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Survey on Veterinary Student Perceptions of One Health at St. George's University

Abstract

One Health is of critical importance to veterinary and medical education in the post-modern era, where both human and animal healths are increasingly impacted by zoonoses, environmental changes, and socioeconomic variables. It is vital to address the multiple facets of One Health at veterinary institutions, which may be neglected or misunderstood by students. This study, based in the Caribbean at St. George's University School of Veterinary Medicine, is a preliminary evaluation of student perceptions of One Health. Pre-and post-course written surveys were assessed from students completing One Health-related courses. Although precourse assessments showed agreement with provided One Health definitions, comparisons of pre- and post-course responses revealed statistically significant differences when the student's country of origin was considered (p<0.05). In addition, gender difference was observed, including more females agreeing that One Health is important to veterinarians (p=0.011). This and future studies have the capacity to provide relevant insight into the development of Interprofessional educational initiatives with a global perspective. This study also illuminates potential gender differences in One Health understanding which merit future study, particularly given the higher influx of females into the profession. Further, exploration of the overall lack of consideration of environmental and socioeconomic concerns in One Health is pertinent for future curricula design at this institution and could also have relevance at other veterinary institutions.

Keywords: One health; Veterinary; Medical education

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Abbreviations

SGUSVM: St. George's University School of Veterinary Medicine; CDC: Centres for Disease Control and Prevention; FDA: U.S. Food and Drug Administration; USDA-FSIS: U.S. Department of Agriculture Food Safety Inspection Service; USDA-APHIS: U.S. Department of Agriculture Animal and Plant Health Inspection Service; OIE: Office International des Epizooties; WHO: World Health Organization; MERS: Middle East Respiratory Syndrome coronavirus; MPH: Master of Public Health; DVM/MPH: Doctor of Veterinary Medicine/Master of Public Health; IPE: Inter-Professional Education

Introduction

The emergence of highly pathogenic zoonoses (diseases of animal origin transmissible to human) as pandemic severe acute respiratory syndrome (SARS), Nipah [1], influenza and

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Ebola viruses [2], are the impending concerns facing health professionals in the 21st century. These pathogens, along with agents listed by the U.S. Centers for Disease Control and Prevention (CDC) as potential civilian bioterrorism weapons, all zoonotic [1], have had catastrophic implications for global health and national economies [3]. There is increasing recognition that interdisciplinary collaboration between health professionals operating at the interface of human health, animal health and environmental health [4] is crucial to eliminating these global health issues. Efforts to foster interdisciplinary collaboration

require addressing gaps within the medical and veterinary curricula, which remain largely siloed within the domains of each discipline [5].

The recognition of this interdependence between health professionals is the basis for the broad advocacy of a One Health approach to practice by many organizations including the American Medical Association (AMA) and the American Veterinary Medical Association (AVMA) [6] that defines One Health as the combined effort of multiple health disciplines working nationally, and internationally to attain optimal health for humans, animals, and the environment. Despite the broad support that has been mobilized by many international agencies in support of One Health, the lack of integration between agencies responsible for animal, human and environmental health has led to a lack of operationalization of its approach [7].

Several studies have identified a lack of medical and veterinary student recognition of the need for Inter-professional collaboration to address issues impacting global health, and also a reluctance to engage in Inter-professional collaboration [8]. Damborg et al. [9], explained that physician's neglect to consider zoonoses on their differential diagnostic list for patients, which is exacerbated by the reluctance of both physicians and veterinarians to communicate on such issues. Marcotty et al. [10], identify two gaps requiring address to produce effective health outcomes: first, the recognition by medical students of the impact of zoonoses on human health; and second, an understanding of the role of human behavior in disease outbreaks by veterinary students. There is a need for a greater appreciation of environmental health by physicians [11] and veterinarians [12]. Schwind et al. [13], recommend that education is a necessary tool by which the interdisciplinary "capacity" (p.171) required to adopt a One Health approach, can be built.

The objectives of this study were to act as a preliminary study to determine the perceptions of veterinary students at our institution on the One Health approach to practice. Additionally, investigators sought to identify whether these perceptions were influenced by independent demographic variables (such as, gender, age, and citizenship) and educational background. Future implications are to consider the expansion of this study to ascertain the perceptions of medical and dual degree veterinary and medical students on our campus, on the importance of One Health to inform the development of Inter-Professional Education initiatives at the St. George's University campus.

