

Essential veterinary education in zoological and wildlife medicine: a global perspective

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Summary

The current veterinary curriculum leaves graduates ill-equipped for careers in the field of zoological and wildlife medicine. Further postgraduate training is required to be an effective zoo or wildlife veterinarian. However, whether or not students choose to specialise in this field at a later date, the veterinary curriculum should cover several issues that are related to wildlife and zoo animals, including conservation biology, zoology, behaviour, physiology and conservation medicine. These subjects are essential, as we are preparing students to work in a world in which there is a global trade in wild animals, an increasing number of emerging infectious diseases and numerous environmental threats (habitat fragmentation, climate change) linked to anthropogenic change. Veterinary students should also be exposed to new opportunities to identify field and laboratory tools for the management and possible treatment of diseases in captive and wild populations and ecosystems using both *in situ* and *ex situ* approaches to conservation.

Keywords

Ex situ conservation – In situ conservation – Infectious emerging diseases – Transdisciplinarity – Wildlife medicine – Zoological medicine.

Introduction

Zoological medicine and wildlife medicine have been recognised disciplines within the veterinary profession for several decades now. During the mid-1940s a group of veterinarians interested in zoological medicine first got together during an annual meeting of the American Veterinary Medical Association. In 1960, they formed the American Association of Zoo Veterinarians (AAZV). Prior to that (1951), the Wildlife Disease Association (WDA) had been established, and in 1979 veterinarians within the same association founded the American Association of Wildlife Veterinarians (AAWV). Numerous student zoo, wildlife, and exotic animal medicine organisations have rapidly proliferated across the globe (for a list of student clubs visit the Student Center section of the AAZV website [www.aazv.org]). Fowler (9) provides an excellent review of the history of zoo and wildlife medicine.

The first recorded case of providing medical attention for captive animals was at London Zoo in 1865 (13). The first book describing the findings of over 6,000 necropsies of captive mammals and birds performed at Philadelphia Zoo was published in 1923 (11). Prior to 1960, however, formal zoological and wildlife medicine education was practically non-existent. Zoological and wildlife medicine courses were not offered in veterinary colleges and most veterinarians in the field were self-taught or held an advanced degree in Ecology or Wildlife Management. Since then, the fields of zoological and wildlife medicine have been developed enormously.

Today, zoological medicine and wildlife medicine are included in some way in the curriculum of most veterinary colleges in Canada and the United States of America (USA) (8). While only a few veterinary schools in the USA have developed curricula to provide didactic and clinical

training in zoological medicine, many schools give students opportunities to participate in externships at zoos or other facilities offering clinical experience during the summer. Student interest groups develop and sponsor symposia or invite guest lecturers to share information.

Most zoo and wildlife positions in North America require specialised training (through a residency or PhD programme) and may require board certification by the American College of Zoological Medicine (ACZM). Many European countries have a long history of teaching zoological and wildlife medicine. The veterinary curricula in many so-called developing countries have expanded to create courses, internships, specialist diplomas and even departments in zoological and wildlife medicine.

Defining zoological medicine

The field of zoological medicine has seen an expansive broadening and it now includes the study of free-ranging wildlife, conservation medicine, and ecosystem health (see Aguirre and Gomez in this volume). The ACZM states that 'zoological medicine integrates veterinary medicine and the principles of ecology and conservation as applied in both natural and artificial environments' (19). In the veterinary colleges of the USA and Canada several advances have been made in expanding veterinary curricula to deliver the basic key knowledge and skills necessary for the health care of non-domestic or non-traditional species. The broadly comparative and health-maintenance basis of zoological medicine greatly increases the potential for veterinary medicine to make important contributions to the concept of the integrated health of the planet. Emergence of key zoonotic and production-animal diseases derived from and within wildlife populations has increased awareness worldwide of the importance of zoological medicine in protecting both livestock and public health (1). However, these areas are addressed in elective and selective curricular activities, they are not usually part of the core curricula (18).

A recent survey revealed that training received in veterinary colleges in North America inadequately prepared students to succeed as wildlife veterinarians and that additional formal training beyond the veterinary degree is important for success (16). During their annual meeting in 1992, the AAWV and the WDA held a workshop to identify the role of veterinarians in wildlife health and conservation biology and to determine the education they needed (5). It was concluded that the veterinary curriculum is too stringent and inflexible to provide sufficient training to work as a wildlife veterinarian or be effective in the conservation of biodiversity. Therefore, further training in zoology, conservation biology, ecology or a related field in the form of an advanced graduate degree or specialty residency was

required if students were to be effective zoo and wildlife veterinarians.

