



Veterinary epidemiology in Latin America

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ABSTRACT

Veterinary epidemiology began in different Latin American countries during the 1960s and the 1970s in different universities and state-run institutes of animal health. The discipline evolved as a continuation of the activities veterinarians carried out in the areas of public health, infectious diseases, biostatistics, and the planning and administration of animal health programs. From the outset, the concepts were oriented towards covering the whole spectrum of factors involved in animal health, including political and social factors. Subsequently, the aforementioned factors were complemented with scientific and methodological support, backed by post graduate qualifications offered by the North America and European universities, together with financial support from intergovernmental organizations.

One important contribution for the Latin American veterinary epidemiology and economics community was the ISVEE 10 which took place in Chile in 2003, which served to link many professionals and scientists with the world of people working in those themes.

Whilst the study programs of veterinarians of the Latin American universities have different forms and depths when delivering competencies in epidemiology, most have similar conceptual and methodological elements.

Ideally, the profile of an epidemiology teacher should include the qualities of dreamer and explorer of new theme worlds, combined with simplicity and openness to the world. A teacher's knowledge should transcend worlds and be enriched by what takes place outside the bounds of their geographic or university frontiers.

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1. Introduction: influence of epidemiology in Latin America

Historically, the influence of epidemiology in Latin America (L.Am) developed in three areas: the public sector (primarily Ministries of Health and Agriculture), the private sector (principally in animal production establishments) and in universities or research centers.

In practically all L.Am countries, epidemiology was introduced first in Ministries of public health, particularly in areas related to zoonoses, food inspection, and environmental factors, which utilize epidemiologic methodologies. From there, it later moved to the Ministries of

Agriculture, where it was used in programs for control of animal diseases of economic and commercial importance such as Foot and Mouth Disease (FMD), brucellosis, cysticercosis, tuberculosis, Newcastle disease and echinococcosis. At the same time services of information gathering and data analysis were developed, thus creating the first clinical epidemiological surveillance units. During the 1960s and 1970s, different projects to control animal disease received loans from international banks, for example Chile's loan from the Interamerican Development Bank to control FMD.

Simultaneously, universities introduced the subjects of mathematics and biostatistics in the veterinary curricula. Furthermore, courses in epidemiological methodology were developed for both the DVM curriculum and graduate programs. In many cases this coursework development was assisted by international organizations such as the Pan

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American Health Organization (PAHO) of the World Health Organization. Examples are courses on Planning in Animal Health given by the Pan American Zoonosis Center (CEPANZO) in Buenos Aires, Argentina, and courses given by the Pan American Center of Foot and Mouth Disease (PANAFMOSA) in Rio de Janeiro, Brazil. Moreover, during this early period, Colombia, with assistance of GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit) was active in developing epidemiological activities, carrying out field studies, simulation of outbreaks of disease, and the use of computers to collect and analyze information.

There are many distinguished veterinarians who boosted the initiative in training professionals in their own countries and services and also from international organizations. Foremost among these was Dr. Pedro Acha from PAHO who understood the importance of the holistic approach of one medicine and one health, and who, in the mid-1960s assisted Dr. Calvin Schwabe in the design of the Master in Preventive Veterinary Medicine offered by the University of California, Davis. It was in the MPVM Program where veterinarians from all over LAm have trained and where, in recent years, the object of our homage, Dr. David W. Hird, has served as Director.

From 1960 onwards, universities began to design MSc, MPVM, PhD, and MPH, programs, mostly in the United States of America and Europe. In LAm., masters degrees in Epidemiology were developed in the 1970s and by the 1980s were offered in various countries with an emphasis on preventive veterinary medicine and epidemiology. Most of the veterinary medicine curricula in LAm introduced epidemiology as a preventive medicine tool.

2. Veterinary public health – how this approach influenced development of epidemiology in Latin America

As previously mentioned, in LAm the influence of epidemiology in animal health followed development of epidemiology in the area of public health, particularly with the first veterinarians who graduated with Masters or PhD degrees in public health, not only from universities in the United States and Europe, but also from universities in Latin American countries. These LAm universities had begun to offer Master's degrees in public health in the 1950s in human medicine faculties or through postgraduate training offered by the public health Ministries in the different countries. As an example, beginning in 1952 the Faculty of Medicine of the University of Chile offered a Licentiate in public health with courses of health education, administration, epidemiology, economy and statistics.

