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Quantitative and qualitative analysis of disciplines related to veterinary public health in undergraduate courses in veterinary medicine in Brazil

Análise quantitativa e qualitativa das disciplinas relacionadas à saúde pública veterinária nos cursos de graduação em medicina veterinária no Brasil

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ABSTRACT

With the emergence of the Unique Health concept, knowledge about zoonosis became substantial elements in the understanding of diseases transmissible to human beings. Thus, the Public Health actions developed by veterinarians have been considered of great value to several international organizations related to health. Thus, the objective of this work is to analyze how the teaching of Veterinary Public Health (VPS) has been in undergraduate courses in Veterinary Medicine in Brazil, thus enabling us to understand whether the professional trained here meets world's expectations. A total of 1,292 subjects that are related to SPV were counted. The disciplines of Veterinary Public Health correspond to 513.6 hours, 22.7% of the total disciplines in the Sciences of Veterinary Medicine, being offered between the 6th and 9th periods. The subjects were divided into Preventive Veterinary Medicine and Public Health (PVMPH) and Inspection and Technology of Products of Animal Origin (ITPAO). A total of 803 PVMPH subjects were accounted for (average of 303.3 hours) that presented the following content division: infectious and parasitic diseases, including zoonotic diseases (51.1%); epidemiology (16.7%); national and international health policies (15.7%); environmental management (7.0%); health defense and biosafety (6.2%); health planning (3.1%) and production and control of biological and biotechnological products (0.1%). The ITPAO disciplines present an average workload of 210.3 hours for this subarea of the SPV, corresponding to 9.3%. Subjects ranged from 8 to 160 hours of individual workload. It is concluded, therefore, that there is little allocation of workload for the SPV in Brazil and that the distribution of content needs without reformulation to ensure a more balanced training

for students. In this way, professionals trained in Brazil will be able to work in all areas of the SPV, strengthening the concept of One Health

KEY WORDS: Subjects. Education. Environmental health. Animal health. Human health.

INTRODUCTION

It has been a consensus for the World Health Organization (WHO), the World Organization for Animal Health (WOAH) and the Food and Agriculture Organization of the United Nations (FAO) that the Veterinary Public Health activities developed are considered a "public good global" due to its crucial role in human health, food security, poverty and hunger reduction, and environmental sustainability (BRIONES DIESTE et al., 2018).

The bachelor's degree in veterinary medicine actively develops actions as a health professional, based on their knowledge obtained during their graduation. The curricula of courses at higher education institutions have subjects and contents voted for actions of prophylaxis of zoonosis and other infectious diseases, inspection and hygienic obtaining of animal products, in addition to developing communication and health education activities. All this collection of disciplines makes the veterinarian an extremely important and necessary professional for the intersection of animal and human health (CARVALHO et al., 2017).

With the emergence and application of the concept of One Health, which is defined with an interdisciplinary and multisectoral approach, at local, regional, national and global levels, which aims to promote the health of human beings, animals and the environment, in an interconnected and continuous way, the contributions of the veterinarian to Public Health became even more essential (LEITE and TEIXEIRA, 2019). This concept represents the relationship between diseases that affect animals and public health, based on the fact that 60% of known human infectious diseases are of animal origin. In other words, knowledge about zoonosis is a substantial element of knowledge about diseases that can be transmitted to human beings (BRIONES DIESTE et al., 2018).

To this end, the National Curriculum Guidelines (DCN) for undergraduate courses in Veterinary Medicine highlight the areas of Preventive Veterinary Medicine and Public Health and Inspection and Technology of Products of Animal Origin (both comprising Veterinary Public Health) as training areas specific for the undergraduate. The Ministry of Education (MEC) understands that animal health and public health content needs to be transmitted to students and environmental health; preventive veterinary medicine; and inspection and technology of products of animal origin; so that general skills and abilities are developed, with emphasis on health care, communication, leadership, administration and management (BRASIL, 2019).

However, for a graduate of Veterinary Medicine to be able to work in this niche of the job market, Carvalho et al. (2017) state that it is necessary to have a concise training and in the observance of content that would enable them to work in the field of Veterinary Public Health. For that, this article aimed to analyze how the teaching of this great area of action has been in the undergraduate courses in Veterinary Medicine in Brazil, thus making it possible to understand whether the professional trained here meets the expectations of the world.

MATERIAL AND METHODS

An exploratory, descriptive study with a quantitative and qualitative approach was developed here, using document analysis through studies of curricular matrices of undergraduate courses in Veterinary Medicine in Brazil, duly registered in the MEC. To achieve the proposed objective, two inclusion criteria were established for choosing the analyzed courses: a) courses that have graduates, that is, courses that have a start date until the year 2014; and b) courses that make publicly available the documents referring to the curricular matrices. Therefore, matrices of 196 courses were obtained.

