Academic Veterinary Medicine and One Health Education: It Is More than Clinical Applications

Michael Chaddock

INTRODUCTION

The concept of One Health represents a unique and significant opportunity for veterinary medicine to be in a leadership role and to work collaboratively for ecosystem health (a community of humans, animals, and plants interacting with one another and with their physical environment) for the greater good of society. Of the 1,461 diseases now recognized as affecting humans, approximately 60% are due to multi-host pathogens characterized by movement across species lines;[1] and over the last three decades, approximately 75% of new emerging human infectious diseases have been zoonotic.[1]

An integrated approach is the key to promoting One Health, and this approach is best developed by ensuring that veterinarians are extensively involved in collaborative teams, particularly, in leadership roles. The concept of One Health is not new. In the nineteenth century, the German physician and pathologist Robert Virchow stated, "between animal and human medicine there is no dividing line, nor should there be. The object is different, but the experience obtained constitutes the basis of all medicine."[2(p.5–19)] William Osler, a Canadian physician and a founding member of the Johns Hopkins Hospital faculty, was the first to use the term *One Medicine* in the English language literature.[3] One Health perhaps enjoyed stronger endorsement and support in the past, before the advent in the last century of the trend toward specialization and separation of disciplines, education, strategies, and professions within human medicine, veterinary medicine, wildlife diseases, ecology, and environmental health. In the current context of emerging diseases, the resulting separation is counterproductive at many levels. In April 2007, the Association of Schools of Public Health and the Association of American Veterinary Medical Colleges hosted a joint symposium, "Partnerships for Preparedness, Future Directions for Schools of Public health and Colleges of Veterinary Medicine," on veterinary public health, which was attended by more than 240 participants and represented an important step in collaboration between academic public health and veterinary medicine. In reviewing the presentations from this symposium, published in the journals of both organizations (*Public Health Reports*[4] and *Journal of Veterinary Medical Education*),[5] the presentations "affirmed the need [for veterinary and human medicine] to work together more closely to more effectively address both human and animal issues. . . ."[5(p.147)] This need has never been greater than it is today. Not only must the two health professions work more closely together, but the training of the next generation of veterinarians and physicians must include knowledge of ecosystem health and an understanding of the intricate and sometimes delicate relationship between animals, humans, and the environment. In addition, leadership training for veterinarians and physicians is needed to prepare both professions for greater roles in influencing policy development and fulfilling the needs of society.

WHAT IS ONE HEALTH?

In a conversation with a colleague from the Faculty of Veterinary Medicine, University of Calgary,[6] it was emphasized that it is important not to get bogged down in trying to develop a single definition of One Health. It is more important to "just do" One Health.[6] Many have suggested other names for One Health, such as Integrated Health, One Medicine, and One World-One Medicine-One-Health. Regardless of the name and definition of One Health, the concept should be a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals, and the environment, with improved cooperation between physicians and veterinarians. One Health is a cultural and behavioral concept, not a regulated activity. Most definitions imply multi-sectoral cooperation with collaborative efforts across disciplines working locally, nationally, and globally to obtain optimal health for humans, animals, and the environment.

ONE HEALTH EDUCATION

Education plays a particularly important role in realizing the One Health concept. Despite unanimous acknowledgment that the environment plays a vital role in human and animal health, neither physicians or veterinarians receive ecosystem training and environmental health training.[7] The 2011 North American Veterinary Medical Education Consortium (NAVMEC) report[8(p.322)] identifies One Health as a core competency of all graduating veterinarians. Also lacking in the curricula of many veterinary and human medical schools and colleges are required courses in leadership, which the NAVMEC report defines as the ability to take direct action and influence others to take action; the NAVMEC report lists these types of courses as a core professional competency of all graduating veterinarians.[8(p.323)]

Although some progress has been made, the separation of human-health and animal-health education and training systems is still difficult to bridge. Health professionals in human medicine continue to be educated and trained at profession-centric academic institutions with seemingly little appreciation for the integration, coordination, and collaboration or cross-fertilization of ideas and information among disciplines, in particular, disciplines beyond their own professions. There is little teaching on zoonotic infections arising from wild animals, disease