Activities related to zoonoses, food safety, and nutrition have been the principal fields of work for LAm veterinarians working in public health and it is here where it has been possible to put epidemiological knowledge into practice. In the last 20 years the topics of environmental impact, basic sanitation, and pest and plague control have been added.

The contribution of public health veterinarians to the field of epidemiology in public health has been extremely important because the training of professionals in the field

has included themes related to ecology, the environment, animals in the lives of humans, and, therefore, a more holistic vision of human health.

Unfortunately, participation of veterinarians in the area of public health varies greatly from country to country in LAm at both local and national levels, and greater efforts are needed to ensure an optimal level of veterinary expertise throughout all L. Am.

In spite of this, LAm veterinarians have a good understanding of the concept of “one health system”, incorporating both human and veterinary medicine as outlined by Schwabe (1964) and Nolen (2007), along with many professionals and academics, who are reinforcing a holistic vision of “one health”, whereby the health of the environment, control of zoonoses and food quality and safety are becoming more and more relevant, and where collaboration between different areas of health is frequent.

On the other hand, this vision has expanded to other professions, which can be demonstrated by the post graduate courses in epidemiology in the University of Chile in which agronomists and forestry professionals have participated alongside veterinarians for over 25 years. However, there is more work to be done in order to further integrate the tasks from different professions into a more integrated, collaborative vision (King et al. (2008)).

3. Epidemiologic approach to animal health in governmental agencies and universities

In general, the vision of animal health in public services in LAm includes veterinary clinical medicine and animal science. This is because LAm. veterinary schools created at the end of the 19th century and at the beginning of the 20th century were established due to problems of livestock health and related public health issues, not pet health problems. This has had an enormous effect on livestock productivity and as a consequence, an economic impact on the cattle-farming industry. In the last 20 years more than 350 veterinary schools have been created in LAm but just few of them have been accredited.

The animal health orientation of veterinary medicine delayed the adequate holistic understanding and analysis of problems of animal populations—especially from the point of view of State services—that would have allowed incorporation of benefits and social and economic cost in design of animal population programs. This focus on animal disease, with a strong emphasis on the agents and their characteristics, added to the development of diagnostic and immunological techniques and had a huge influence on the fragmentation of the systematic epidemiological vision, which from the outset should have been included disease control programs in the corresponding countries.

It is for this reason, despite the enormous scientific and methodological advances of epidemiology worldwide, that this approach to animal health exists in many state services in LAm. To a large extent this is due to the influence of the entities that train veterinarians in our countries, something which will become clearer later when the development of the epidemiology curricula is presented.

On the other hand, it has been difficult to convince those who require animal health services that the final objective should be creation of animal health rather than treating animal diseases. That is to say that “it is more ethical and economical for our countries to construct a fence on the top of a cliff, and not a fully equipped hospital at the bottom of the abyss.” Unfortunately, most State veterinary services in L.Am. still identify themselves with disease control and not with the outcome of animal health and productivity. Despite this, the importance of epidemiology in veterinary services is increasingly more important in L.Am, with better human resources technical competency, leadership qualities and financial resources in order to give guarantees to stakeholders. Additionally, these improvements in strengthening scientific capacities and the computing systems are needed to comply with norms and international standards of trade of animal products, and in principles of harmonizing, equivalence and zoning (OIE, 2007).

Animal health cannot be seen as merely the lack of biological disease. Preventive action and action regarding local health training need to be considered along with recuperative action. In this wider perspective the damage to animal health is direct (a reduction or loss of production, an increase in mortality) or indirect (losses in productive capacity, deficiencies in biological development or a reduction in reproductive capacity). With either, the result is a short-term effect or a chronic long-term effect. An important effect of this epidemiological way of thinking has been the control of FMD and external and internal parasites in Brazil. Other damages are seen in relation to the investment made by both the private and the state sector when expected production yields are not met (Astudillo et al., 1991).