A detailed exploratory reading and analysis of the curricular matrices were directed to the subjects that make up the large area of Veterinary Public Health (VPS). In other words, subjects of “Preventive Veterinary Medicine and Public Health” and “Inspection and Technology of Products of Animal Origin”. This didactic division is presented in the DCN (BRASIL, 2019) that define the contents of each sub-area as follows: 1) Preventive Veterinary Medicine and Public Health (PVMPH): bringing together essential content for activities aimed at health planning, epidemiology, prevention, control and eradication of infectious, contagious, parasitic, including zoonotic diseases. Sanitary defense, prevention and control of emerging and re-emerging diseases, providing knowledge on biosafety, production and control of biological and biotechnological products and environmental management. Contents related to the health policies of the Unified Health System and international health guidelines; 2) Inspection and Technology of Products of Animal Origin (ITPAO): including all phases of the food production chain, with an emphasis on classification, processing, standardization, conservation, quality control, certification, product development and hygienic and sanitary inspection of products from animal origin and its derivatives.

After separating the subjects in these sub-areas, the workload allocated to them was tabulated and information regarding their names and periods in which they were offered was identified. The compilation and analysis of data from the subjects were conducted separately by HEIs, later grouped by state and then by Brazilian region; thus, being able to observe an overview of these disciplines in Brazilian courses.

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For quantitative analysis, data were tabulated in Microsoft Excel® software (Windows, 2010) using descriptive statistical procedures, such as arithmetic average, percentage, and minimum and maximum values. And for the qualitative analysis, the main nomenclatures that name the subjects were analyzed, building a word cloud with the most used terms using the Microsoft Word ® software (Windows, 2010) and the Pro Word Cloud ® extension; in addition to comparing the period in which the subjects are offered in Brazil with the recommendations of the Basic Education Plan for Veterinary Training of the WOAH (2013) and Consejo Panamericano de Educación en las Ciencias Veterinarias (COPEVET).

RESULTS AND DISCUSION

Considering the analyzed curricula, a total of 1,293 subjects related to SPV were counted, which includes subjects from PVMPH and ITPAO. It is noteworthy that only mandatory subjects within the curricular matrices were analyzed. Brazil has an average of 513.6 hours for this content, which represents 22.7% of the total number of disciplines in the Sciences of Veterinary Medicine. In other words, Brazilian courses do not allocate even one third of their specific training subjects to the SPV. There are considerable differences between states in the distribution in these disciplines, ranging between 14.7% (in Pará) and 34.3% (in Roraima). Information by Brazilian state, average workload and percentage are presented in Table 1; and information by Brazilian region is available in Table 2. Emphasizing that there is no record of veterinary courses in the State of Amapá, which justifies their non-inclusion in the Table. Mondadori (2018) says that this disparity in content interferes with the quality of recent graduates, a consequence of pronounced institutional differences and variations in the quality of pedagogical projects. This leads to the required competencies for the first day of employment, as advocated by the WOAH, not being met.

To understand how professionals are trained, especially in SPV, it is extremely important to provide feedback to the process of building the curriculum and ensure the evolution of Veterinary Education. An example of this was a work developed by Quintero (2016) in Mexico, which certified veterinarians on their abilities to develop various activities inherent to the profession and found that only 35% of respondents said they had skills to develop PVMPH activities and 34% mastered knowledge related to ITPAO.

For Akers et al. (2008), in the USA, Veterinary Medicine has not met the national need for veterinarians able to work in public health. It also states that Veterinary Medicine needs to change to meet the needs of society and face new challenges related to public health, national and international security and trade.

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Table 1. Average workload, in hours and percentages, of the disciplines of Veterinary Public Health (SPV) of the curriculum of undergraduate courses in Veterinary Medicine in Brazil, by federative unit.

STATE	VETERINARY PUBLIC HEALTH	
	WORKLOAD	PERCENTAGE (%)
Acre	480,0	25,4%
Alagoas	540,0	24,8%
Amazonas	559,1	23,1%
Bahia	459,8	21,0%
Ceará	453,3	21,0%
Distrito Federal	530,0	24,6%
Espírito Santo	422,6	19,6%
Goiás	436,1	22,1%
Maranhão	630,0	24,7%
Mato Grosso	467,5	18,7%
Mato Grosso do Sul	432,3	18,0%
Minas Gerais	485,3	21,4%
Pará	450,0	14,7%
Paraíba	490,0	25,0%
Paraná	428,4	18,5%
Pernambuco	637,5	29,8%
Piauí	577,5	27,2%
Rio de Janeiro	679,3	27,3%
Rio Grande do Norte	450,0	20,1%
Rio Grande do Sul	482,1	21,1%
Rondônia	513,3	20,5%
Roraima	690,0	34,3%
Santa Catarina	520,7	22,3%
São Paulo	477,9	18,3%
Sergipe	490,0	25,2%
Tocantins	570,0	20,8%
AVERAGE	513,6	22,7%

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Table 2. Average workload, in hours and percentages, of the disciplines of Veterinary Public Health (SPV) of the curriculum matrices of undergraduate courses in Veterinary Medicine in Brazil, by region.