 doi:10.3138/jvme.0612-062

ecology, or transmission of infections from pet animals to humans, which would be best taught in an integrated way to medical and veterinary students.[1] In addition, those core professional competencies that extend beyond the teaching of medicine alone—such as communication, collaboration, management, scholarship and the value of research, leadership, diversity and multicultural awareness, and how to adapt to changing environments—should also be integrated into the veterinary and medical curricula. The disciplines of veterinary pathology and human pathology are operationally separated despite obvious benefits that would accrue from an integrated approach to cancer biology, genetic diseases, and the pathogenesis of infectious diseases. These educational deficiencies, in addition to a shortage of collaborative student programs among the health professions, insufficient ecosystem training, and environmental health training for health professionals and lack of institutional support, impede progress in providing the integrated preventive and primary health care that society deserves. Graduate education in medicine, environmental sciences, and veterinary medicine can offer unique opportunities to promote the One Health paradigm by cultivating interdisciplinary thinking and fostering collaborations early in the careers of veterinarians, physicians, and environmental scientists. Education in each discipline should develop collaborations among relevant fields; this maximizes the knowledge base while minimizing the resources used for individual education, and limits the demands of core course requirements on students. By exposing students to relevant information from each discipline, professionals will know why, how, and when to access experts and resources from another field in response to a particular health issue.

The value of developing and cultivating diverse, interdisciplinary ecosystem-professional relationships, and maintaining them throughout a career, should not be underestimated. The following are suggestions for how educators and practitioners might collaborate:

- Look for opportunities for a team approach of interdisciplinary faculty to collaborate and teach in the curricula of ecosystems, human medicine, and veterinary medicine.
- Collaborate and co-locate researchers in ecosystem health including, but not limited to, human medicine, dentistry, veterinary medicine, nursing, and environmental health. Strengthen research agendas and share laboratories such as infectious diseases, stem cell research, and ecosystem health.
- Integrate One Health concepts with the food-animal or food system department in academic veterinary medicine to include, but not limit to, pasture management, waterways, environmental contaminations, and land use options.
- Consider prominently displaying the words *ecosystem* and *public health* along with *veterinary medicine* when naming a One Health entity on campus. Consider including the following types of faculty, educators, or researchers in One Health:
    - Veterinarians
    - Physicians
    - Anthropologists
    - Wild-life biologists
    - Ecosystem professionals
    - Environmental health professionals
    - Public health professionals
    - Economists
    - Ethicists
    - Social scientists
- Consider integrating veterinary, medical, and ecosystem and environmental science students via common coursework, thereby encouraging interdisciplinary interactions and exchanges. Courses that could enable this collaboration include global health, public health, ecosystem and environmental health, pathology, microbiology, physiology, leadership and ethics, and the study of emerging infectious diseases.
- Utilize web-based collaboration and education and distance learning, which could enhance the offerings of supplemental courses while limiting the strain on existing curricula.
- Consider developing a summer elective "One Health Institute" workshop that would bring together students with equal disciplinary representation and include lecture, problem-based, and hands-on learning.
- Analyze cases from a leadership and ethical perspective in the One Health educational experience.
- Consider establishing virtual continuing education in One Health, offered as a certificate or graduate program. This will enhance the understanding of One Health and develop and increase capacity to respond to emerging and reemerging public health threats. This provides an opportunity for the college to collaborate and partner with state veterinary medical associations by reaching out to the community and providing research and applied information. This adds value to veterinary medical education and the state's economy, and is within the mission of the college and university.
- Consider establishing a center of excellence in One Health education through enhanced collaboration among colleges and schools of veterinary medicine, human medicine, public health, ecosystem and environmental health, and business colleges and leadership institutes. Centers of excellence are authorized in the Food, Conservation, and Energy Act of 2008[9]; however, congress has not appropriated funds yet, nor has the USDA moved forward with specific plans for implementing the program.

Co-locating basic science researchers in veterinary medicine, human medicine, and environmental and ecosystem health provides an additional benefit in that their collaborations and partnerships increase the chances of obtaining research grants.

The 2012 National Research Council Report[10] found little evidence of workforce shortages in most fields of veterinary medicine and noted that some veterinary

colleges have increased enrollment and that the American Veterinary Medical Association has accredited additional schools or colleges of veterinary medicine. The report warns that companion-animal veterinary medicine has come to dominate the curriculum and resources of veterinary schools, sometimes to the detriment of other fields of veterinary medicine. A new paradigm for veterinary medical education will be necessary, requiring courage and effort on the part of the profession's leaders to spearhead an interdisciplinary approach to understanding the health effects of mismanaged ecosystems and to acknowledge the relationships among the environment, as well as the health of wildlife, domestic animals, and humans. Unless the accrediting bodies and the licensing examinations emphasize some of the key concepts related to ecosystem health, the knowledge and application of One Health concepts for veterinary medical students may remain a mystery.