In Brazil, zoological and wildlife medicine has experienced exceptional development over the last 20 years. The Brazilian Association of Wild Animal Veterinarians (ABRAVAS: *Associação Brasileira de Veterinários de Animais Selvagens*) was established in 1991 at the 24th World Veterinary Congress. Today, zoological and wildlife medicine is one of the most popular disciplines among veterinary students belonging to the more than 100 veterinary colleges in that country. Specific information on the biology and medicine of South American wildlife was published recently in an excellent book compiled by Fowler and Cubas (10). Last year, a compendium on zoological and wildlife medicine was published in Portuguese setting up the standards of zoological medicine in a Latin American country (7).

Zoological and wildlife medicine in the veterinary curricula worldwide

Stoskoft *et al.* (19) conducted a survey reviewing the current status of 31 North American veterinary colleges and found that 21 (68%) had incorporated educational opportunities in zoological medicine within the required curricula. The same authors recommended to the American Veterinary Medical Association that all veterinary schools be expected to enable students intending to work in small animal medicine to gain clinical competency with birds, reptiles, small mammals and fish. In terms of knowledge of zoological medicine, the authors recommended that as a minimum schools should teach clinical skills, comparative anatomy, physiology and behaviour. The curriculum should address the huge diversity of wild animals, from amphibians to marine mammals and from insects to fish seen in a zoo, aquarium, game park or veterinary practice. An understanding of local and global implications of infectious disease emergence and zoonoses and the concepts of population and preventive medicine as they relate to zoological medicine is also essential. A key understanding is that health connects all species and that veterinarians have an important role to play in working on the interactions of wildlife health, human health and ecosystem health. In addition, training linked to veterinary ethics and to the science of animal welfare as it applies to the zoo and wildlife field may be required (1, 6, 18).

Zoological medicine and wildlife medicine are now such specialised fields that to become a zoo veterinarian (a generalist) requires focused training to obtain the knowledge needed to work in these areas. The type of

training undergraduates choose will depend upon the interests of the student and the time and energy they have to take elective and selective courses in amphibian, avian, reptile, aquarium/fish and zoo and laboratory animal medicine. Other areas in which students could take elective or selective courses include marine mammal medicine, population management, zoonotic diseases, environmental health, epidemiology, game farming, primate medicine and ecosystem health/conservation medicine. A general course in ethology can be incorporated into the first or second year of the curricula together with a zoo husbandry course. More advanced courses can easily be incorporated into the veterinary curriculum during the third and fourth year of the undergraduate course or can be pursued as summer internships and externships in zoological gardens, aquaria and game parks. Schools should provide sufficient time for students to take advantage of external rotations that complement the resources of their programmes (19).

In the author's experience, two disciplines 'dreaded' by many if not most veterinary students are pathology and epidemiology. However, it is perhaps these two areas of specialisation that have become the most important contributing fields to the development of a solid zoo and wildlife veterinary field. A strong background in these two disciplines can provide the graduate with unique opportunities to study zoo and wildlife populations. Specialised associations have been formed to fulfil the need for specialised training, for example, the Association of Amphibian and Reptilian Veterinarians and the American Association of Avian Veterinarians.

The European Association of Zoo and Wildlife Veterinarians was formally established in 1996. In Europe, current educational opportunities in zoological and wildlife medicine vary widely. The need to establish agreed standards in education across Europe and to foster the mobility of students and teaching staff is reflected by international agreements. Education opportunities to specialise in zoological and wildlife medicine are currently available in Europe, and these opportunities are likely to increase in the future (12).

Perhaps the biggest challenge for veterinary colleges is adapting their curricula to local needs while at the same time providing a competitive global education. Many countries in the developing world have imitated the curricula from countries like the USA or the United Kingdom and made the mistake of emphasising individual medicine instead of herd management and population health. For example, Sherman (17) describes several examples in African countries, identifying the need for effective national disease control and an increase in educational opportunities in epidemiology, zoonotic disease control and wildlife medicine for veterinary students.