BRAZILIAN REGION	VETERINARY PUBLIC HEALTH	
	WORKLOAD	PERCENTAGE (%)
Centro-oeste	466,5	20,9%
Nordeste	525,3	24,3%
Norte	543,7	23,1%
Sudeste	516,3	21,7%
Sul	477,1	20,6%
AVERAGE	505,8	22,1%

Wijayawardhane et al. (2020) warns of the negative impacts of a lack of training in SPV, as disease surveillance and animal health defense regulations are compromised. According to the authors, for a country to reach an excellent level of national veterinary services, it is necessary to have medical and veterinary professionals with theoretical and practical skills that have at least a minimum standard, providing the professional with updated knowledge and resources for the prevention and control of zoonosis; and this is up to the universities, which must promote reforms in their curricula.

When analyzing the moment of graduation in which the SPV disciplines are offered (Table 3), a growing and gradual distribution can be noticed over the periods. The highlight is for the 6th and 9th periods, with the highest percentages. Thus, training in SPV in Brazil has taken place from the middle to the end of the course. However, an equal distribution over the entire course, including the early years, would be extremely interesting. Newcomers need to have contact with the areas of activity of the veterinarian in SPV, this will be able to better develop the professional who has been asked to meet the needs of the world.

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Table 3. Distribution of disciplines related to Veterinary Public Health (VPS) throughout the Veterinary Medicine graduation courses in Brazil.

PERIOD	PERCENTAGE
1th	0,6%
2nd	0,6%
3rd	3,2%
4th	7,1%
5th	13,1%
6th	19,6%
7th	15,3%
8th	18,1%
9th	20,2%
10th	2,2%

Although a global analysis was conducted, the DCN brings the SPV disciplines divided into two groups (PVMPH and ITPAO), which leads to individual analysis of these contents. In relation to PVMPH, Brazilian courses have an average workload of 303.3 hours for this sub-area of the SPV. That corresponds to 13.4% of the total number of CMV disciplines for the entire undergraduate course. There is a need to include PVMPH disciplines in the curricular matrices, including practical classes, and to avoid late student contact with disciplines in this area (CARVALHO et al., 2017). Table 4 presents the average workload, by Brazilian state, of the PVMPH disciplines, and Table 5 in relation to the Brazilian regions. Emphasizing that there is no record of veterinary courses in the State of Amapá, which justifies their non-inclusion in the Table.

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Table 4. Average workload, in hours and percentages, of the disciplines of Preventive Veterinary Medicine and Public Health (PVMPH) of the curriculum matrices of undergraduate courses in Veterinary Medicine in Brazil, by federative unit.

STATE	PVMPH	
	WORKLOAD	PERCENTAGE (%)
Acre	285,0	15,1%
Alagoas	370,0	17,0%
Amazonas	350,8	14,5%
Bahia	296,9	13,6%
Ceará	280,0	13,0%
Distrito Federal	345,0	16,0%
Espírito Santo	252,3	11,7%
Goiás	257,1	13,0%
Maranhão	330,0	12,9%
Mato Grosso	267,5	10,7%
Mato Grosso do Sul	243,3	10,1%
Minas Gerais	273,7	12,1%
Pará	150,0	4,9%
Paraíba	265,0	13,5%
Paraná	250,6	10,8%
Pernambuco	390,0	18,2%
Piauí	300,0	14,1%
Rio de Janeiro	346,6	13,9%
Rio Grande do Norte	315,0	14,1%
Rio Grande do Sul	292,8	12,8%
Rondônia	313,3	12,5%
Roraima	420,0	20,9%
Santa Catarina	361,4	15,5%
São Paulo	306,1	11,7%
Sergipe	223,3	11,5%
Tocantins	400,0	14,6%
AVERAGE	303,3	13,4%

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Table 5. Average workload, in hours and percentages, of the disciplines of Preventive Veterinary Medicine and Public Health (PVMPH) of the curriculum matrices of undergraduate courses in Veterinary Medicine in Brazil, by region.

BRAZILIAN REGION	PVMPH	
	WORKLOAD	PERCENTAGE (%)
Centro-oeste	278,2	12,5%
Nordeste	307,8	14,2%
Norte	319,9	13,8%
Sudeste	294,7	12,4%
Sul	301,6	13,0%
AVERAGE	300,4	13,2%

When we compare the existence of this group of PVMPH disciplines in Brazilian courses to European curricula, we will see that there is no equivalent group. Disciplines such as epidemiology and public health are classified in the group of basic sciences and clinical sciences, respectively (UNIÃO EUROPEIA, 2005; EAEVE, 2016). COPEVET suggests a similar group of disciplines, called simply "Public Health" (SAN MARTÍN H, 2003).

A total of 803 PVMPH courses were accounted for, 298 in public courses and 505 in private courses, with a workload between 5 and 216 hours, ranging from theoretical, practical, theoretical-practical and non-presential. It was also analyzed, in general, the period/semester in which the PVMPH subjects are most taught to undergraduates. This distribution is presented in Table 6. Chart 1 brings a comparison with the WOAH recommendations and Chart 2 with the COPEVET recommendations on the moment of the course that the contents need to be taught.

Table 6. Distribution of disciplines related to Preventive Veterinary Medicine and Public Health (PVMPH) throughout the Veterinary Medicine graduation courses in Brazil.

