On Less Bad Practices in Veterinary Education and Assessment

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"Curricular reorganization has some semblance to an epidemic disease in that it occurs at fairly regular intervals; it is.. like an inflammatory reaction characterized by heat and occasional pain… it takes up a great deal of time of a great many people, often to little avail as the more startling proposals tend to cancel each other out and at the end the faculty is usually left with a similar curriculum; it leaves behind a considerable amount of immunity but with some residual infection so that when a sufficiently large susceptible population is again built up, the phenomenon reappears." Robertson (1974) J.S. Afr. Vet. Ass. 45:21-25

We have been tasked with addressing the question, "Can we make evidence-based decisions on the best way to train future animal health professionals?" This topic has a long history of discourse surrounding it in all facets of schooling including, but not limited to, health professions education, K-12 education, and higher education. We have broken the topic in to three components: 1. Can we predict the future needs of the profession? 2. Can we identify those traits necessary to future proof the profession? 3. Are there evidence-based approaches to educate for the future? We cannot do each topic justice within one essay; we provide an overview and potential solutions to help focus this ongoing dialogue in veterinary medicine, and evidence-based resources for further reading.

The importance of context and pragmatism needs to be made explicit in this conversation. These factors are often not discussed nor taken into consideration when planning for or implementing curricular structures, or in our discussions regarding evidence to support teaching or assessment practices of veterinary students. Context may include broader considerations such as country or region of animal health profession practice. Or it may include a more focused lens, such as making explicit the objectives of the school, the economic and political climates (within school and country) where the training occurs. Pragmatism is an extension of context, while we all may want to match training to the veterinary field of practice, this may be neither feasible nor useful for an unpredictable future. Identifying the resource allocations and constraints should be taken into consideration when having discussions regarding an evidence-based way of educational reforms. By outlining and making explicit the context, including the financial, political, and socio-economic opportunities and challenges, provides a foundation by which to think about future needs, attributes of our students, and ultimately training in veterinary education.

Can we predict for future needs of the profession? We would argue that this is difficult, and perhaps a wasted effort, beyond generalisations (e.g., increasing role of technology). As an example, who would have predicted the rapid (probably exponential) growth in telehealth in

veterinary medicine that has resulted from the Covid-19 pandemic? Notably, this experience is not unique. Advances in healthcare have emerged from other largescale events, such as war (e.g., sanitation and epidemiology during the Crimean War, adoption of anesthesia during the American Civil War, antiseptics during WWI, management of shock and stabilisation during WWII and the Korean War). Therefore, the rest of this essay will focus on traits and evidence for training.

What are the traits of applicants that we should be selecting for? Predicting future needs or identifying what a successful veterinarian is, is multifactorial. What is the definition of a successful veterinarian? What attributes or variables should/could/can be collected that we use in our analyses and what should we be training to? Are we selecting for the school or are we selecting for the profession? KGH (Hecker and Norman, 2017) and others have argued that academic ability is necessary but not sufficient for future performance within a program. There are other attributes upon which schools place more or less emphasis at the time of selection. For those interested in selection criteria and methods we would refer you to the 2017 issue in Advances in Health Sciences Education, "The Science of Selection into Healthcare: International Insights and a Future Research Agenda" in Advances in Health Sciences Education.

Are there evidence-based ways to educate for the future? Time frame is relevant to this conversation, are we training to provide skills for a 30-year career or for "day 1" abilities (or a mix, depending on skill type). Our focus is more "proximal" for day 1 abilities because training programs typically cannot account, or take credit, for what is learned once in practice. With the focus on day 1 abilities, when something is perceived (might not be evidence based) to not be working (i.e., a curriculum) we begin by saying the system has failed us, there is a systemic issue, or the process is flawed, and we need a new curriculum. We externalize. Whereas, we wonder, if we were to internalize and say, "we need to be better educators, assessors, clinical role models and ambassadors of our profession", maybe, just maybe, there would be a greater effect on student selection, education and ultimately retention with the profession.