Furthermore, as cattle-farming is an important part of the economies of various L.Am countries, the damage caused by animal health problems has a direct effect on exportation, not to mention internal economies. Moreover, the epidemiological approach helps with control animal diseases. Examples are the eradication of FMD, velogenic Newcastle disease, equine infectious anemia and avian influenza in Chile; control of FMD in other L.Am countries such as Uruguay, Argentina, Brazil and Paraguay; control of Chagas disease in Chile and Argentina; control of cysticercosis in Perú and others. Losses in animal production affect public health, especially loss of food, resulting in malnutrition, and also through the direct effects of zoonoses.

Moreover, depending on the input–output matrix of each country, livestock production will have a greater or lesser impact on the gross domestic product, employment, etc (Astudillo et al., 1991).

One large area of impact on animal health is that of small animal producers that exist in all the rural populations of L.Am. In many cases (Chile, for example), they are an important part of meat production of cattle, goats and sheep for the internal consumption of the country. It is these small producers of meat from cattle, goats and sheep, with barely enough land, who, due to disease of their animals and scarcity of food, see limited possibilities for exportation of their products, currently

making it an important epidemiological and social challenge.

Human intervention in the environment with new techniques of cultivation, introduction of new vegetable and animal species, expansion of cities, amplification of business, political situations, economics and the educational processes of their populations, amongst other variables, establishes new specific forms of social interaction that modify historical tendencies of animal health, sometimes in a dramatic way.

All these interventions affect livestock exploitation and, therefore, they impact livestock health, affecting the network of the interaction of variables that, in the main part, are either directly or indirectly provoked by humankind, its ambitions and convictions. It is for this reason that it seems convenient to separate the effects that mankind provokes in the famous ecological “agent-host-environment triad approach”. Traditionally, these have always been considered part of the environment, but, with its relevance being so large and varied, it is essential to handle it as a special group of factors considering therefore a “Four-pronged ecological approach.” This articulates perfectly what King et al. (2008) suggest, the idea that the convergence of people, animals and environment has created a new dynamic in which the well-being of each group is intimately interconnected.

It is in this way that directly or indirectly mankind is responsible for animal disease, particularly in L.Am, with health and disease being a reflection of the economic and social conditions of its people, who to a large extent survive thanks to the policies of their governments, the sterile power struggles, the lack of equality and comprehension of the responsibilities of one group for the other, and the exclusion or lack of participation in decision making. From here, the development of cattle-farming is a consequence of the interaction of multiple factors: political, economical, social, environmental, cultural, administrative, and matters of human resources that are part of the self-sufficiency or food exportation strategies used to maximize utilities or for other objectives.

From a similar viewpoint, the health of the animal populations whose final destination is sports-related or domestic, to a certain extent, continues the same general pattern whereby the specific emphasis is on the interest of animal in sports, competitions or the domestic market (Astudillo et al., 1991).

This aforementioned holistic mode of envisaging animal health (Schwabe et al., 1977), involves other interests related to the livestock industry such as refrigerators, veterinary products, food suppliers, construction of livestock facilities, agrochemicals, machines and equipment, and a range of services such as transport, product storage, and shipping services amongst others, factors that should be taken into consideration for risk analysis in the process of the commercialization of animals and their products.

The panorama of animal diseases in L.Am countries is a kaleidoscope of existing situations and of economic impact within each country, where nuclei of livestock exporters of extraordinary dynamism and quality in their sanitary conditions whose production and sanitary conditions rival

those of any developed country exist side-by-side with large rural animal populations in the hands of small agricultural producers, with a low level of investment, who have their animals like “small banks” which they can resort to when there is a need due to illness or festivals and celebrations (Astudillo et al., 1991).

Extensive animal production systems are typically used by these rural groups (including owners without land who pasture animals on roadsides) and animals in these systems often are malnourished, have internal and external parasites (many of them zoonoses), and viral and bacterial illnesses. The systems have little or no hygiene for installations, limited sanitary management, lack of economic resources, poor levels of education with gradual aging of rural workers (the younger generation tends to migrate to the cities) and low levels of information.