Opportunities and challenges for veterinary students

The ACZM has established a residency and internship programme for veterinary graduates. As of September 2008 there were 17 approved residencies and 15 approved internship programmes in zoological medicine in North America. In addition, 8 non-approved residencies provide training opportunities in this field. The recently recognised European College of Zoological Medicine is providing board certification for their veterinarians (12). Although the number of opportunities for individuals is growing, the current number of training programmes is inadequate to meet demand. Also, there are increasing numbers of veterinary students entering veterinary schools with an interest in zoological and wildlife medicine but the job market is still extremely limited for the moment. As in many fields, positions and opportunities in zoological and wildlife medicine are available only for a few selected graduates (6). However, the wildlife medicine field has radically changed in the past 20 years in North America and there is likely to be an increase in the number of positions available for wildlife and zoo animal specialists. During the 1970s only a few natural resource and fish and game agencies in the states of California, Colorado, Florida, Georgia, Wisconsin and New York had a full-time wildlife veterinarian or wildlife pathologist on their staff. As of 2008, 23 of 50 (46%) states have hired state government wildlife veterinarians through their fish and game agencies. If the trend continues, within the next 10 years all states and provinces in North America will have a full-time veterinarian on their staff.

This increase in opportunities correlates to the increase in emerging infectious diseases (EIDs) in wildlife and their potential spillover to domestic animals and humans. EIDs are a major threat to global health and they include diseases that have caused mortality on a global scale (e.g. human immunodeficiency virus, bovine spongiform encephalopathy, foot and mouth disease), and others that threaten global health because there are no available vaccines or therapies (e.g. severe acute respiratory syndrome [SARS], Ebola virus and Nipah virus infections). EIDs also devastate economies: it is estimated that the single global outbreak of SARS cost between US\$50 billion and US\$100 billion, and the economic impact of the avian influenza pandemic is reaching US\$300 billion. Their impact on developing countries is especially severe, where vaccine coverage and availability of new drugs is lowest, and where governments are swamped with other priorities. Emerging diseases seem to spring from nowhere, with each year bringing new threats to our health and welfare. Most

EIDs emerge from animals (zoonoses), with the highest-impact pathogens 'spilling-over' from wildlife into people with remarkable regularity. The causes of zoonotic disease emergence are a series of environmental, socio-economic, and ecological changes that provide new pathways for pathogens to move into human populations. For example, SARS emerged through the trade in wildlife in China in 2003 (15). The inclusion of zoo and wildlife veterinarians in global transdisciplinary teams is indispensable in addressing these threats.

As stated earlier, it is only recently that employment opportunities for well-qualified graduates in the field of zoological and wildlife medicine have begun to expand globally. Two years ago, the Food and Agriculture Organization of the United Nations realised that there was a need to hire a full-time wildlife veterinarian to deal with H5N1 highly pathogenic avian influenza. The World Health Organization, the Centers for Disease Control in the USA, the United Nations Development Programme and other governmental agencies are following this trend. Also, opportunities exist within non-governmental organisations such as the Wildlife Trust, the Wildlife Conservation Society, and the World Wildlife Fund, among others. However, the success of new graduates correlates to the postgraduate education they have pursued, the mentoring they have received from experienced veterinarians, the types of courses they have taken within the veterinary curricula and the externships, internships and clinical rotations that they have undertaken (16).

Transdisciplinarity in zoological and wildlife medicine

The converging global challenges of climate change, biodiversity loss, emerging infectious diseases, wildlife conservation and sustainability are requiring novel and effective approaches and solutions. The complexity of these challenges is such that teams of experts are needed to adequately address the issues. Transdisciplinary (TD) thinking brings together academic experts, field practitioners, community members, research scientists, political leaders, and business owners, among others. They come together to solve some of the pressing problems facing the world, from the local to the global, in areas such as sustainability, social science, ecology, ecosystem health and animal health. Assessment, intervention, and evaluation are carried out jointly and that is when the input of wildlife veterinarians is essential. We need to instil and continuously activate TD thinking in the zoo and wildlife veterinary curricula and go beyond wildlife conservation and sustainability (4).

Sorta situ: linking zoo and wildlife populations

Veterinary participation is required in *ex situ* propagation programmes, reintroduction programmes and *in situ* conservation efforts (14). Zoo and wildlife veterinarians play an evolving role in regional, national and global management plans. Veterinarians serve as advisers, collecting and collating information regarding the medical issues of a species or taxa and making recommendations. With the increasing threat of EIDs, veterinarians have more pressing responsibilities in both *ex situ* and *in situ* programmes. Baseline health information is not always available for many wildlife populations (3); however, in the absence of precise information for wild animals veterinarians working with captive populations can contribute to the collection of information that is essential when developing species management in the wild.

