize research outputs as part of evidence-based practice. Research and EBVM are complementary and interlinked; the need to promote both is stated in accreditation standards⁵⁻⁸ and frameworks^{9,10} and further highlighted through initiatives such as conferences.^{11,12} There are recognized and ongoing challenges when integrating these into the curriculum including student engagement and increasing cohort size. Potential solutions have been proposed, outcomes defined and useful learning resources are available. However, relevant information is scattered across the literature.^{4,13-23}

Veterinarians are uniquely qualified to be involved in research regarding public health and emerging diseases, and yet studies have shown that the number of veterinarians considering a career in research is not sufficient to fulfil societal needs in this area.⁴ Many

veterinary and medical academic institutions are trying to increase the interest of their students in following a research career by introducing them to research during their undergraduate and postgraduate education.

A clinical definition of Evidence-based Veterinary Medicine (EBVM) is “the conscientious, explicit, and judicious use of the current best evidence in making decisions about the care of individual patients.”³⁴ Although in principle many practitioners have been practicing elements of EBVM, it has only been described in the veterinary literature in detail in the last 20 years.³⁵ Skills necessary to perform good quality EBVM include turning a clinical situation into an answerable question, searching for and appraising literature for their quality and clinical applicability, applying the information gained to the clinical situation and assessing the outcome of the new approach.^{15,34} Therefore, many institutions aim to include EBVM skills within the curriculum to enable students to perform EBVM in their future careers. This will equip practitioners with the skills to find the information when needed (“just in time knowledge”), rather than try to accumulate all the knowledge during their education (“just in case knowledge”).³⁴

It became clear during a recent review of research instruction in the curriculum at St. George’s University’s School of Veterinary Medicine (SGUSVM), Grenada many of the challenges of incorporating research and/or EBVM into the curriculum at this school were shared by other veterinary educational institutions. The lack of a cohesive body of information to identify and address the challenges, as well as the lack of a forum for curriculum designers and educators from other institutions to discuss these issues, lead to the formation of an international group of interested parties with experience in education, curriculum design and delivery as well as research in biomedical and clinical science. This

international inter-institutional collaboration responded to a funding program call from the Association of American Veterinary Medical Colleges (AAVMC)'s Council for International Veterinary Medical Education (CIVME) with a proposal for a project with the aim to undertake a literature review on research and EBVM in veterinary education. The proposal was to complement this information by interviews with stakeholders from across the eight regions of CIVME to deepen the understanding of contextual issues, obtain unpublished input and identify additional available learning resources. Collectively, the aim was to assemble this information into a 'toolbox' to be made freely available to the veterinary educational community.

METHODS

Part 1: Literature Review

The review team developed an initial search strategy for the project literature review which included some of the papers cited in the CIVME application and their reference lists.^{4,10,11,13-}

¹⁷ The search aimed to identify papers and other documents with information relevant to teaching evidence-based veterinary medicine and research skills and conducting mentored research projects in a veterinary curriculum. The search was restricted to English language texts and had a primary focus on undergraduate veterinary medicine. As one area of interest was how to incorporate the teaching into professional (often overcrowded) curricula, papers from medicine, dentistry and nursing were also considered. The search was refined in an iterative process through team discussions and with input from librarians. The literature review included searches of two electronic databases (Medline and CAB Abstracts), key educational journals and the grey literature as well as citation searches of

selected papers. The resulting lists of papers and other documents were screened (titles and abstracts) by one or more team members (MJ, SB, HJ and SW) for relevance.

Data extraction

A data extraction sheet was created in Excel for the team to collect information for the literature review. For each article basic data were recorded including journal (or other source), year of publication, country, profession, stage of education (e.g. undergraduate, postgraduate) and primary focus (EBVM, research skills or both).. The sheet was tested and refined by several members of the team (SB, HJ, DS) using some of the papers from the CIVME application. Information from each article was reviewed and summarized in the data extraction sheet by one of four authors (SB, HJ, DS, MJ).

Data synthesis

Thematic analysis was undertaken within each of the main themes of the study: reasons for incorporating EBVM and/or research skills in curriculum; learning outcomes; approaches used; barriers/challenges; and facilitators to implementation. Two authors (SW and HJ) independently analyzed 10% of the data, prior to comparing, discussing and clarifying findings to create an initial thematic template. This template was used as a basis for subsequent analysis of the remaining data by one of two authors (SW or HJ), with any queries or changes to the template discussed and agreed.

The synthesized data were then used to create a 'toolbox' to include information under each of the main themes and to be made available online for educators to consult when reviewing or introducing research and/or EBVM in a curriculum.