ONE HEALTH AND LEADERSHIP

Veterinarians are well grounded in population health, comparative medicine, and preventive medicine and should be the leaders in One Health, thereby influencing other health professions on the benefits of a One Health education for tomorrow's health professionals. Leadership is learned and if society looks to veterinarians as the leaders in developing and advocating for One Health concepts, it is imperative that veterinary students be scholars in leadership concepts and applied education. Leadership curriculum for One Health can be characterized by three primary themes: leading teams and organizations, tools for leadership, and looking to the future. Leadership skills and ethical considerations and actions are fundamental to the One Health vision and implementation. Part of developing leadership skills is understanding public policy development and the political processes and how to develop and nurture relationships and networks to influence decisions by policy makers in order to accomplish One Health concept outcomes. Among the many components of leadership that veterinarians need to be knowledgeable and skilled in to be most effective and influential are:

- effective communications;
- risk analysis, assessment, and management;
- quandaries of leadership (i.e., ethical and moral issues);
- leading and building teams;
- establishing and maintaining trust;
- creating, changing, and understanding cultures;
- leading and managing change;
- sense of urgency;
- managing in a crisis;
- scenario planning and anticipating the future;
- leading in an international context;
- decision making;
- negotiations;
- power and influence;
- leading and managing in a multicultural world; and
- trust and community building (i.e., developing human social capital).

ONE HEALTH AND FOOD SAFETY

With the ever growing global population it is vital to provide safe and adequate food and water. The movement of people, animals, and agricultural products can quickly spread disease pathogens around the world.[11] Globalization of the food supply has spread livestock and agricultural crop diseases into previously unaffected areas.[11] Several emerging infectious zoonotic diseases threaten the safety of our food supply and the control of these diseases requires the collaborative efforts of various health workers.[11] Veterinarians and public health and human health professionals must use the One Health concept and be continually involved in a collaborative effort in the trace-back and control of food-borne illnesses. The spread of food-borne zoonotic disease is attributed to intensified food production to meet increased consumer demands for fresh produce, centralized food processing followed by widespread distribution, and expanding markets for regional and ethnic foods resulting in global trade expansion with the potential for introduction of food-borne diseases into new geographic areas. The US Centers for Disease Control and Prevention estimate the number of foodborne illnesses at 48 million each year in the United States with 128,000 of those cases requiring hospitalization and over 3,000 resulting in death.[10] Cooperation and collaboration between the veterinary and medical professions along with food-animal and crop producers must be strengthened to combat these and other emerging threats to the world's food supply. The need for this stronger relationship between veterinarians, producers, and other health professionals was reinforced by the passage of the 2010 Food Safety Modernization Act,[12] which expands the inspection power of the Food and Drug Administration over farms and increases the need for improved hygiene on the farm with the aim to ensure that the US food supply is safe by shifting the focus from responding to contamination to preventing contamination.

ONE HEALTH, ECOSYSTEM SERVICES, AND ECONOMICS

Ecological systems perform fundamental life-support services upon which human civilization and animal life depend, and therefore represent part of the total economic value of the planet. Many of these services are performed seemingly for free, yet are worth trillions of dollars. The economies of the earth would grind to a halt without the services of ecological life-support systems; in one sense, their total value to the economy is infinite. For the entire biosphere, the ecosystems value is estimated to be in the range of $16–54 trillion per year, with an average of $33 trillion per year.[13] As ecosystem services become more stressed and scarce in the future, their value can only be expected to increase. Examples of ecosystem services include wetlands that provide natural flood protection services to the Mississippi River Valley, natural medicinal products relied upon by 80% of the world's popula-

tion, the 100,000 different animal species that provide pollination services, and biological control of populations of certain animal species by natural predators.[14] Ecosystem services are severely threatened every day by human activities through growth in the scale of human enterprise (population size, per-capita consumption, and effects of technologies used to produce goods for consumption) and by a mismatch between short-term needs and long-term societal well-being. Economists are essential partners in the One Health education of students, providing them with the knowledge needed in training, research, and policy development, along with assisting in understanding the drivers of risk. Economists evaluate and show some of the financial value of the services provided from ecosystems. Economists can also provide economic data and information to help build a business case for educating students about One Health and demonstrating the economic benefits of a One Health approach. Calculating the associated dollar value of ecological services and developing cost-benefit scenarios for One Health applications are compelling strategies that can demonstrate One Health's importance to both the public and private sector administrators and public policy makers. Economists can also provide expertise in developing business plans as background information and, in partnership with communications experts, approach public policy makers and potential donors for resources to develop and maintain integrated and collaborative One Health programs on campuses.

