EPIDEMIOLOGY AND THE VETERINARIAN

by

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PREFACE

The purpose of this report is to give the reader a very brief insight to the accomplishments of the veterinary profession to public health and to recognize the veterinarian as a qualified and appreciated member of the public health team.

It is intended to make emphasis of the increased utilization of the veterinarian in the field of epidemiology, that medical aspect of ecology which studies the interactions between populations and their environment, which result in disease.

The training and background in epidemiology is inherent to the herd or population basis of veterinary medicine and enables the veterinarian to assume an ever increasing role as an epidemiologist.

With these tools he can seek, in an orderly manner, rational concepts of causation for various diseases and conditions, and with this knowledge predict disease incidence, stress prevention and control of or eradicate specific diseases.

INTRODUCTION

Veterinary medicine as a health profession applies the principles of the biomedical sciences to health and disease in animals, contributes to numerous areas of human need through research and in its practice has important direct and indirect bearing on human health. In addition to the commonly recognized responsibilities of veterinary medicine, those of animal care, the profession shields the human populations from scores of animal diseases that affect people, and contributes significantly through research efforts and epidemiology to the conquest of such major human health threats as cancer and heart disease.

Veterinary interests in the zoonoses and in public health have developed slowly with man's accumulation of knowledge about diseases. The zoonoses are infections and infestations which are shared in nature by man and animals and transmitted between them naturally (Schwabe, 1969). There are more than a hundred of these zoonoses, many of which are of public health significance. Mustard (1945) mentioned that human health problems become public health problems when they can no longer be solved by the unassisted effort of the citizen and the uncoordinated resources of the community.

While the development of these interests rarely received important or widespread recognition, a number of individuals

at different times made significant contributions to human health. The historical role played by veterinarians in promoting human health may be best appreciated, however, by consideration of specific examples drawn from the work done in a few important infectious diseases. For instance, the work of the French veterinarian Gaston Ramon in the development of diphtheria toxoid "has all but eliminated, the incidence of diphtheria in children" (Murray, 1948). He was also responsible for the development of tetanus toxoid.

The fundamental studies of Daniel Salmon and Theobald Smith on porcine salmonellosis lead to the discovery of the first Salmonella, and more importantly killed vaccines, which proved to be the foundation of preventive inoculation against various diseases. Bernard Bang's contributions to the control and eradication of brucellosis and tuberculosis are well known. Kilborne, Smith and Curtice's recognition that an arthropod (tick) could serve as a vector of an infectious disease, Texas fever of cattle was an important milestone which has led to many important discoveries on arthropod-borne viruses. Karl F. Meyer's work on botulism and equine encephalomyelitis received wide acclaim.

Many equally significant examples of the direct benefits of research to human health might also be cited. Through the efforts of veterinarians, numerous other diseases of man are now more fully understood (Schwabe, 1969).

THE TEAM APPROACH

Veterinarians entered the public health field, usually with responsibilities for zoonoses control such as rabies, and for meat inspection, the hygiene of foods of animal origin. Public health authorities began to realize that public health practice and veterinary practice share a number of common roots and common approaches to problems.

Following World War II, the United States Public Health Service began to integrate the veterinarian into many diverse programs, not necessarily recognized activities of the profession. With the successes and influence of this organization, there was a concurrent interest in the utilization of public health veterinarian at the state and local levels. The veterinarian became a more established, important and appreciated member of this health team.

Organized interdisciplinary and interprofessional cooperation, the "team approach", became the keystone of public health practice. In this joint team effort, there is daily collaboration of veterinarians, physicians, nurses, engineers, social workers, laboratory scientists, statisticians and others in the accomplishment of tasks which no single one could satisfactorily perform alone. The existence of this public health team is a constant reminder that the objectives of public health practice are too broad to be served by an individual or a group of individuals with similar training.

Public health practice requires the combined skills of a variety of specialists. For a long time the veterinarian has continued to make notable contributions to health, but the veterinarian as a career specialist in public health is a relatively new phenomenon (Schuman, 1959).