Part 2: Interviews

In parallel with analysis of the literature, semi-structured interviews were undertaken with 11 key stakeholders (experienced veterinary educators) across the eight CIVME regions, using a purposive sampling strategy aiming to identify individuals likely to be familiar with the teaching of EBVM and/or research skills. One or two stakeholders were recruited from each of the CIVME regions; more than one participant was recruited from some of the regions with the highest outputs of literature identified in Part 1. Participants either were or had been faculty at a veterinary institution and were recruited for one or more of the following reasons: lead author on a paper describing incorporating EBVM and/or research into a veterinary curriculum, nationally or internationally recognized expert in teaching EBVM and/or research in a veterinary curriculum or recommended by curriculum coordinator of an established veterinary university in a particular region.

The aim of the interviews was to deepen the understanding of contextual and regional issues which may facilitate or hinder implementation of research and EBVM training within the curriculum and identify available learning resources. Ethical approval for interviews was obtained (St George's University Institutional Review Board: 18060). An interview guide (see Appendix 1) was developed to explore the participants' involvement in their institutions' curriculum and the teaching of research and EBVM skills to veterinary students. Participants were asked to consider the reasons for inclusion in the curriculum of either research or EBVM skills in their country, any challenges they have encountered, the approaches they have tried, and any tips for success. They were then asked to identify any freely available learning resources, followed by an opportunity to raise any other points related to the topics discussed. All participants provided written consent. Interviews were carried out by

telephone or Skype and were audio-recorded. They were then transcribed. Thematic analysis was then undertaken using the thematic framework created from analysis of the literature to further enrich the themes identified, identify any new emerging themes, and enhance input from regions underrepresented in the literature. Two authors (HJ and SW) analyzed one of the transcripts; one author (HJ) then analyzed the remaining transcripts. Any queries were discussed, and consensus reached by HJ and SW.

RESULTS

Part 1: Literature Review

Data extraction

A total of 105 articles from the literature search were entered into the data extraction sheet. Most were journal papers (95) and the most frequent journals were Medical Teacher (18), Journal of Veterinary Medical Education (16), BMC Medical Education (11), Academic Medicine (9), Veterinary Record (5), and Medical Education (4). A further 26 journals were represented and there were 10 items from other sources (e.g. competency frameworks and accreditation standards). The year of publication ranged from 1999 – 2019.

The authors represented 19 different countries, individually or in combination, with the majority being from USA, UK, Australia, Canada and The Netherlands. The veterinary papers only represented four of the CIVME regions: North America, United Kingdom, continental Europe and Australia. Papers were reviewed from four health professions. Most were from medicine (62) and veterinary medicine (42) with two from nursing and one from dentistry, and the list included one across three professions. There was a focus on papers representing undergraduate training (i.e. leading to a DVM or equivalent) across all professions as these

were considered the most relevant to the project. This resulted in 86 of the articles representing undergraduate education (entirely or in combination with postgraduate and/or the workplace). The articles were classified as focusing on evidence-based (veterinary) medicine (EB(V)M) (44% of articles) or research (38%) in the curriculum and some covered both (18%)

Data synthesis

The themes identified in the literature review are summarized in Table 1.

Reasons for including in curricula

Three main reasons were identified for including research skills and EB(V)M in healthcare curricula. Firstly, it was widely acknowledged that there is a *societal need* for research capacity within healthcare professions. Not only is there a need to ensure capacity for biomedical, public health, translational and clinical research, there is also a need to ensure that clinicians have appropriate scientific and research training to critique and use appropriate evidence in clinical decision making.^{1,2,4,17,24,30,32,46-51,56,60} This social expectation translates into accreditation requirements and expectations of competence in basic research skills at graduation.^{10,15,40,52,55,60} Secondly, training in research, and to a lesser extent EB(V)M, skills were considered important to support *career development and employability* in graduates, primarily through raising awareness of the possibility of, and preparing graduates for, a research career.^{1,4,14,17,24,30,46,49,50,54,56,60} There was also a perception that specific research training (such as through intercalated degrees) for doctors

might increase competitiveness in the job market post-graduation, enhance professional credibility (e.g. through publication), and support graduates to contribute to research during their professional lives. It was also recognized that research training can enhance transferable skills essential for the workplace such as teamwork, time management and critical thinking, as well as help students develop skills essential for lifelong learning.^{1,2,17,52-55,57,60} Finally, it was recognized that EB(V)M training supports development in a specific range of *skills important for clinical professional life*, related to learning the 5 “steps” of EB(V)M: how to ask questions, acquire and appraise information was a common theme; apply and assess were less commonly discussed. It was also noted that training can help students learn how to make decisions in the face of both uncertainty and the ever-increasing body of literature available.^{1,2,4,14,15,16,17,27,36,40,41,43,44,55,57,60}