PERIOD	PERCENTAGE
1th	1,1%
2nd	0,9%
3rd	5,0%
4th	9,3%
5th	18,5%
6th	25,2%
7th	13,3%
8th	10,4%
9th	14,5%
10th	1,8%

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An interesting example is at Kansas State University, USA, where Veterinary Medicine students receive information about concepts and areas of expertise in PVMPH throughout their graduation. In the first year, students enroll in Veterinary Guidance and Principles of Epidemiology, and in the first year career opportunities in Veterinary Medicine are presented; including lectures relevant to public health practice with a focus on population medicine and public health services; in the second discipline, the student is introduced to the key elements of epidemiology and preventive veterinary medicine. During the second year, the main zoonotic agents in the disciplines of Bacteriology, Virology and Parasitology are presented. In the third year, the student attends the discipline of Zoonosis and MVP, knowing the essential roles of veterinarians in the prevention and control of diseases. A highlight of this course is the offering of an online module on emerging and exotic animal diseases. At the end of the course, during the fourth year, students participate in hands-on activities, indoors and outdoors, at locations such as the Kansas Department of Health and Environment and the Centers for Disease Control and Prevention (AKERS, 2008).

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Chart 1. Comparison between the recommendations of the World Organization for Animal Health (WOAH) and the situation of the disciplines of Preventive Veterinary Medicine and Public Health (PVMPH) in Brazil in relation to the phases of the undergraduate course in Veterinary Medicine in which they are taught.

RECOMMENDATIONS: WOAH		**BRAZIL**	
SUBJECTS/CONTENT	**COURSE PHASE**	**SUBJECTS/CONTENT**	**COURSE PHASE**
Contagious diseases	Mid	Infectious and Parasitic Diseases	Mid
Epidemiology	Mid	Epidemiology	Mid
Veterinary Legislation National and international	Mid or End	National and International Health Policies	End
Herd Health Management	End	Animal Health Defense and Biosafety	End
Public health	End	Public Health	End
		Planning and Health	End
		Production and Control of Biological Products	Mid

Chart 2. Comparison between the recommendations of the Pan American Council for Education of Veterinary Sciences (COPEVET) and the situation of the disciplines of Preventive Veterinary Medicine and Public Health (PVMPH) in Brazil in relation to the phases of the undergraduate course in Veterinary Medicine in which they are taught.

RECOMMENDATIONS: COPEVET		**BRAZIL**	
SUBJECTS/CONTENT	**COURSE PHASE**	**SUBJECTS/CONTENT**	**COURSE PHASE**
Preventive Veterinary Medicine and Public Health	Mid	Infectious and Parasitic Diseases	Mid
		Epidemiology	Mid
		National and International Health Policies	End
		Animal Health Defense and Biosafety	End
		Public Health	End
		Planning and Health	End
		Production and Control of Biological Products	Mid

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And also in relation to the analyzes of the present study, the subjects were separated into seven groups, according to the contents described in the DCN, with their respective percentages presented below: infectious and parasitic diseases, including zoonotic diseases (51.2%); epidemiology (16.7%); national and international health policies (15.7%); environmental management (7.0%); health defense and biosafety (6.2%); health planning (3.1%) and production and control of biological and biotechnological products (0,1%).

The Federal Council of Veterinary Medicine (CFMV) conducted a survey on when the topic of public health was addressed, and whether the contents of the subjects listed included Epidemiology, Epidemiological Surveillance/Zoonosis, Sanitary Surveillance, Environmental Surveillance, Health Education, Health Worker and Sanitation. The research evaluated ninety-five undergraduate courses in Veterinary Medicine and it was observed that the contents of the disciplines focused on public health are disconnected from the other disciplines, with the need for a greater connection between the contents of the disciplines (SOUZA et al., 2010).

The highlighted content is aimed at teaching infectious and parasitic diseases, which for the WOAH (2012) is of great importance in the development of specific skills such as: transboundary animal diseases, zoonosis (including foodborne diseases, emerging and re-emerging diseases, program prevention and control of disease. In Brazil, this expressive destination may happen, probably, due to the interest of knowing diseases transmissible to animals for the application of clinical and therapeutic knowledge, since in these disciplines content on non-zoonotic diseases and the Clinic are also taught. Veterinary is an area of great interest for IES and academics.

On the other hand, with a tiny percentage, there is the content of production and control of biological and biotechnological products, which leads to the understanding that issues that address the probability of an incident harmful to human or animal health and the likely magnitude of its biological consequences and economic are not properly addressed in Brazil. According to WOAH (2012), this content would develop professional competence to apply risk analysis, which involves hazard identification, risk assessment, risk management and risk information. The importation of animals and animal products, for example, poses a risk to the importing country. Risk analysis applied to imports offers the importing country an objective and structured method to assess disease risks associated with the importation of animals, animal products, animal genetic material, animal feed, biological products and pathological material, using as a particular basis for the standards existing WOAH.

About the most used terms to compose the names of the PVMPH disciplines, a word cloud was built, shown in figure 1. In this visual resource, the terms are organized in different

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colors and sizes, based on the number of repetitions within the name list. of the disciplines. It is noteworthy that numerals, prepositions, articles, among other grammatical elements of limited symbolic value to content analysis were filtered out.