Methodology

Materials

To examine the perceptions of veterinary students on the One Health approach, a survey was developed. The survey consisted of six sections: (1) demographic information (age, gender, and country of origin), veterinary background and interests, and future veterinary practice expected to enter; (2) familiarity with One Health and One Health-related agencies; (3) defining the One Health concept, including zoonoses, human and animal health, evidence-based medicine, interdisciplinary collaboration, and environmental roles; (4) defining the veterinarian's role in One Health, including perceived importance of One Health to veterinarians (along with other healthcare providers and disciplines); (5) exploring the importance of veterinary coursework in public health and epidemiology and client education; and (6) an open-ended question asking to define One Health. The survey was used as both the pre-course and post-course surveys and was the same in format and composition.

Methods

Surveys and informed consent forms were administered in paper format to participating term 4 St. George's University School of Veterinary Medicine (SGUSVM) students during spring term of 2015. Pre-course surveys were given in paper format before the commencement of the Veterinary Epidemiology and Veterinary Public Health courses in January 2015; post-course surveys were given upon completion of Veterinary Epidemiology and Veterinary Public Health in May 2015. Students developed an anonymous identification code for use in both the pre- and postcourse surveys to enable researchers to obtain paired responses. Students were given one week maximum after receipt to return surveys and consent forms to their class representative.

Ethics

A written survey and information consent form was developed, and approved by the St. George's University Institutional Research Board. The purpose of the survey and the students' role in the study was described in the information consent form that accompanied the survey. All participating students completed the consent form before conducting the survey.

Statistics

Survey data were analyzed using the Statistical Package for the Social Science (SPSS) version 21.a Descriptive statistics were provided for all variables. To assess differences in pre and post-responses chi-square analyses were conducted. Responses were analyzed to determine if there were any differences based on the student's country of origin and gender. Statistical significance was considered if $p \le 0.05$. There was one open-ended item where the student was asked to define the One Health concept. All statements were approximately one sentence and were reviewed for the inclusion of each of the four dimensions:

- 1. Human health
- 2. Animal health
- 3. Ecosystem health
- 4. Public health

Each dimension was scored as present or not present. Thematic analysis was used to evaluate the open-ended student responses to their description of the term One Health.

Results

Descriptive analysis

In total, 77 out of 90 term 4 SGUSVM students (86%) completed the pre-course questionnaires. Among those who completed

the pre-course questionnaire 32 students (41%) completed the post-course questionnaire. Twenty-nine out of 90 students (32%) completed both pre- and post-course questionnaires. The students ranged in age from 20 to 32 years with an average age of 25 years (std. dev.=±2.9 years), and the majority (25 out of 29 students, 86%) were female. Although most were from the United States of America, students from Jamaica and the United Kingdom were also represented. All students had small animal exposure as children. In addition, some had exposures to other species, notably exotic animals (69%) and avian species (38%). With respect to preveterinary or undergraduate animal experience, most (93%) had small animal experience. When asked about future career paths, 69% of students had a preference to enter small animal practice, 31% mixed practice, and 24% government or regulatory positions (Table 1). Only 2 (7%) of 29 students mentioned the environment in the pre-assessment; none of the students mentioned the environment in the post-assessment. With respect to the concept of public health, 4 (14%) of 29 students mentioned public health in the post-assessment. No students mentioned public health in the pre-assessment. Prior to entering the course, the majority of students agreed with the concepts defining One Health that were provided. Examining the familiarity with One Health terms and agencies, most students knew the term One Health; and all students knew pre- and post-course the term zoonoses. In addition, the majority of the students knew the acronyms for the CDC and FDA. However, there were some differences in the preand post-course responses for USDA-FSIS (43% and 100%), USDA-APHIS (71% and 100%), OIE (29% and 93%) and WHO (79% and 97%). The majority of students agreed with all the given roles and responsibilities of veterinarians in One Health in both pre-course (89%) and post-course (97%) responses. The majority of students indicated that both vector-borne diseases and food-borne diseases of animal origin were of importance for client education (vector-borne diseases: 89% and 97%, food-borne diseases 93% and 100%). Overall, there were differences in response to the importance of the veterinarian to be familiar with and educate clients about avian influenza (pre=86%, post=100%), West Nile virus (pre=82%, post=100%), Ebola (pre=68%, post=97%), Hanta virus (pre=39%, post=93%) and MERS (pre=39%, post=86%).

Pre-course assessment

When asked if infectious agents from animal reservoirs can be used as a bioweapon, there was a statistically significant difference in response between those from the U.S. and from other countries (p=0.005), with 44 (69.8%) of those from the U.S. agreeing with the statement compared with 4 (33.3%) from other countries. No statistically significant difference in response was found in the pre-course assessment.