It is from this perspective that many L.Am authors have pointed out that the profiles of animal health in these countries are determined by the size of the properties, the means of production, social organizations and State aid, rather than by the bio-medical problems that affect them (Astudillo et al., 1991).

As part of the current strategies of cattle-farming production, either voluntary or involuntary, the producers introduce chemical or biological elements that impact the environment. This is a cost that should be incorporated into the productive processes, yet is a topic which lacks legislative support to enforce current regulations. Subsequently, it is often the country which wishes to import animal products which forces the enforcement of certain norms regarding the use of biological products with livestock.

If the means of production is evaluated from a holistic viewpoint, it is possible to appreciate that the animal population finds itself immersed in a determined social, ecological, administrative and economic context. Frequently, it is the social relationships that mark the means of production which appear in a specific geographical space. This allows for spatial limits for cattle-farming to be established at a rural level, with spaces for the development of sports and urban conditions for the population of pets. This is done in accordance with the structure for the production of animal food, sports or pets (Obiaga et al., 1979).

It is in this particular production structure, where animal diseases are prevalent. Therefore, it is possible to study the complete set of disposable or determined factors of said prevalence and, at the same time, move closer to the set of factors that best express the possible casual explanation, thus opening an area for measures of control (Rosenberg, 1986).

In L.Am, in addition to the biological context, the only way to understand the situation of animal health should be through its interpretation as a complete whole and in its socio-economic-political context. This should be done by means of a totalizing discipline like epidemiology, allowing better understanding of the full picture and the means of correcting undesired situations of which diseases, among others, are a part.

It is when poverty and inequality exist, which is the situation in the L.Am countries, that we should optimize

human and financial resources in an obligatory fashion, leveling out the importance of the multi-factorial problems.

Ideally, promotion of health in livestock emphasizes disease prevention and promotion of good health. Unfortunately, on many occasions, we in L.Am have followed the path taken by developed countries that have not used epidemiological strategies with the necessary depth.

It is for this reason that the problems of the animal populations require a precise regional characterization of all their factors in an established time and space, trying to understand the phenomena in their global context and also particularly to all those things that interfere with the health and productivity of the animals (Zepeda et al., 2001; Zepeda, 1998).

Epidemiologists must work with other professionals, because no single person or discipline can adequately master all component fields necessary to ensure a high standard of animal health. However, it will always be necessary to have a team member capable of putting the pieces of the puzzle together, and that person should be an epidemiologist.

In general, the progress of animal health control programs in L.Am is related to progress of epidemiology in such L.Am countries as Chile, Brazil and Uruguay.

4. International symposium on veterinary epidemiology and economics (ISVEE): participation of Latin American academics and professionals in ISVEE

Sharing of scientific and technological information is greatly facilitated when scientists, professionals and technicians can meet with their peers. Congresses and symposia allow professionals to keep up to date with the enormous amount of scientific information generated in their fields, in addition to reading select periodical publications. These meetings are the precursor of ideas and work in progress that are subsequently published, and they are also the place of contact amongst scientists and professionals.

These events, apart from serving as a place to receive and present information, are a special place for meeting and establishing direct contact with researchers from diverse university origins, and companies from both the private and public sector with similar orientation, which encourages the gradual incorporation of other health and economics professionals. Non-participation in these events produces a slow and gradual scientific isolation.

As Dijkhuisen et al. (1995) point out, the economics of animal health offers veterinarians a set of concepts, procedures and data that support the decision making process and optimize animal health management. It was Morris (1969) in Australia and Ellis (1972) in England who, as pioneers almost 40 years ago, gave scientific sustenance to this process. Moreover, it is in the scientific founding of this process that we should give thanks to the contribution that these “masters” gave. They showed us the principle of “marginal utility” which totally changed the opinion that the control of disease was all or nothing. This we have learned well in L.Am and it is a road that many countries are following in the control of diseases when it is

frequently inconvenient to eradicate disease if it is not possible to demonstrate the real benefits that this action has. One good example was the FMD control in Uruguay when they changed the stamping out strategy to vaccination.