There is also clearly the emphasis on the term “diseases”. This term, associated with three other words, “parasitic”, “infectious” and “animals”, which are also highlighted, completes the meaning. The objectives of Veterinary Public Health are to know animal diseases transmissible to humans, their control and prevention measures, as well as the legislation applicable to them, and to know the contributions of Veterinary Medicine to human health, particularly, but not only, in relation to food safety (BRIONES DIESTE et al., 2018).

When analyzing the figure, the highlight of the word “health” is evident. As simple as this data may seem, this information brings with it a strong reaffirmation that the veterinarian is indeed a health care professional, so much so that he receives training for this. Veterinary Medicine was recognized in Brazil as a profession in the health area in 1998, according to Resolution No. 287 of the National Health Council (CNS) (BRASIL, 1998). Carvalho et al., (2017) emphasizes that the need for dissemination and perception about the real role of the veterinarian in society, as the propagation of the importance of their performance in Public Health would lead to the population's knowledge, breadth and importance. area, in this way the new students who enter the course would already have greater chances of becoming interested in this area of expertise.

Figure 1. Word cloud containing the terms used for the titles of disciplines related to Preventive Veterinary Medicine and Public Health in undergraduate courses in Veterinary Medicine in Brazil

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In the second and third prominent planes are the words “epidemiology”. According to the WOAH (2012), epidemiology is a specific competence that grants the veterinarian knowledge and understanding of the general principles of descriptive epidemiology and its application to disease control, without forgetting the ability to access and use appropriate sources of information; in addition, understanding and the possibility of participating in epidemiological studies in cases of occurrence of mandatory notification diseases, including the collection, handling and transport of necessary specimens or samples.

Carvalho et al. (2017), states that to facilitate Public Health practices, Epidemiology, which focuses its studies targeting populations, was inserted in the context of Preventive Veterinary Medicine. In this same thought we can observe the highlight of the word “zoonosis”. The training of veterinarians in the areas of Epidemiology and Zoonosis control aimed at prevention and surveillance, allowed the access of Veterinarians to work in Public Health (CARVALHO et al., 2017). According to the WOAH (2020), the etiology of diseases that affect humans are 60% zoonotic. To ensure human health, the most efficient way is to fight these pathogens in the animal source. For example, in sanitary inspection, in which the veterinarian is the protagonist, following the production chain from creation to the final product, being responsible for the decision on the food to be judged as appropriate or inappropriate for consumption (ARAÚJO et al., 2020). An outstanding and relevant fact is the existence of unique disciplines, among the analyzed amount, offered by Veterinary Medicine courses in Brazil, that is, from the amount of analyzed disciplines, there are disciplines that differ from the others due to their originality and profile.

The first observation refers to a course (1/196) that exclusively offers the discipline of “Single Health”, of thirty semester hours, taught in the ninth period. It is a course in the State of Rio Grande do Sul. The Unique Health in Veterinary Medicine is not restricted to the prevention of zoonosis but also encompasses the benefits to human health with living with animals. Adding benefits to human beings, with the use of animals for food production, in tests for research on human pathogens and pet-assisted therapy, in other words, the Veterinarian works both in the prevention of zoonosis and in the promotion of *zooeyia*, a term of Greek origin for positive implications of the relationship between animals and humans (HODGSON e DARLING, 2011).

The fact that there is only one discipline entitled "Single Health" among the 196 courses analyzed can be justified by the concept (One Health or One Health) being on the rise for 11 years, which highlights the links between human, animal and environmental health (WOAH, 2020). However, in the academic context, according to Gibss (2014), One Health must be prioritized in veterinary education, and the curriculum in veterinary schools must be

remodeled to adapt to changes in global trade patterns and disease transmission. Only with the inclusion of specific Unique Health content will it be possible to train in academics the interdisciplinary nature of Veterinary Medicine which, according to the CFMV (2020), has been strengthened since 2011, when veterinarians became part of the Health Support Center of Family (NASF), working alongside other professionals who work for the quality of primary health care in Brazilian municipalities.

A discipline similar to this one is identified in a postgraduate course, of the residency type, in which there is an interaction between veterinary medical residents with other public agencies and entities related to health. The completion of the Single Health discipline has been essential to maintain the link between graduate students and public health, its different segments and municipal and state sectors (DÖWICH et al., 2017).

There is also a course that, in a unique way, offers the discipline of "Vomous, Poisonous and Harmful Animals", with a workload of 60 hours, without being informed in which period of the course it is taught. Accidents with venomous animals are not a transmissible disease, but they are treated together with zoonosis, since it is an injury resulting from aggression by an animal and the clinical picture is a consequence of the action of the toxins inoculated by the bites (BRASIL, 2020a). The Veterinarian can act in the identification and control of venomous and synanthropic animals, to enable the determination of specific approaches to surveillance and control actions of venomous and synanthropic fauna, according to the ecosystems in which the animals are found. Also mention that they are mandatory notification grievances in SINAN.

This subject "Vomous, poisonous and harmful animals" belongs to a course located in the State of Mato Grosso do Sul and its creation and inclusion in the curriculum is related to the increased incidence of accidents by venomous animals in the state. And when analyzing the historical series, Mato Grosso do Sul jumped from 17.4 cases for every 100,000 inhabitants in 2000, to 127.5 cases in 2018 (BRASIL, 2020b).