Post-course assessment

There was a statistically significant difference between those students from the U.S. and elsewhere when asked if the intended to enter small animal practice (p=0.003), with 21 (84%) of those from the U.S. intending to enter small animal practice compared with 0 from the other countries. More females (96.0%) thought it was important for veterinarians to be familiar with the MERS compared with males, the difference being statistically significant

(p=0.004). At the post-course assessment, a statistically significant difference (p=0.036) was observed when asked to define the One Health concept between those who indicated that they were going to enter academic/research aspects of veterinary science and those who were not. Of those entering the academic/research aspects of veterinary practice, 1 (3.6%) indicated that the phrase "One Health" meant that there was collaboration between animal and human medicine working toward improvement of health on a global level. For those who answered no to entering academia/research, 21 (77.8%) indicated that the concept meant a collaboration of animal and human practitioners; 2 (7.4%) indicated that there was also collaboration with other sciences; while 4 (14.8%) stated that there was an integration of animal and human health, and the environment.

Analysis of data for students completing both pre and post-course assessment

For those completing both the pre- and post-course assessments, there was a statistically significant difference (p=0.03) in response to if they would enter small animal veterinary practice and those who did not when country of origin was considered. No statically significant difference was noted pre-course. At the pre-course assessment 19 (73.1%) of those from the U.S. stated that they would enter small animal practice compared with 1 (33.3%) from the other countries. After the course, 21 (84%) of those from the U.S. wanted to enter small animal practice compared with 0 (0.0%) from the other countries.

When asked if animals can act as sentinels of human diseases, 25 (92.6%) of those who agreed were females, the difference being statistically significant (p=0.003). All persons (29) agreed with the statement at the post course assessment. In the pre-course assessment, the majority of females agreed that climate change and habitat destruction has contributed to the emergence of current zoonoses (72% females compared with 0% males); as well as agents responsible for human food borne disease outbreaks originating in animal reservoirs (87.5% females compared with 50.0% males). The differences were statistically significant (p<0.05). This difference was not observed in the post-course assessment.

When country of origin was considered, 22 (88.0%) of those from the U.S. agreed that agents responsible for human food-borne disease outbreaks originating in animal reservoirs compared with 1 (33.3%) of those from the other countries at the pre-course assessment. The difference was statistically significant (p=0.023); and not observed in the post-course assessment. More persons from the US also agreed that infectious agents having animal reservoirs can be used as bioweapons, 15 (57.7%) compared with 1 (50.0%) from other countries in the pre-course assessment; the difference being statistically significant (p=0.042).

Females were more aware of the USDA-APHIS in the pre-course assessment compared with males, 19 (79.2%) compared with 1 (25%) respectively, the difference being statistically significant (p=0.0326). This difference was not observed post-course. Gender differences (p<0.001) were observed at the post-course assessment when students were asked if it was important that they be familiar with MERS as a veterinarian (96% females versus

25% males). This difference was not seen in the pre-course assessment. Significant differences were observed pre (p=0.047) and post-course (p=0.011) when students were asked if it was important for them as veterinarians to be familiar with Ebola.

There was a statistically significant difference (p<0.05) in the definition of the One Health concept during the pre-course assessment, when country was considered. This difference was not observed in the post-course assessment. In the pre-course assessment, a gender difference (p=0.011) was observed with more females (89.3%) compared with males (100%) thinking that one health was important to veterinarians. The majority of persons from the U.S. (92.6%) thought that the One Health concept was important to laboratory workers compared with 50% from the other countries.

Discussion

Animal health

The survey conducted established that veterinary students were already familiar with the One Health concept, before embarking on their courses in Veterinary Epidemiology and Veterinary Public Health. Suggesting prior knowledge gained from background courses in microbiology, parasitology and virology have been successfully integrated, enabling their familiarity with zoonotic agents impacting human health. Of the 29 students that completed both pre- and post- course assessments, all mentioned that veterinarians and physicians should work together to improve health, recognizing the collaborative work needed to improve global health. While there were no statistically significant differences in their recognition of the veterinarian's role in One Health implementation before or after these courses were conducted, this was reinforced upon completion of the courses. This suggests that there is a broad acceptance of the role of the veterinarian in One Health practice.

Ecosystem health

Based upon thematic analysis and key term identification of the open-ended statement description of the students interpretation of "One Health", it was noted as significant that the use of terminology related to ecosystem or environmental health was notably absent in the pre-course assessment. All of the students in the pre- and post-course assessment defined the concept of One Health as collaboration between animal and human health practitioners only. Importantly, 4 of 29 (18.4%) students revealed an appreciation of the importance of environmental health to One Health in the post-course assessment and 1 of 29 (3.4%) indicated it was a collaboration between animal and human health practitioners operating at a global level suggesting some elements of the curricula gap as it pertains to environmental health in One Health had been addressed.