Small, usually one man, veterinary public health sections were placed in the divisions of preventive medicine, communicable disease control or epidemiology. According to Emerson (1952), "a trend seems to be to place the public health veterinarian in the division of preventive medical services, since their most effective contributions are in the field of epidemiology."

The former Commissioner of Health for the city of Philadelphia, James Dixon, further recognized "that the veterinarian can extend his use of this tool of epidemiology far beyond the scope of the zoonoses." The veterinarian has not always been aware of his potential (Dixon, 1956).

As this interaction between veterinary and human medicine continues, the prospects of exciting results from these interdisciplinary and interprofessional team efforts will become increasingly apparent, particularly in the areas of basic studies in general medicine and in epidemiology.

DEFINITION OF EPIDEMIOLOGY

In the very narrowest sense, epidemiology may be defined, and still is by the American College Dictionary (1966), as the science of epidemics. Initially, the function of the epidemiologist was to investigate epidemics, trace their source and introduce control measures to prevent their occurrence.

The recognition epidemiology as a discipline of medical science developed, as did the state of the art, since the turn of the century. It was more comprehensively defined by a meeting of American epidemiologists in 1952 as a broad and complex discipline encompassing "the study of all factors, and their interdependence, that effect the occurence and course of health and disease in a population" (Rogers, 1967). Epidemiology is no longer limited to communicable diseases, but is the study of health of population groups in relation to total environment, the study of population ecology dealing with biological phenomena in all their natural complexities.

Epidemiology is, then, the medical aspect of ecology, the study of the interactions between populations and their environments which result in disease, particularly with their trends in time and distribution in space, causes, patterns, and with modes of transmission of disease in nature. Epidemiology is the ONE BASIC SCIENCE which is

unique to population medicine. The epidemiologist is aware that man is but one of the vertebrate species, who shares with his fellow animals susceptibility and resistence to illness. Thus, the epidemiologist's concern for disease is "holostic" (Schwabe, 1969). It is only through a study of epidemiology that we can understand the principles of disease control, for epidemiology is the backbone of disease prevention (Anderson, 1962).

Epidemiology is a descriptive, analytic and constructive science. It is used to describe the origin and spread of a disease in a population concerned as much with methods as well as results. The term "epidemiological method" is frequently employed, but rarely defined. It is not so much a unique method in itself, as it is the employment of <u>all</u> available methods and tools toward the goal of ascertaining the distribution and dynamics of disease and synthesizing the derived information to acquire understanding of disease processes (MacMahon, 1970). These available tools are the combination of those of clinical medicine, anthropology, vertebrate and invertebrate zoology, taxonomy, meteorology, demography, and other established disciplines.

VETERINARY EPIDEMIOLOGY

The wide interest in epidemiology as a human medical discipline is a comparative recent development, and it unquestionably provides a new and broad approach to the field of medicine, whose principal focus has been toward curing sick people who are in bed (Paul, 1966). This epidemiological approach has traditionally been part and parcel of veterinary medicine and special emphasis to epidemiology in the veterinary curriculum enables one to make observations consciously, consistently, and systematically and this is the foundation.

The practice of veterinary medicine and of public health are based upon identical population concepts. The herd and preventive medicine has almost always assumed a more important place in the veterinarian's thinking than has the individual animal. In public health the individual is not the patient, the community is. Interactions of man with his environment determine patterns of disease as they appear among human populations. Diagnosis of the causes of these community ills is dependent upon epidemiology. Public health is herd medicine (Allison, 1958).

The veterinarian, like the physician, is subject to a rather rigid curriculum during his didactic training. The physician's training has two directions, the first being in the basic sciences and the second in the clinical special-

ities. Veterinary medicine, on the other hand, has a third dimension in the application of scientific and medical knowledge to a variety of animal species. Because of this third dimension, the veterinary curriculum is, perhaps, even more crowded than the medical curriculum and is equally more difficult to compress. However, as a result of this additional dimension, the veterinarian is in a position to exert a more comparative approach to the field of epidemiology, which is invaluable.

The majority of veterinary and medical students enter and leave their respective colleges with the sole intent of entering private practice. Because of the low interest in public health as a career, there is a great resistance put forth effort in learning public health and related subjects.