Approaches used

A range of approaches have been used to provide training in research and EB(V)M. For research skills training, *compulsory activities* can include traditional training in e.g. scientific methods, paper writing and statistical analysis, delivered through lectures and small group teaching. Practical activities are used in a range of ways supporting students to learn specific aspects of the research process, for example through writing an abstract or literature review. Compulsory research projects are also widely used. EB(V)M training often takes a stepwise, blended learning approach with lecture-based delivery of theoretical concepts supported by student activities, such as problem-based learning sessions, engagement with online resources, integration with clinical learning, and creation of “knowledge summaries”.^{1-4,14,15,17,25,27-29,36,40,41,43,44,48,51,55,57} *Optional learning opportunities* include

EB(V)M focused elective courses, summer projects, externships, intercalated research degrees, and mentoring programs for interested students.^{4,24,25,26,30,44,46,49,50,54,57}

Barriers to inclusion in curricula

Four themes relating to barriers to inclusion in curricula were identified relating to students, staff (including faculty), the curriculum itself, and financial resource.

Students: Engaging students in research and EB(V)M can be challenging. Some clinically focused students can find it difficult to engage in research/EB(V)M training within a busy curriculum, uncertain as to the relevance to their future professional lives; it was recognized that students are often more engaged when involved in optional training opportunities.^{1,2,14,17,40,44,52,54,55,60} Ironically, it is also recognized that a lack (or a perceived lack) of training makes it harder for students to engage in the often-limited opportunities for authentic research experience.^{2,4,17,20,32,54,55} A few studies also noted that students can find it challenging to deal with the uncertainty and conflicts of evidence integral to research and EB(V)M.^{15,40}

Faculty/Staff: Differing expectations between students and faculty regarding definitions, importance and role of research/EB(V)M skills can raise challenges; teaching and supervision can be inconsistent with some students finding self-directed learning difficult or having perhaps unrealistic expectations of publication.^{1,14,40,41,46} For EB(V)M, in particular, faculty can themselves lack expertise in, and enthusiasm for, the skills required to support students, with training often disconnected from the clinical workplace. Activities such as student research projects require a significant number of skilled faculty and staff supervisors (research, librarian and IT) which can be challenging to resource;^{1,2,17,25,30,32,40,41,44,57,60} a

small number of studies also highlight the relative lack of gender and ethnic diversity to act as role-models in many areas of research.^{30,40}

Curriculum: A perceived lack of time is the most common barrier to training, whether in already crowded curricula, or in the clinical workplace. Additionally, students may be reluctant to extend their training by engaging in opportunities such as intercalated degrees.^{4,15,17,25,27,30,40,41,44,55,60} Furthermore, there are challenges around the timing of training within the curriculum, with a stepwise, longitudinal approach perceived as beneficial, along with the integration of EB(V)M with clinical training.^{25,36,40,43,55,60} There can also be challenges relating to access to resources within the curriculum or workplace, including access to quality teaching resources, physical space for groupwork, virtual learning environments, and databases; there is also a relative lack of quality evidence particularly in veterinary literature.^{17,36,44,57}

Financial barriers: Research training opportunities are particularly hampered by lack of access to funding and student debt.^{4,25,30,46,50,54,60} Faculty recruitment can be impacted by competition from the private sector and financial pressures that encourage faculty to prioritize their own research and/or clinical work over student mentoring.^{1,4,44} In developing countries, faculty resources can also be impacted by overseas migration.^{1,30}

Tips for success

Four key themes emerged as tips for successful integration of research and EB(V)M training. Firstly, the importance of motivated, *enthusiastic faculty and staff* from a range of backgrounds (academic, library, IT) was highlighted to provide effective supervision, mentoring, instruction and role-modelling to students.^{2,4,14,15} *Contextualizing* training was also highlighted as important for student engagement and learning, integrating closely with

clinical experience, career aspirations and current research.^{15,52} *Resource development* and access was frequently highlighted: multi-modal, blended learning approaches with access to online databases and teaching resources, as well as face-to-face activities; embedding core activities vertically within the curriculum with additional optional activities for interested students; and appropriate training, support and time allocation for faculty and staff.^{4,15,30,36,40,41,43,57} Access to research funding for students was valued. More *specific tips* included: access to a “research office” for students;³⁰ using low-cost platforms such as “YouTube”;⁶² using inter-professional approaches to training;⁴⁰ sharing evidence findings with patients and evaluating online evidence accessed by patients;⁶³ and activities such as student clubs focusing on research and/or EB(V)M skills.^{24,36,60}