Using data on captive populations to build a picture of the missing information and help develop plans for the management of wildlife populations has been termed a '*sorta situ*' approach. Aguirre and Pearl (2) developed this term from the English 'sort of' (meaning somewhat, rather, in between). As habitat becomes more compressed, with migration routes cut off, small species gene pools are stranded in isolated, habitat fragments. The result is that wildlife is more vulnerable than ever to the possibility that a new disease could wipe out a local population. The health problems observed in free-ranging wildlife today resemble those seen in captive wildlife. Species are now vulnerable to encroachment, malnutrition, environmental pollutants, and epidemics from domestic animals and humans. Furthermore, the continuous degradation of ecosystems is leading to increased stress, immunosuppression and, therefore, greater susceptibility to disease. Zoo and wildlife veterinarians are becoming 'megazoo' veterinarians (1, 2). The need for veterinary training in this '*sorta situ*' approach is essential for dealing with the current health problems of the planet.

Conclusion

The field of zoological and wildlife medicine has become highly specialised and requires appropriate training. Due to current environmental threats linked to anthropogenic change it is important that the veterinary curriculum includes several subjects related to wildlife and zoo animals, including conservation biology, zoology, animal behaviour, physiology and conservation medicine. In addition, veterinarians should be encouraged to form transdisciplinary teams to solve current issues. We must minimise the threat of any potentially catastrophic disease

outbreaks resulting from our own changes to the environment. Veterinary students should also be exposed to the current and future diagnostic molecular techniques that offer new opportunities to identify tools for the management and possible treatment of diseases in endangered species and ecosystems. The wildlife disease

problems seen today are most likely linked to human activities and thus resemble those found in captive zoo populations. Perhaps the new generations can avoid becoming 'megazoo' veterinarians. ■

Les fondamentaux de l'enseignement vétérinaire dans les domaines de la médecine zoologique et faunique : une perspective mondiale

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Résumé

La médecine zoologique et la médecine faunique sont des domaines qui requièrent un haut niveau de spécialisation et de formation. En raison des menaces que les modifications anthropiques (fragmentation de l'habitat, changement climatique, mondialisation des échanges d'animaux sauvages et des maladies infectieuses émergentes) font actuellement peser sur l'environnement, les étudiants vétérinaires désireux de se spécialiser dans la médecine zoologique et faunique doivent préalablement acquérir des connaissances solides et approfondies dans de nombreuses matières, dont la biologie de la conservation, la zoologie, l'éthologie, la physiologie et la médecine environnementale. Les futurs vétérinaires doivent également avoir la possibilité de s'exercer à l'utilisation sur le terrain et au laboratoire des différents outils permettant de gérer et de traiter les maladies qui affectent les populations animales sauvages ou captives ainsi que les écosystèmes, en participant à des activités de conservation aussi bien sur site que hors site.

Mots-clés

Conservation hors site – Conservation sur site – Maladie infectieuse émergente – Médecine faunique – Médecine zoologique – Pluridisciplinarité. ■

Perspectiva mundial de la formación veterinaria básica sobre medicina zoológica y de la fauna salvaje

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Resumen

La práctica de la medicina zoológica y de la fauna salvaje requiere un alto grado de especialización y capacitación. Para poder ejercerlas y enfrentar correctamente las amenazas medioambientales contemporáneas inducidas por los seres humanos – que comprenden la fragmentación del hábitat, el cambio climático, el comercio mundial de animales salvajes y las enfermedades infecciosas emergentes –, los estudiantes de veterinaria deben recibir una

amplia y sólida formación sobre distintas esferas, como la biología de la conservación, la zoología, el comportamiento, la fisiología y la medicina de la conservación. También deben tener la oportunidad de descubrir las nuevas técnicas de campo y laboratorio para combatir y – de ser posible – tratar las enfermedades, tanto de las poblaciones en cautividad, como salvajes, y de los ecosistemas mediante métodos de conservación *in situ* y *ex situ*.

Palabras clave

Conservación ex situ – Conservación in situ – Disciplina transversal – Enfermedad infecciosa emergente – Medicina de la fauna salvaje – Medicina zoológica.

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