Attendance at the International Symposia on Veterinary Epidemiology and Economics (ISVEE), along with the presentation of research work, has been gradually increasing. Whilst there were only 65 participants at ISVEE 1 in 1976 in Reading, England, there were over 1,000 in attendance for ISVEE 11 which took place in Cairns, Australia in 2006, and it is hoped that attendance will be even higher for ISVEE 12 in South Africa in 2009. However, it is difficult to calculate exact figures on continent of origin of the participants, for while many come from one continent, they may be doing postgraduate study or working in another at the moment they attend.

A general view suggests that up until ISVEE 9, which took place in 2000 in Breckenridge, USA, the majority of the participants were from the USA, followed by Europe, then Australia/Oceania, Asia, Africa, and Central and South America and the Caribbean, which had the least representation (Urceland, 1990).

The long distances from L.Am to these international congresses was what probably led to the interest to offer to carry out an ISVEE in L.Am, so that more L.Am scientists and professionals could attend and have the chance to relate their experiences and work on veterinary epidemiology and economics. The aforementioned occurred when Drs. Hernán Rojas and Julio Pinto, who obtained their doctorates in epidemiology in Reading, England, attended ISVEE 8 in Paris (1997) where they proposed that a future ISVEE should take place in L.Am. This proposal was supported by many attendees, including Professors David Hird, Peter Ellis, Mo Salman, Roger Morris and others. This proposal was facilitated by the visit to Chile of the ISVEE President, Dr. Brian Perry, who was able to verify Latin America's commitment to organize ISVEE 10, as shown by pledges of the Ministry of Agriculture, the University of Chile, the Veterinary College, private associations of producers and animal health services in Chile and in other L.Am countries.

As always, language has been a barrier for presentation of work in international congresses. This was addressed in ISVEE 10 by allowing abstracts to be submitted in both Spanish and English. In said Symposium, another innovation was the incorporation of either Spanish or English as the language for the presentation of papers, which facilitated attendance of more non-English (Spanish) speakers, principally from L.Am, although some were from other Spanish-speaking countries. For example, papers presented in Spanish, not including the work of Spanish-speaking researchers working in North American, Canadian or European universities in ISVEE 10 amounted to 13.4% of 432 oral presentations, whilst in previous events the number of presentations by L.Am scientists had been less than 2%. This shows the importance of searching for mechanisms that facilitate the incorporation of presentations and that veterinary epidemiology, as a way of thinking of animal health, is incorporated in the world as widely as possible. This is an important task for the groups

responsible for future events because our mission is to appeal to many more professionals about with this strategy of seeing animal sciences and public health in professional practice and academia. This will lead to decision makers having better support in the utilization of human and economic resources, a wider commercial coverage, and the facilitation of better understanding.

I want to highlight something unknown to many, which spotlights the figure of our homage, David Hird. It refers to the fact that he unselfishly used valuable time from his sabbatical to directly support the selection and organization of all the presentations that were submitted for ISVEE 10. He also planned the program, which, as those who attended can vouch for, turned out to be flawless.

ISVEE 10 was the first symposium carried out in an L.Am country and it was thanks to the intervention of visionary epidemiologists who attended ISVEE 8. They had faith that it was possible to organize a complex scientific event on the topic of epidemiology in a country like Chile, far from most developed countries, which increased the cost of transport for many participants. It was a gamble of trust and solidarity for which we in L.Am are deeply grateful. Also, the decision to stage ISVEE 10 in Chile subsequently stimulated interest among young L.Am professionals to undertake postgraduate studies in epidemiology in their own countries and also in developed countries. To a large extent, it was these young L.Am professionals who made the organization of ISVEE 10 possible, and those who rose to face the challenge. We deserve to have more confidence in our countries in the future because we can rest assured that these youngsters will be the harvesters of the seeds we have sown throughout the universities, state services and companies in the private sector.

5. Curricular development and training in epidemiology in Latin America veterinary sciences programs

It is difficult to establish clear landmarks regarding the incorporation of epidemiological concepts and activities into the tasks of the veterinary public health or animal health services in L.Am. However, the beginnings can be traced back to Mexico with the huge FMD epidemic from 1946 to 1952, or the public views towards rabies, both paralytic and urban, Venezuelan equine encephalitis and screwworm in Central America and further to the South of America with sporadic outbreaks of FMD, brucellosis, cysticercosis, trichinosis, and bovine tuberculosis.