The science of epidemiology becomes a part of the knowledge of veterinary students, for much of their curriculum is dedicated to the concept of the herd, which is the population that epidemiology is concerned with. The principles of epidemiology are acquired early by the veterinary student and he rapidly realizes that he must live and work in an ecosystem in which the magnitude of occurrence of a given disease is the result of a multifactorial display of causes and modifying factors, the dynamic interaction of the characteristics of the agent, the host, and the environment. This is accomplished before the student falls into the rut of believing that disease is invariably the result of a

single agent acting on a host.

He also realizes early in his career that, even though the cure of a disease may have a trace of glamor, a more realistic approach is the control of spread or continued production of disease in a population or herd, and that only the epidemiological approach can provide him with the necessary expertise for such control.

The details of epidemology of blocks of representive diseases are not belabored, because these are more meaningfully integrated later with other subject areas in the individual disease study. It is more important that the student conceptualize the principles of epidemiology and see and appreciate the "big picture", so to speak, rather than memorize the bits of information, all to frequently meaningless which remain isolated facts instead of illustrations or examples of an integrated, interacting whole.

With these basic concepts clearly understood, the facts that must be mastered are more easily handled, and more important, the student has developed the ability to understand the mechanisms in epidemiologically related diseases through transfer and application of these concepts. Experience will add the concentric layers of sophisticated details to the core. These principles of epidemiology and the emphasis of their concepts are presented for their own sake, as common denominator truths for all diseases, or at least for groups of epidemiologically related diseases.

The primary aim of veterinary education is the qualification of an individual to promote and maintain the health of economically important agricultural animals by preventing and treating their diseases, not to produce a specialist in public health or epidemiology. It is stressed, then, that as far as veterinary public health and all other non-central areas of veterinary service are concerned, the veterinarian is useful precisely because he is trained to fulfill the essential relationship of veterinary medicine to agriculture, because he is an exponent on the herd basis for medicine and because he does view prevention in the herd more revelant than cure in the individual. Thus public health and epidemiology at the professional level in the curriculum is only to insure that the veterinary student is thoroughly aware of the broader implications of his field and the wide range of opportunities afforded him to serve (Schwabe, 1969).

METHODS AND CONCEPTS

Basically, epidemiology seeks to determine rational concepts of causation for various diseases and conditions. By various applications, community groups and agencies can use this body of knowledge to:

a. Predict epidemics.

b. Measure disease incidence in a population.

c. Stress prevention of disease rather than just reacting to epidemics.

d. Control and/or eradicate specific diseases.

When each communicable disease is studied separately, it is evident that each disease has its own:

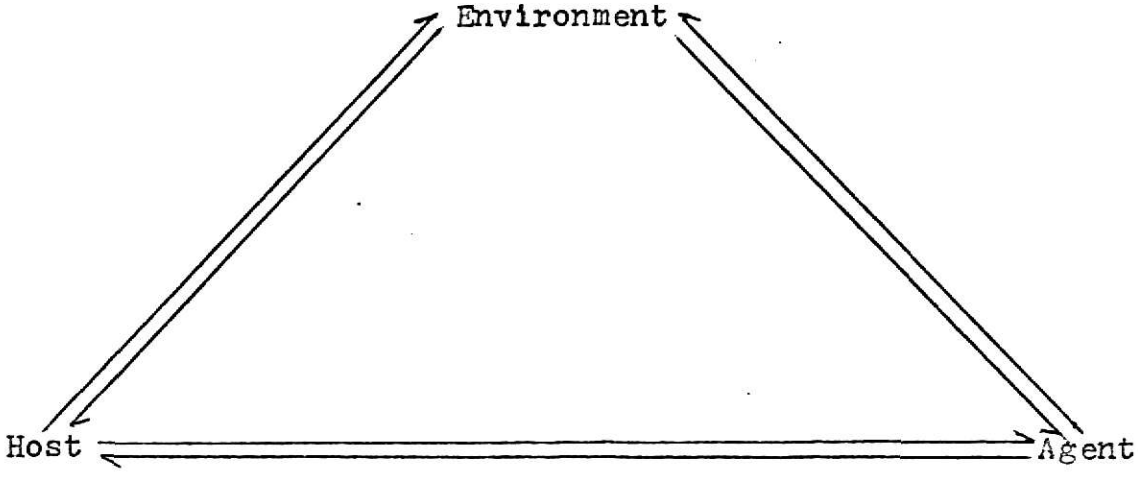
a. Syndrome.

b. Etiological agent.

c. Prevalence.

d. Geographic/seasonal distribution and selectivity for certain population groups.