In order to protect global human health, it is essential that environmental health issues be addressed and the veterinary curriculum is a good place to begin. The lack of emphasis on environmental health issues as it relates to the One Health concept, suggests that implementation of environmental health factors be implemented across the curriculum. Indeed, despite universal recognition that environmental integrity plays a vital role in human and animal health, neither physicians nor veterinarians receive environmental health education [14]. The lack of emphasis placed on One Health generally based upon few publications representing the concept, and particularly the lack of emphasis of the role of environmental health on One Health across all health professions, suggests the need for interdisciplinary collaboration between medical, veterinary, public health and environmental health professionals.

Barrett et al. [15], discussed the lack of integration of environmental variables in discussions on One Health issues. Integration of the environmental aspect requires greater involvement of environmental professionals in addressing One Health. A meta-analysis of the literature on One Health revealed that most published articles related to One Health were published in veterinary journals, with environmental and public health journals responsible for only (4%) and (5%) of articles respectively [15]. The latter percentages align with our own study as it relates to the lack of our curriculum coverage pertaining to environmental health in public health. Aguirre et al. [16], concur with the recommendations of Barrett et al. [15] as it relates to introducing ecosystem health preservation into veterinary curricula. With the rise in emerging zoonoses resulting from wildlife habitat destruction and climatic factors, veterinarians play an important role in the link between human, animal and environmental health. Aguirre et al. [16], also suggest that veterinarians are highly trained in comparative medicine, some background educational exposure on environmental husbandry factors place them in a position whereby they can expand their skillset in ecosystem health preservation. Simply introducing causal environmental variables into courses in epidemiology, pharmacology, husbandry and similar courses will not require massive changes to course syllabi [16]; however, it will provide a mechanism to reinforce the importance of the environmental on human and public health.

Alternatively, an independent course that addresses the environmental health aspect of One Health may be developed as part of an interdisciplinary course in One Health for our medical and veterinary students.

Improvement of public health

The significance of public health goes unrecognized within the conceptual framework of One Health, to address this; Tufts University offers inter-professional courses integrating medical and veterinary students within their public health program using experiential learning methods [17]. Our study results concur with the lack of recognition of public health within the One Health definition by our veterinary students.

Future of One Health in the SGUSVM curriculum

Leondari [18], describes the importance of depicting relevance and value to course content in enabling learner engagement. Crick et al. [19], proposes that to enable learner engagement, design of curriculum, pedagogical and assessment methods must be (or perhaps should be) learner-driven. Stephen [20] describes that this was a consideration at the University of Calgary in designing their courses in an ecosystem and public health within their veterinary curriculum. Our courses in Veterinary

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Table 1 Demographic characteristics of survey participants.

Survey response	Pre (%) Post (%)	Both (%)
Gender		
Female		25 (86)
Male		4 (14)
Country of origin		
United States of America		24 (83)
Germany		1 (3)
Jamaica		1 (3)
United Kingdom		1 (3)
Did not respond		2 (7)
Childhood exposure to animals		
Small animal		29 (100)
Exotic		29 (69)
Avian		11 (38)
Equine		6 (21)
Farming and livestock		3 (10)
Parent was an animal handler/trainer		1 (3)
Education background		
Small animal		27 (93)
Academia research		17 (59)
Equine		15 (52)
Exotics		15 (52)
Food science		8 (28)
Master of public health		2 (7)
Type of veterinary practice expected to enter		
Small animal		20 (69)
Mixed practice		9 (31)
Government/regulatory		7 (24)
Equine		5 (17)
Farm animal		3 (10)

Table demonstrates demographics for all SGUSVM term 4 students that participated in the surveys. Pre, pre-course survey responses (n = 79); Post, post-course survey responses (n = 32); Both, linked pre- and post-course survey responses (n = 29)

Public health and Epidemiology are fully didactic with a teachercentered approach that does not facilitate peer-peer and faculty interaction. The Veterinary Epidemiology course consists of 16 lectures, which includes two study exercises that require students to participate via the use of clicker technologies, with a discussion that follows to address gaps reflected in their answer responses. The Veterinary Public health course consists of 30 lectures that encompasses ten lectures in food safety and meat hygiene, zoonoses and emerging zoonoses with a focus on the agencies in the U.S. and internationally veterinarians must report to in the event that they suspect the occurrence of noticeable and reportable diseases. Interventions that provide alternatives to the conventional didactic model can enable learner motivation and facilitate a student-centered socio-constructivist approach to learning. A group-based approach that incorporates role-playing methods along with discussion that results in visual descriptions of the roles of each professional assists and enables the collaborative and knowledge construction activities that enable communication and an appreciation of each professional's role.