In an attempt to track the evolution of the development of the epidemiology study programs in veterinary clinics in L.Am, a short questionnaire with four questions (Appendix A) was sent to well-known professors from different L.Am. From a total of 26, 12 replied and a large part of the opinions that were gathered then are given in this presentation.

In the University of Chile, the subjects of biostatistics, public health, agricultural economics, and infectious diseases were formally incorporated in the veterinary curriculum in 1962. In infectious disease courses, a section on epizootiology was included for each of the diseases studied. Epidemiology as such was incorporated into the

Masters' program in 1971 and in the graduate program in 1976 in a course entitled Epidemiology and Public Health. In Mexico, public health was explicitly incorporated into the study program in the 1960s, whilst epidemiology was incorporated independently in the 1980s. In Colombia, and in a somewhat similar fashion in Argentina and Uruguay, the epidemiological focus in the veterinary syllabus was covered as a part of the subjects of infectious diseases or microbiology and public health. Between the 1960s and the 1990s epidemiology was gradually incorporated as an independent subject. The development of the epidemiological area in the training of professionals was strong in the Colombian Institute of Agriculture and Livestock (ICA) and in the Technical Institute of Agriculture and Livestock (INTA) in Argentina.

In L.Am universities, the veterinary curricula, as those in developed countries, have a medical emphasis on individual animals, and more specifically in recent years in the medicine of small animals. In L.Am countries the emphasis in the first half of the 20th Century was oriented towards animal production and veterinary public health. In the last 25 years we have begun to see a major emphasis on small animal clinics, than in large animals.

In other universities, the incorporation of epidemiology began in the 90s, with the arrival of academics trained, in general, in North American, European and also L.Am universities.

The end of the 1960s saw the arrival in L.Am of the first Masters graduates in Preventive Veterinary Medicine from the USA, and during the 1970s the graduates of the advanced postgraduate courses in Animal Health Planning, a course coordinated by the Argentine engineer Osvaldo Fernandez-Balmaceda of the Pan American Centre of Zoonosis (CEPANZO) PAHO/WHO. This enriched the State animal health projects by incorporating proper use of statistics, epidemiological methodologies of analysis, economic evaluations and educational strategies for health. At the end of the 1970s and the beginning of the 1980s, epidemiology courses coordinated by Dr. Felix Rosenberg were also offered through the Pan American Centre of Foot and Mouth Disease (PANAF-TOSA)

With regards to postgraduate courses in the University of Chile, the subject of epidemiology was incorporated into the Masters in Animal Pathology beginning in 1972. In the 1980s, the Masters in Preventive Animal Medicine included descriptive epidemiology, analysis and parametric and non-parametric statistics, along with Administration and Economy. In the case of Mexico, the subject of epidemiology first appeared independently in the study programs of the Department of Postgraduate Studies in 1973. In Argentina, the Postgraduate degree and Advanced Certificate in Epidemiology date from the 1980s to 1990s. In Brazil, the oldest veterinary faculties also follow this pattern.

The themes that have been developed within graduate-level epidemiology programs in L. Am. are fairly conventional and similar to one another. They may contain a change of name or order but they tend to cover: health and disease from the population perspective; prevention, control and eradication of disease in animal populations;

risk and risk analysis; sampling and sampling design; epidemiological studies; diagnostic tests; epidemiological surveillance; and health economics.

There is still a pending task in the teaching of veterinary epidemiology in L.Am universities and this is to define and agree upon the minimum range of competences required in order to offer the L.Am countries the security needed with regards professional work in the sector. In the same sense, the veterinary services in Epidemiology are becoming more and more important globally. Due to this, universities have to prepare professionals for the State and private sector that give guarantees to all the business partners in their respective countries. They should have the best trained human resources and sufficient financial resources to carry out their activities, thus retaining the professionals with technical competences and leadership.

On the other hand, it is necessary to emphasize the focus of "One Medicine" methodologies for governmental programs to help such animal production industries as salmon, poultry and pigs and the same approach must be followed in all the Veterinary Medicine curricula.