"Health Education", 60 hours and in the first period of a course in the State of São Paulo. Health education is a health practice that has evolved over the years, from a normative orientation to a transformative dialogue of knowledge and, in this sense, it starts to be developed from the association of knowledge and experiences in order to facilitate actions relevant to the health of a population, from the perspective of disease prevention and health education. Thus, it assumes the pretext of discussing good health practices that a community develops from the development of critical thinking about its own territory, promoting the autonomy of individuals over their own existence (OLIVEIRA et al., 2020). Health Education is an important activity that can be developed by the veterinarian and must be highlighted

within the field of public health. This professional can act in the dissemination of information and awareness of people through programs that involve the protection and promotion of human health in communities within the principles of sustainability (PFUETZENREITER et al., 2004).

There is a discipline of a totally practical nature, entitled “Practice in public health: planning and zoonosis”, which differs from the other disciplines of the PVMPH group, which are mostly of a theoretical nature. This discipline is offered in the eighth period of a course in the State of São Paulo, with a workload of 30 hours. It is likely that the inclusion of this matter is related to the role of the veterinarian in Zoonosis Surveillance Units (UVZ), structures responsible for surveillance actions and services of animal populations of relevance to public health, with the aim of identifying timely and the risk early, and thus, prevent and monitor zoonosis and accidents caused by venomous and poisonous animals. It is noteworthy that they are linked to the Unified Health System (SUS) (BRASIL, 2014).

The relationship between the offer of this discipline and the State of São Paulo may be related to the need to train qualified personnel to work in the more than 152 UVZ's existing in the Southeast Region. When compared to other Brazilian regions, the Southeast region accounts for 54.8% of the total existing structures for surveillance, prevention and control of zoonosis (BRASIL, 2016).

This practical discipline of planning and zoonosis meets a competence described in the WOAH recommendations (2012), which is “Programs for the Prevention and Control of Diseases”, which includes zoonosis. Developing this competence allows recent graduates to apply established programs for the prevention and control of the most frequent zoonosis, contagious diseases or emerging/re-emerging diseases, including the identification and traceability of animals; understand and participate in the implementation of contingency plans aimed at controlling cross-border diseases; understand and participate in regular or emergency vaccination campaigns, as well as in periodic programs that involve laboratory tests; explain the concept of “early detection system”, which designates a system that allows the detection and early identification of the entry or emergence of diseases or infections in a country, knowledge of mandatory notification diseases in order to mitigate the transmission of diseases; and knowing where to look for up-to-date and reliable disease-specific information, its control and prevention measures, including rapid response mechanisms.

One Higher Education Institution, located in the State of Minas Gerais, is responsible for offering the discipline "Production and control of immunobiologicals" to students in the sixth period of the Veterinary Medicine course, which has a workload of 30 hours. The course addresses in its syllabus contents such as immunology concepts applied to

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immunobiologicals, production and quality control of vaccines for the most diverse animal species, production of hyperimmune sera, production of immunoglobulins in poultry eggs, control of biologicals for use in immunodiagnostics, genetic engineering in production of biological products, among others. The CFMV (2020) highlights the importance of veterinarians and veterinarians for the development of Brazil, such as the preservation of public health through the production of immunobiologicals.

Perhaps the offering of the discipline is a visionary attitude of the Higher Education Institution focused on the opportunities that future professionals may have within the state itself, there is, for example, the installation of a research and development center for veterinary immunobiologicals, aimed at the production of vaccines in the area of animal health. It is a unit of the Butantan Institute, located in the capital of Minas Gerais, in partnership with a private company (SÃO PAULO, 2006). Or the existence of the Ezequiel Dias Foundation, FUNED, recognized as an important Institute of Science and Technology in the state of Minas Gerais, which has worked to strengthen the Unified Health System, protecting and promoting health. FUNED is a reference in scientific research on snake, spider, scorpion and bee venoms, it also has modern medicine production units and also houses the Central Public Health Laboratory of the State of Minas Gerais (Lacen-MG), composed of by 42 laboratories that carry out state-of-the-art analyzes and examinations for sanitary, epidemiological, environmental and worker health surveillance (FUNED, 2020).

Finally, in Santa Catarina, a discipline of 54 hours per semester is offered, destined to students of the third period, entitled “Interpersonal relations in health”. This discipline refers to the concept of Health Communication, which in turn, is one of the points considered essential for the development of actions that involve the management of information for decision-making in the SUS, in which its components are related to the understanding of health issues, involving the population, the country's health managers and professionals (NARDI, 2018), which includes the veterinarian.

This discipline is very similar to a specific competence of the veterinarian profession, recommended by the WOAH (2012) called Communication Skill, which generally assumes an exchange between people, institutions and the public with the purpose of informing, guiding and motivating an action. The application of veterinary sciences and the technique of communication implies adapting messages to the situations, objectives and target audience. Developing this competence allows new veterinarians to transmit technical information so that the public can understand and communicate with other healthcare professionals to exchange scientific and technical information, as well as practical experiences.