The effects (or lack thereof) of formal curricular structure on student performance was studied and reported by KGH (Hecker and Violato, 2007, Hecker and Violato 2008). In two publications, studying 116 medical schools in the United States over a 10-year time period, he reported that formal curricular structure (systems based, problem based, discipline based and others) accounts for less that 5% of the variance in student performance on content based and application assessments when you take into consideration incoming performance. Furthermore, longitudinal studies published by A. W. Astin in 1977 and 1993 on student learning in higher education pointed to two key components for success in student learning: student peer group and quality of interaction with faculty. In other words, student characteristics and quality of instruction/educators matter more for student learning than does curricular structure. These two pieces of evidence would suggest that, while a formal curricular structure built using best practices is necessary, where we can affect greater change in veterinary education is by spending more deliberate time/funds/effort in our student recruitment (we are only as good as our applicant pool) and selection policies, as well as our quality of instruction, educational implementation, and delivery.

Evidence-based strategies for learning have been well described in cognitive psychology. These strategies are applicable in veterinary medical education. "Understanding How We Learn", by Weinstein and colleagues (2020), describes six learning (as well as teaching) strategies for effective learning: spaced practice, retrieval practice, elaboration, interleaving, concrete examples, and dual coding (speaking and providing diagrams). Within veterinary medicine, studies of learning based on these strategies reinforce this evidence. If such teaching strategies are used, greater learning and retention occur.

Another dimension currently discussed in Health Professions Education leverages off evidence for training that incorporates "preparation for future learning". Mylopoulos and Woods (and others; Mylopoulos et al. 2018, Kulasegaram et al. 2015) argue that clinical and decision-making expertise incorporates adaptability to complex, changing environments. This is highly relevant as it reflects and acknowledges the continually increasing body of knowledge that clinicians (and scientists) face. Therefore, education programs should foster environments to develop this attribute, labeled "adaptive expertise". This does not mean that clinical and basic sciences should be replaced or removed from a program; instead, cognitive science learning principles are applied to teaching and learning activities, integrating basic and clinical sciences. In other words, foundational knowledge combined with multiple repeated exposure to clinical content increases the likelihood of better decision-making skills in varied environments. Mylopolus and colleagues explain how to build learning environments to support preparation for future learning, stating, "Critically, training that fosters both [procedural and conceptual knowledge] dimensions of adaptive expertise does not necessarily require new tools and approaches, but rather a reorientation to education using many of the instruction and assessment format already available." This re-orientation of our teaching and learning environments provides evidence-based ways forward so that we educate for the future by preparing students to adapt to the future.

Discussions of training cannot exclude assessment, specifically, using assessment to both make decisions about student progression and to reinforce learning. There is no one perfect assessment method, each method has its strengths and limitations. Understanding and justifying which assessment should be used and the intended use of the resulting scores needs to be made explicit within our programs. Understanding the role of assessment on learning (both assessment for learning and test-enhanced learning) needs greater recognition. Learning in lower stakes (not for marks) environments with deliberate feedback assists in development of competency. Lastly, there is strong evidence to support longitudinal and programmatic assessment programs. The premise is to collect data within an individual across multiple low and high stakes assessment methods to provide a competency profile of a student. Evidence is beginning to emerge of how this could best work (see Bok et al. 2018 for one of the definitive studies performed in veterinary medicine), however, the feasibility, cost and acceptability of such programs must be considered within local context.

To conclude this essay and stimulate discussions, we provide some proposed evidence-based solutions to the initial question:

1. Explicitly state the objectives of the training program, design the program backwards and deliver forwards (i.e., what is our explicit target outcome/ end-goal?).
2. Student characteristics account for greater gains in learning than does curricular structure. Focus on student attributes that meet or complement your program objectives. Consider if you should select for these attributes, train to these attributes, or both.
3. Provide/encourage/mandate teaching and assessment training for instructors. Quality of instruction accounts for greater gains in student learning than does the curricular structure.
4. Align assessment methods explicitly to program delivery and build in assessment principles for learning retention and application. Be wary of short term, primarily knowledge-based, assessment cycles.
5. Provide opportunities for struggle and productive failure (with feedback). Learning is reinforced by understanding actions and consequences of actions/decisions.
6. Integrate basic and clinical sciences explicitly during individual learning sessions.
7. Provide training opportunities (facilitated and with feedback) to evaluate evidence: both emerging evidence (e.g., research papers) and evidence from a variety of sources (e.g., CE events with "experts", internet discussion forums, pharmaceutical materials etc.).
8. Take into consideration regional and local contexts to make pragmatic evidence-based decisions about changes to veterinary education.