ECOSYSTEMS AND ENVIRONMENTAL HEALTH

Environmental health is the ability of an ecosystem to cope with human induced change; it is not the sole objective of conservation, but a concept emphasizing balance among social, ethical, aesthetic, and biological goals. One of the most important indicators of the health or integrity of an ecosystem and its components is the health of indigenous wild or domestic animals. Veterinarians can make important contributions to procedures established to manage ecosystem health. They have the responsibility and expertise to assess disease in the interest of the animal and in the context of the ecosystem within which it exists.

Pollution and contamination of our environment has greatly reduced its health and sustainability. Such degradation of the environment will continue to create favorable settings for the expansion of existing infectious diseases, as well as increase the number of acute and chronic non-infectious disease events detrimental to both human and animal health.[1] Non-infectious threats also include toxins and chemical contaminants such as endocrine-disrupting chemicals in the environment. A study by the World Health Organization determined that an estimated 24% of the global burden of disease and 23% of all global deaths can be attributed to environmental factors.[7] This underscores the importance of the environment and its influences in all aspects of the relationship between human and animal health.

GLOBAL ONE HEALTH

An education around One Health is not complete without an understanding and study of global One Health. In today's world, health events in one nation or geographic area often have repercussions for the health and well-being of populations beyond that region. Global environmental changes, population growth, and increasing international trade have resulted in expansive and rapid movement of people, pathogens, animal (companion, livestock, and wildlife) products, and produce worldwide. Concern about emerging infectious diseases, water toxicity due to pathogens, pesticides and chemicals, and multi-drug resistant diseases have contributed to an increasing appreciation of the interdependency of human, animal, and ecosystem health worldwide.[15] To address One Health in a global context, there must be an understanding of the culture, governance, and history of developing countries. The study and understanding of veterinary medical and human medical students of integrated global approaches to reduce human suffering and improve the health of humans, animals, their shared environments, and the understanding and acceptance of multicultural differences are proving to be in the best interest of all countries and contribute to political stability and security.

ONE HEALTH RESEARCH

Defined One Health collaborative programs, which include schools of veterinary and human medicine and allied health professions, should include a robust research agenda to develop tomorrow's knowledge for education and applied applications that benefit society. Researchers in the health professions in colleges or schools should co-locate and collaborate with each other and include, but not be limited to, researchers from the fields of economics, agriculture, ecosystem and environmental health, wildlife, leadership, and ethics. This interdisciplinary approach to research should also increase the receipt of grant money.

COMMUNICATING THE BENEFITS OF ONE HEALTH

One Health education and research programs, including success stories and examples of how One Health concepts have provided healthier lives for animals, humans, and the environment, should be showcased and marketed to a wide range of audiences through universities' communications infrastructure and expertise. This may include a centralized online portal for One Health success stories where past and ongoing One Health information can be accessed, which can serve as a neutral portal in which partnering and collaborating universities share their One Health related programs and information. This type of information, disseminated through communications initiatives, will demonstrate that the use of One Health interventions lead to better cross-species and ecosystem health outcomes than comparable health care systems not using One Health concepts.

BARRIERS AND THREATS TO A ONE HEALTH CONCEPT AND PROGRAM

Limited time, disciplinary inertia, and lack of funding will pose the most serious obstacles to the integration of One Health into education.[7] Other important barriers that will discourage participation in the One Health education include

- a shortage of One Health practitioners;
- liability risk for professionals acting in an unfamiliar field;

- reluctance to collaborate with bureaucratic federal agencies;
- administrators at the highest level not committed to a systemic integrated collaborative approach;
- health professionals working within their own professional silos;
- adversity to change;
- philosophical differences;
- project scope;
- duplication of effort;
- legal barriers for the sharing of data.

An initial One Health team of individuals trained in leadership should help overcome these obstacles.

ONE HEALTH SUCCESSES: THREE TO FIVE YEARS

It is important that the One Health education and research programs experience short-term wins within the first three years of existence for these successes to be shared with the public. These success stories build upon themselves and over time yield ever-changing ambitious long-term goals that result in improved health and welfare of humans, animals, and the environment. Among the goals for One Health education and research programs to consider are

- increased capacity of One Health trained veterinarians, physicians, and ecosystem specialists;
- One Health research projects in progress with metrics developed for measuring success and assessing outcomes. A culture of mutual respect, trust, and open communications across health professions and environmental specialists;
- increased visibility and recognition by the public of the increased value-added benefit of ecosystem health;
- increased recognition of the benefits to humans, animals, and the environment of One Health concepts by the public policy makers which may yield increased public funding of One Health programs; and
- collaborative and coordinated responses by animal health, human health, and environmental health experts for disease surveillance programs, epidemiological investigations to outbreaks, treatment plans, and data sharing.