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All these disciplines exclusive to their Higher Education Institution contribute to the objectives of Veterinary Public Health, which are to know animal diseases transmissible to humans, their control and prevention measures, as well as the legislation applicable to them and to know the contributions of Veterinary Medicine to health human, particularly, but not only, in relation to food security (BRIONES DIESTE et al., 2018).

Additionally, for the field of Preventive Veterinary Medicine and Public Health, it is recommended the development of a teaching plan that provides students with the acquisition of knowledge and learning experiences that help in solving the health problems of the communities. Within the teaching, research and extension triad, some current themes that need a sanitary approach could be worked more intensively in the courses, covering knowledge of Public Health, ethics and legislation, control of epizootic diseases (PFUETZENREITER; ZYLBERSZTAJN, 2004).

The professional trained in Veterinary Medicine who has solid foundations in the contents relevant to Preventive Veterinary Medicine and Public Health, in addition to the ability to work in an interdisciplinary manner, will be prepared to help human populations to face their main challenges (PFUETZENREITER; ZYLBERSZTAJN; AVILAPIRES, 2004), corresponding to the aspirations of the modern world.

Regarding the disciplines of Inspection and Technology of Products of Animal Origin (ITPAO), Brazilian courses have an average workload of 210.3 hours for this sub-area of the SPV. That corresponds to 9.3% of the total number of compulsory subjects for the entire undergraduate program. The subjects evaluated ranged from 8 to 160 hours of individual workload. Table 7 presents the average workload, by Brazilian state, of the ITPAO subjects. And Table 8 brings the same information, but in relation to the Brazilian regions. Emphasizing that there is no record of veterinary courses in the State of Amapá, which justifies their non-inclusion in the Table.

It is worth remembering that the existence of this group of subjects is in accordance with the basic education plans suggested by COPEVET and the European Union, which have a group of subjects focused on ITPAO contents, entitled "Food Technology and Quality" and "Safety and Food Quality", respectively (EUROPEAN UNION, 2005; EAEVE, 2016).

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Table 7. Average workload, in hours and percentages, of the disciplines of Inspection and Technology of Products of Animal Origin (ITPAO) in the curriculum matrices of undergraduate courses in Veterinary Medicine by Brazilian state.

STATE	ITPAO	
	WORKLOAD	PERCENTAGE (%)
Acre	195,0	10,3%
Alagoas	170,0	7,8%
Amazonas	208,3	8,6%
Bahia	162,9	7,4%
Ceará	173,3	8,0%
Distrito Federal	185,0	8,6%
Espírito Santo	170,3	7,9%
Goiás	179,0	9,1%
Maranhão	300,0	11,8%
Mato Grosso	200,0	8,0%
Mato Grosso do Sul	189,0	7,9%
Minas Gerais	211,6	9,3%
Pará	300,0	9,8%
Paraíba	225,0	11,5%
Paraná	177,8	7,7%
Pernambuco	247,5	11,6%
Piauí	277,5	13,1%
Rio de Janeiro	332,7	13,4%
Rio Grande do Norte	135,0	6,0%
Rio Grande do Sul	189,3	8,3%
Rondônia	200,0	8,0%
Roraima	270,0	13,4%
Santa Catarina	159,3	6,8%
São Paulo	171,8	6,6%
Sergipe	266,7	13,7%
Tocantins	170,0	6,2%
AVERAGE	210,3	9,3%

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Table 8. Average workload, in hours and percentage, of the disciplines of Inspection and Technology of Products of Animal Origin (ITPAO) in the curriculum of undergraduate courses in Veterinary Medicine by region of Brazil.

BRAZILIAN REGION	ITPAO	
	WORKLOAD	PERCENTAGE (%)
Centro-oeste	188,3	8,4%
Nordeste	217,5	10,1%
Norte	223,9	9,4%
Sudeste	221,6	9,3%
Sul	175,5	7,6%
AVERAGE	205,4	9,0%

A total of 490 subjects were counted that address the contents of ITPAO, with 191 subjects in public institutions and 299 in private institutions. Of the total disciplines, 32.7% have an exclusive character for food technology, 42.4% for food inspection and 24.9% have content from both areas. When analyzing the ITPAO subjects separately, it is noted that the graduates of Veterinary Medicine have had in their curriculum 40.3% for technology and 59.7% for inspection.

The distribution of ITPAO contents throughout the course was also analyzed. The percentage of each period is shown in Table 9. It can be seen that the curricula of Brazilian courses effectively start the ITPAO contents from the fourth period onwards, with a gradual increase in the following semesters. It is noted that in the 8th and 9th periods there is a greater allocation to disciplines focused on this group of contents, which is in accordance with the recommendations of COPEVET and the WOAH on the order that the disciplines should take place throughout the undergraduate course (SAN MARTÍN H, 2003, WOAH, 2013). These comparisons are available in Chart 3 and Chart 4, which present the content and phase of the course in which its administration is suggested.

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Table 9. Distribution of subjects related to Inspection and Technology of Animal Products (ITPAO) throughout the Veterinary Medicine graduation courses in Brazil.