Table 1: Summary of themes and subthemes emerging from the literature

Part 2: Interviews

A total of eleven interviews were conducted incorporating at least one stakeholder from each of the eight CIVME regions: Two were from ‘North America’, two from the ‘United Kingdom & Ireland’, two from ‘continental Europe’, one from ‘Australasia’, one from the ‘Caribbean/Latin Americas’, one from ‘China/South Asia/India’, one from ‘Middle East/North Africa’ and one from ‘sub-Saharan Africa’. Nine participants were currently employed at an academic institution and actively involved with teaching undergraduate students. Two participants had been involved with curriculum design and teaching but were now working in corporate roles.

The resulting themes mirrored themes identified during the literature review; illustrative quotes are included below:

Reasons for including in curricula

Most interviewees described research/EBVM skills within the curriculum being required for accreditation purposes, either for obtaining a veterinary degree or for professional licensure. Stakeholder (government, industry, clients, educators) expectations played a major role, including a need for veterinarian-researchers and also as a requirement for best practice: “[...] there is [...] an ongoing need to replace researchers, whether they're basic science or clinical researchers who have veterinary training and research training [...]”. Career development and employability was also identified as an important reason for including research, especially in countries where the majority of graduates would go on to work in governmental jobs, large animal practice or the pharmaceutical industry: “[...] because it helps with their careers, so they have a better opportunity to get a job if they have a master's degree or a PhD.” Additionally, teaching these skills was considered important for clinical professional life: “It's more about the continual learning angle and setting them up [...] to continue to practice a high standard of care throughout their careers, while continually [...] evaluating, appraising what they're doing, seeing if it's best practice, and [...] continuing to learn when they encounter different cases.”

Approaches Used

As reflected in the literature, a number of different approaches were used in the various institutions, from didactic courses to longitudinal projects, including mandatory and voluntary opportunities. Research projects were necessary for licensure in two institutions (CIVME regions: continental Europe and Australasia) and included in the curriculum due to

pressure from stakeholders in two institutions (Caribbean/Latin Americas and China/South Asia/India): “But you know, we got the feedback from the field that it is needed.” Four institutions included formal EBVM training in their curricula (continental Europe, United Kingdom & Ireland x 2 and North America) and another (sub-Saharan Africa) allowed their students to choose between a research or EBVM project. One institution (Middle East/North Africa) had no formal research or EBVM requirements in their curriculum with the explanation that there was no pressure from stakeholders (“[...] the stakeholders would be the main reason [to include in the curriculum]”) and time (“So, [...] the main [...] problem we face is the time [in the term].”), but they did include a mandatory presentation of a literature review and had didactic teaching in statistics. Only one institution included both a research project and formal EBVM training in their curriculum (CIVME region: United Kingdom & Ireland). Institutions that had no formal training in EBVM did agree that this would be beneficial and a few informally incorporated it into their clinical teaching: “So, if you [...] find somebody who's trying to train the students to find the evidence for whatever problem they have, it would be a personal effort rather than a structured requirement in the course, currently speaking.”

Barriers to inclusion in curricula

A lack of buy-in from both the students and faculty was identified as a major issue. Interestingly, this was identified as a challenge in all geographical locations. Students are asked to deal with uncertainty in a fact-based program: “[Students have] been taught to absorb the content and then show the content [...] as opposed to thinking about the content, [...]. It's hard to do that. It's hard to teach it. It's hard to assess it, it takes more time. And so, [...] those are all the challenges to incorporating evidence-based medicine into

the curriculum at any level.” In addition, finding trained and experienced faculty and staff that are motivated to teach research and EBVM skills can be difficult, especially when considering that faculty are dealing with a full academic workload. Finding the time within an already overburdened curriculum can be difficult and most of the institutions that had recently developed new curricula mentioned this as a major problem, whereas those institutions that had either been incorporating research/EBVM for some time or did not incorporate it in a mandatory manner, did not mention time as a challenging factor. Interestingly, funding seemed to be an issue mainly in the institutions that had a mandated research project. One interviewee also mentioned the language barrier (most literature is written in English) as an issue for the students.