CONCLUSION

Veterinary medicine, and specifically academic veterinary medicine, has a tremendous opportunity and responsibility to educate students of veterinary medicine, human medicine, and environmental health. This education should include One Health concepts, applied applications, and benefits to society. Veterinary medicine is the only profession that is educated in comparative medicine and understands the relationships between species. In the *New York Times*, Barbara Natterson-Horowitz, a cardiology professor at the University of California, Los Angeles (UCLA), said the following:

> Most physicians see animals and their illnesses as somehow 'different.' Humans have their diseases. Animals have theirs. The human medical establishment has an undeniable, though unspoken, bias against veterinary medicine.... My medical education included stern warnings against the tantalizing pull to anthropomorphize.... But scientific advancements of the past two decades suggest that we should adopt an updated perspective. Seeing too much of ourselves in other animals might not be the problem we think it is. Underappreciating our own animal natures may be the greater limitation.[16(p.SR1)]

In order for veterinarians to be successful in meeting this opportunity and responsibility, they must be able to get extraordinary things done in organizations and be able to transform values into action, visions into realities, obstacles into innovations, separateness into solidarity, and risks into rewards.[17] In other words, they must learn how to be leaders.

REFERENCES

1 One Health: A new professional imperative [Internet]. American Veterinary Medical Association, One Health Initiative Task Force: Final Report; 2008. [cited 20 Jun 2012]. Available from: http://www.avma.org/onehealth/onehealth_final.pdf.

2 Kahn LH, Kaplan B, Steele JH. Confronting zoonoses through closer collaboration between medicine and veterinary medicine (as 'one medicine'). Vet Ital. 2007;43(1):5–19. Medline:20411497

3 Cardiff RD, Ward JM, Barthold SW. 'One medicine—one pathology': are veterinary and human pathology prepared? Lab Invest. 2008;88(1):18–26. http://dx.doi.org/10.1038/labinvest.3700695. Medline:18040269

4 Veterinary Public Health. A joint publication with the Journal of Veterinary Medical Education. Public Health Rep. 2008;123(3): 257-414.

5 Veterinary public health [Issue theme]. J Vet Med Educ. 2008;35(2); 145-324.

6 Buntain, B. (Faculty of Veterinary Medicine, University of Calgary). Oral communication. 2012 Apr 26.

7 Barrett MA, Bouley TA, Stoertz AH, et al. Integrating a One Health approach in education to address global health and sustainability challenges. Front Ecol Environ. 2011;9(4):239–45. http://dx.doi.org/10.1890/090159.

8 Roadmap for veterinary medical education in the 21st Century: responsive, collaborative, flexible [Issue theme]. J Vet Med Educ. 2011, 38(4); 319-416.

9 Food, Conservation, and Energy Act of 2008. Pub. L. No. 110–234, 5925i Stat. 923 (May 22, 2008).

10 National Research Council of the National Academies. Workforce Needs in Veterinary Medicine; 2012. Washington: The Council; 2012.

11 Osburn B, Scott C, Gibbs P. One World—One Medicine—One Health: emerging veterinary challenges and opportunities, Rev. sci. tech. Off. Int. Epiz. 2009;28(2):481–6.

12 Food Safety Modernization Act of 2010. Pub. L. No. 111–353, Stat. 3885 (Nov 30, 2010).

13 Costanza R, d'Arge R, de Groot R, et al. The value of the world's ecosystem service and natural capital. Nature. 1997;387(6630):253–60. http://dx.doi.org/10.1038/387253a0.

14 Ecosystem services [Internet]. Ecological Society of America; 2000 [cited 2012 Jul 11]. Available from: http://www.esa.org/education_diversity/pdfDocs/ecosystemservices.pdf .

15 Conrad PA, Mazet JA, Clifford D, et al. Evolution of a transdisciplinary "One Medicine-One Health" approach to global health education at the University of California, Davis. Prev Vet Med. 2009;92(4):268–74. http://dx.doi.org/10.1016/j.prevetmed.2009.09.002. Medline:19819575

16 Natterson-Harowitz B, Bowers K. Our Animal Natures. New York Times. 2012 Jun 10; Sect. SR:1.

17 Kouzes J, Posner B. The Leadership Challenge. 3rd ed., 2002.

AUTHOR INFORMATION

Michael Chaddock, DVM, EML, is Deputy Director, Association of American Veterinary Colleges, 1101 Vermont Avenue NW, Suite 301, Washington, DC 20005–3536 USA. E-mail: mchaddock@aavmc.org.