PERIOD	PERCENTAGE
1th	0,0%
2nd	0,0%
3rd	0,2%
4th	3,6%
5th	4,2%
6th	10,4%
7th	18,7%
8th	30,6%
9th	29,5%
10th	2,8%

Another important piece of information, still thinking about the ITPAO disciplines, is the observation that of the 196 evaluated courses, eight only teach inspection disciplines and one only technology discipline. This last situation is equivalent to that found by Climént Bonilla (2014) who identified only 20% of the courses in Mexico that taught content on food technologies or technological processes for obtaining, preserving and processing food, and in contrast Spain taught these contents in 90 .9% of their courses.

About the most used terms to compose the names of the ITPAO subjects, a word cloud was built, shown in figure 2. In this visual resource, the terms are organized in different colors and sizes, based on the number of repetitions within the name list of the disciplines. It is noteworthy that numerals, prepositions, articles, among other grammatical elements of limited symbolic value to content analysis were filtered out.

Chart 3. Comparison between the recommendations of the World Organization for Animal Health (WOAH) and the situation of the disciplines of Inspection and Technology of Products of Animal Origin (ITPAO) in Brazil in relation to the phases of the undergraduate course in Veterinary Medicine in which they are taught.

RECOMMENDATIONS: WOAH		BRAZIL	
SUBJECTS/CONTENT	COURSE PHASE	SUBJECTS/CONTENT	COURSE PHASE
Food Safety and Hygiene	End	Food Technology	End
		Food Inspection	End

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Chart 4. Comparison between the recommendations of the Pan American Council for Education of Veterinary Sciences (COPEVET) and the situation of the disciplines of Inspection and Technology of Products of Animal Origin (ITPAO) in Brazil in relation to the phases of the undergraduate course in Veterinary Medicine in which they are given.

RECOMMENDATIONS: COPEVET		**BRAZIL**	
SUBJECTS/CONTENT	**COURSE PHASE**	**SUBJECTS/CONTENT**	**COURSE PHASE**
Technology, hygiene and inspection of food of animal origin	End	Food Technology	End
		Food Inspection	End
Food certification and typification	End		

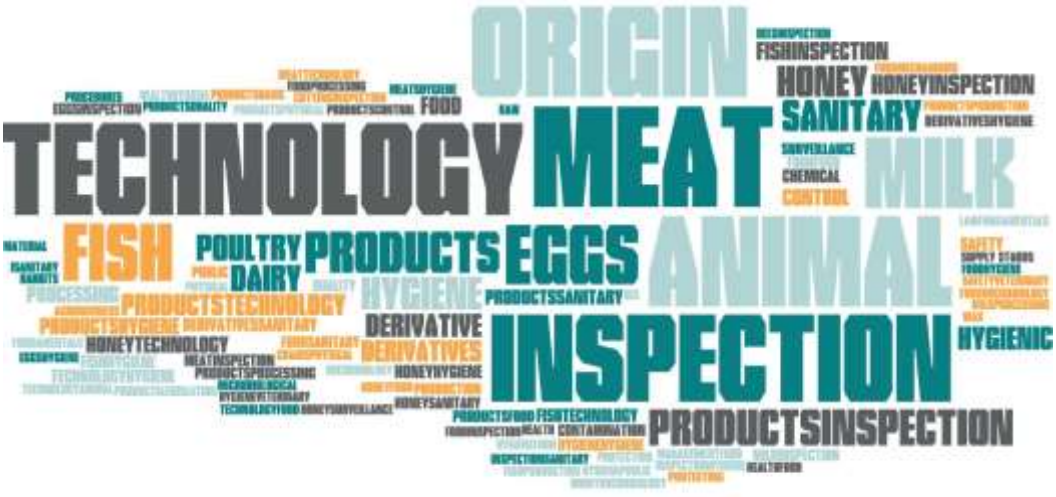

Figure 2. Word cloud containing the terms used for the titles of disciplines related to the area of Inspection and Technology of Products of Animal Origin in undergraduate courses in Veterinary Medicine in Brazil

CONCLUSIONS

Brazil does not allocate even one third of its specific training disciplines to the SPV within undergraduate courses in Veterinary Medicine. There are considerable differences between the states in the distribution in these subjects, and this disparity interferes with the quality of recent graduates, causing the skills required for the first day of graduation, recommended by the WOAH (World Organization for Animal Health), not to be met. There is a growing and gradual distribution over the periods of distribution of the SPV disciplines between the phases of the courses, with emphasis on the middle and the end of the course.

The unequal division between the disciplines of Preventive Veterinary Medicine and Public Health (PVMPH) and the Inspection and Technology of Products of Animal Origin

requires a reformulation of the curricular matrices and the curricula themselves to ensure a more balanced training for students.

The most used terms for the PVMPH disciplines were health, disease, epidemiology and veterinary; for the ITPAO disciplines were the words inspection, technology, products and derivatives. In addition, some unique subjects were identified among all those evaluated, that is, there is no other similar or similar in Brazilian courses. These disciplines have contributed and favored the training of students in universities where they are offered.

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Conflict of interest: The authors declare that they have no conflict of interest.

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