6. Profile of a professor of epidemiology in Latin America

In general, the profile of a Professor of Epidemiology in L.Am has followed that of their own teachers from public health, biostatistics or infectious diseases, when studying to obtain degrees and titles in their own countries. They have also received the influence of professors from universities in developed countries carrying out research and case studies relevant to the sanitary conditions in their own countries.

In this way they have created a database of background information on the application of concepts and epidemiological methodologies, to which the graduate dissertations and Master's and Doctoral thesis with which disciples have been created can be added. The younger academics have obtained their academic degrees in foreign universities or in their own countries. They have taken this path using the skills their teachers helped them develop whilst adding their individual abilities and curiosity. Incorporating a new topic into a study program is no easy task given that time is scarce and the requirements of the other subjects are greater than those available, above all if there is no clear graduate profile and clearly defined desired competences. In the case of the study programs in veterinary medicine in L.Am, the majority of them have included components of animal science and public health.

What best characterizes a Professor of Epidemiology in Latin America is curiosity and the challenge of being a pioneer of a new way of thinking about health and disease, often to the incomprehension of their own colleagues. At the same time, trying to open a new frontier obliges them to have skills in various dimensions of knowledge such as veterinary medicine, statistics, animal sciences, computers, data management, economics, social sciences, demography and other topics, and, as a result, the need to integrate themselves into academic and professional teams. Moreover, they need a special vocation for research and social projection.

With regard to skills, it is recommended that they have a solid training in quantitative methodologies. They need practical experience in at least one concrete veterinary activity that allows them to fluently exemplify the application of epidemiological concepts. They should develop research, whenever possible with graduates and thesis students, in a way that helps them learn about the creation of alternative analysis together. They also need to establish good contacts with the farming sector and the sanitary service sector so that they have a wide field for research and exchange with real-life situations.

It is also useful to have a good stock of experiences to motivate these students beyond the subject matter due to the force of their professor's personality. The university professor should have characteristics that are well expressed by Neghme (1986) and some of these should be asked for from the epidemiology professors, in particular the aim of encouraging students to carry out postgraduate and advanced study in epidemiology.

The professor should make students feel that they are responsible for their education beyond the subject matter, and they should understand that the professor is transmitting a new way of thinking that complements the specific training. In the University of Chile, work has been done in incorporating other professionals in topics related to epidemiology and in successful strategies for controlling disease in the country.

The Professor of Epidemiology should try to gently enchant his students with the topics of epidemiology, and in order to do this he should know about the concerns of the students, what they are looking for and what they expect from the teaching, in order to give them the tools that will allow them to start a journey in the search of clarification of their doubts or to point them in the right direction.

Ideally, the profile of a teacher of epidemiology should include the qualities of dreamer, and explorer of new theme worlds, combined with simplicity and openness, given that the teacher's knowledge should transcend worlds and be enriched by what takes place outside the bounds of their geographic or university frontiers. Professors of Epidemiology also should have a wide cultural knowledge that allows them a holistic vision of the topics, given that this helps to orientate the multi-disciplinary teams with their way of thinking.

We have learnt from David Hird, apart from the many achievements already mentioned, his sense of humanity, generosity, humility and above all his authenticity and sobriety. His love of the truth is present in all his actions, without abandonment. Moreover, his great sense of humor which he blended with the particular sense of humor of the Latin Americans, is a great help for the teaching that he offered in almost all its countries, from Mexico to Chile and Argentina, and that we hope he continues to offer us in the future.

7. Conflict of interest statement

Dr. Santiago Urcelay does not have a financial or personal relationship with other people or organizations

that could inappropriately influence or bias the paper entitled "Veterinary Epidemiology in Latin America".

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Appendix A. Questionnaire

What do you consider the most important influences on the veterinary epidemiological focus in your country?

- (a) From a public health perspective
- (b) From an animal health perspective

When was veterinary epidemiology incorporated into the study programs in the curriculum of veterinary medicine in your country's universities?

Which are the most important themes incorporated into veterinary epidemiology study programs?

When were the postgraduate and post title activities in veterinary epidemiology initiated in your universities?

What is the profile for a Professor of Epidemiology, and what knowledge/abilities/experience can reinforce this profile?

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