Dale [21] proposed that a redirection of veterinary pedagogy from the traditional didactic to a problem-solving applied-based pedagogy that encourages the student to apply theoretical knowledge to practice. Knowles [22] provides the assumption to andragogy that underscores the need for instructor approaches that appreciate the prior experience that enables construction of knowledge (through engagement of cognitive, motor and affective skills) [21]. A socio-constructivist approach that builds on case-based scenarios that require collaborative learning with environmental/public health and medical students may enable learner motivation and facilitate an appreciation of One Health collaboration.

Our study is limited by the lack of post-course questionnaire completion, while 79 of 90 (88%) of students completed the pre-course questionnaire, only 29 (37%) of the 79 students that completed the pre-course questionnaire, completed the postcourse questionnaire. This has limitations as the sample size is insufficient to determine the accurate differences in information gained pre- and post-courses in veterinary epidemiology and veterinary public health. Additionally, the format of the questionnaire did not allow discussion of agreement, rather students were presented with statements and asked to qualify their degree of agreement or not. The student responses to the open-ended questions "state here" did however correlate with their agreement to the predetermined closed-ended questions presented in the questionnaire. Preferably, the incorporation of focus interviews would have provided a greater in depth qualitative analysis of the true depth of their appreciation of the importance of One Health upon completion of these courses, and also the lack of significance they apportioned to the role of the environment and environmental health on One Health and public health.

In a study by Winer et al. [23], 92% of students considered One Health as important to practice, with 73% of medical students concurring with this. Similarly, a study conducted by Wong et al. [6], 88.2% of veterinary students agreed that One Health was important to practice. This concurs with our own findings where 89% of our veterinary students in the pre-course questionnaire (97% in the post-course questionnaire) agreed that One Health was important to veterinary practice.

Increasingly, recognition of the importance of a holistic approach to One Health, which incorporates environmental health and food safety and security, often neglected in focused approaches that consider the animal and human health relationship solely [24]. Increasingly, the economic benefits to interdisciplinary professionals working together to address the socio- ecological factors implicated in global health issues are recognized as requiring policy address and development [24]. The recent Ebola outbreak in West Africa stemming from bush meat consumption practices that spread beyond the African continent [25] is just one example of the need to address the role of cultural practices and social context of the human agency that impacts emergence of zoonotic diseases impacting global health. Babo et al. [26] discuss the economic benefits of a cooperative surveillance framework that draws on the expertise of veterinarians and physicians collaborating to address antimicrobial resistance concerns impacting human health from overuse of antimicrobials in foods of animal origin [27]. Risk mitigation arising from a One Health approach that addresses the relationship between the food supply and animal sources resulting in foodborne diseases has implications for both economics and human health [28]. Interdisciplinary collaboration that targets surveillance at multiple points in the food chain can intercept to prevent the occurrence of foodborne diseases in poverty stricken nations reliant on livestock sources for income and those with implications for threatening global food security and antibiotic stewardship [28]. Narrod et al. [3], reiterate the economic burden encountered by economies affected by zoonoses that emphasizes the importance for an

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approach that draws on the need to embrace a holistic approach to addressing global health that draws on the intellectual capital of economists, health professionals and governments through education and interdisciplinary collaboration. The veterinary curriculum with implications.

IPE [29] has implications for strengthening a One Health approach to patient care, through shared learning efforts, communication and collaboration between medical and veterinary students that offer potential for transdisciplinary education Medical and veterinary schools coexist on our campus which presents an ideal opportunity for interdisciplinary collaboration. Council on Education for Public Health accredited Masters in Public Health (MPH) courses along with combined DVM/MPH and MD/MPH dual degree programs are offered to students at St George's University.

Despite widespread support given to incorporation of the principles of One Health within the curricula of veterinary and human medical colleges internationally, this is rarely implemented within medical Higher Education Institutions internationally. Specifically, most published studies on IPE are focused on medical students and there appears to be no published work on those evaluating the perceptions of veterinary, dual degree and medical students on the importance of IPE/One Health to practice in countries elsewhere.

Conclusion

It is expected that findings from this study will contribute to the development of another study to detect if significant differences exist in the recognition of the importance of the One Health approach to medical students at St George's University in their roles as future physicians. Limited studies exist that demonstrate the effectiveness of IPE and it is hoped that findings from this study may reveal the potential benefits of developing an IPE course that incorporates One Health on our campus.

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Notes

^a SPSS version 21, IBM, Armonk, New York, USA.

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