Tips for success

Independent of teaching research or EBVM skills, it was clear that finding enthusiastic and motivated faculty and support staff, as well as making the teaching relevant (contextualizing) within the curriculum, was important: “Like a lot of the rest of the curriculum, making it relevant to reality, because like physiology and anatomy, the students get more engaged when they see how those skills are useful as a clinician [...]”. In conjunction with this, ensuring students had access to literature was considered essential. Offering both students and faculty incentives, such as funding and publishing opportunities, access to conferences to present research, etc. aided in engaging both students and faculty.

Overall, the themes arising from the interviews were similar to those described in the literature. One major geographical difference was noticeable, namely, the North American

and European institutions were more likely to be explicitly incorporating EBVM into their curricula.

Developing the Toolbox^a

The information gathered from the literature and interviews is being made available in the format of a 'toolbox': a free, web-based resource for educators. The thematic template developed for analyzing the literature and interviews was adapted for the outline of the toolbox with the themes to be presented in the following order: Reasons for including research/ EBVM in the curriculum -> learning outcomes -> approaches used -> barriers/ challenges identified -> facilitators/ top tips. The complete list of articles will be available in the reference section of the toolbox. Resources identified in the literature and during the interviews were collected, valid URLs were identified and will also be made available on the toolbox website. Resources identified in the literature and by interview fell into the following categories: Learning resources for developing EB(V)M or research skills, databases of critically appraised topics (CATs), databases of systematic reviews, databases of clinical studies, journals relating to EB(V)M, free access and other search databases, databases for research funding, research tools (e.g. reference manager or statistics programs).

DISCUSSION

There is an agreement across the literature and interviewees of the necessity to teach skills related to research and EBVM within the veterinary curriculum. The main reason relates to societal need, although the interview results indicate that stakeholder expectations may differ by region. In geographical locations where the majority of veterinary graduates aim

for careers in public health, government or production animal medicine, research skills are considered more important, with the potential to improve employability.

The veterinary and medical literature across geographical regions describes the importance of introducing research skills in education to engage and inspire the next generation of physician-scientists at an early stage as a key factor in reversing the decline of medical graduates interested in a career in research and academia,^{2-4,14,17,24,29,30,33,46-53} which is crucial in acquiring the information necessary to underpin EB(V)M. This view is supported by input from interviews, especially in countries lacking in region specific epidemiological information regarding disease prevalence and monitoring. Research skills are also considered important to develop critical thinking skills and enable future clinicians to better assess research and perform EB(V)M.^{1,14,31,52-60}

The necessity to incorporate EB(V)M specific skills into the curriculum is predominantly confined to literature originating from North America, the UK, Western Europe and Australia, with some accrediting bodies specifically identifying these skills in their frameworks and accreditation standards (e.g. AAVMC, RCVS, GMC),⁵⁻⁸ although this may be due to search limitations to English language literature only.

The literature describes a range of approaches on incorporating research skills and EB(V)M into the curriculum, both compulsory and optional.^{3,24-29} The amount and depth of instruction varies between institutions and there is no evidence of geographical differences aside from those already discussed concerning regional perception of importance. When developing a new course incorporating research or EB(V)M skills into an existing curriculum, a recurring theme is finding the time and identifying the ideal placement within the program.^{15,16,38,41,44,45} Having access to appropriate resources are also frequently raised as

an issue, including enough skilled and motivated faculty and technical resources (e.g. access to quality literature).^{16,38,41,42} There was no evidence of geographical location playing a role, instead institutional philosophies appeared more significant.

Literature originating in the United States included finances as a possible deterrent for graduates engaging in research during and after their studies,^{3,4,55,61} which is likely due to the fact that US students have already completed an undergraduate degree and have significant student debt to consider. Funding for veterinary research is a universal challenge and especially for institutions in regions outside of North America, Europe and Australia, funding for research projects were identified as a major reason for difficulties in incorporating in particular research skills into the curriculum.^{1, 3, 30,62}

We acknowledged that there is no 'one size fits all' solution, recognizing that there are regional differences and local needs and challenges. In addition, our study accessed a limited number of databases and only included English language publications. However, providing a comprehensive resource in the format of an online, freely available 'toolbox', that is available to all will facilitate the work of curriculum designers and instructors by raising awareness of challenges, providing examples and potential solutions and creating a platform for continued communication. It would be interesting to investigate whether integrating research into the curriculum is leading to an increase in the number of clinicians interested in careers in research and whether more awareness of EB(V)M is identifying knowledge gaps that are being addressed by these researchers.

NOTES

- a. The URL for the toolbox is:

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