It would appear that each disease is separate and distinct unto itself and that there are few generalizations that can be applied to overall. Yet epidemiology recognizes that all diseases are based on an equilibrium between <u>host</u>, <u>agent</u> and <u>environment</u>, and that disease results when changes occur in one or more of these very complicated factors.



Epidemiology, then is equally dependent upon the study of the HOST, and AGENT, the ENVIRONMENT, and all of their complicated interrelationships.

The predominant purpose of epidemiology is the search for causal relationships between diseases or other biological processes and specific environmental experiences. The methods used to further this purpose may be classified as follows:

a. Descriptive epidemiology -- description and distribution of disease, with comparisons of its frequency in different populations and in different segments of the same population.

b. Formulation of hypothesis -- tentative theories designed to explain the observed distribution of the disease in terms of causal associations of the most direct nature possible.

c. Analytic epidemiology -- observational studies designed specifically to examine the hypotheses developed as a result of the descriptive study.

d. Experimental epidemiology -- experimental studies on populations to test in a stringent manner those hypotheses that stand the test of observational analytic studies.

If epidemiology operated independently of knowledge gained in other biological and medical disciplines, these methods of investigation might be expected to proceed in the order listed. However, according to the contribution made by other disciplines, particularly by clinical medicine and laboratory experiment, any, one, none or all of these methods may be used in epidemiological investigations of disease (MacMahon, 1960).

PROCEDURES

The study of the ecology of a disease, even though it may lead to definite and correct conclusions on the part of the investigator, will ordinarily serve no useful purpose unless the investigator is able to assemble the same conclusion in the minds of others, usually people of intelligence, but without technical knowledge of epidemiology. The following outline is not intended as a rigid rule, but rather as illustrative of a sequence which will ordinarily lead to a conclusion by easy steps. The sequence itself need not be followed rigidly, for in the investigation of an outbreak several components will, out of necessity, be dealt with concurrently. It is sum total of the team approach with the epidemiologist putting the pieces together.

I. Establish the existence of an epidemic.
   A. Verification of the diagnosis. This is essential.
      1. This may require only a brief review of the clinical findings, or may necessitate the initiation of laboratory tests.
      2. Reporting sources. Consider reliability.
         a. Competent laboratories.
         b. Physicians.
         c. Others.
      3. Laboratory vs clinical.
         a. Some diseases have no laboratory tests applicable.

b. Some verifiable only by laboratory findings.

c. Some have complex tests performed only by highly specialized laboratories.

4. Health Department encouragement of immediate reporting.

5. Search for additional cases which may not have been recognized or reported.

B. Delineation of group involved into definite, probable, and suspect cases.

C. Incidence as compared with normal.

D. Significance of distinct departure from normal incidence or previous experience.

II. Orient the epidemic as to time, place, and person by:

A. Chronological distribution of onsets of cases: by days, weeks, or months (in some diseases, hours).

B. Geographic distribution in civil or sanitary subdivision of the area affected; in detail by spot maps to determine concentrations within given areas.

C. Make a rapid preliminary analysis of available information on population and reported cases and deaths, according to race, sex, age, occupation, residence, to discover what group or

groups have been selected for attack. This analysis involves specific attack rates.

D. Initial impression as to type of outbreak. Attempt to classify the epidemic as to mode of transmission, as follows:

Common Vehicle (holomiantic) - a. Single exposure (point source).
b. Continued exposure.
c. Person to person spread (prosodemic).
d. Inapparent infections.

Propagated - e. Arthropod vector.
f. Animal reservoir of infection.

Determine the character of the epidemic curve, to ascertain whether it suggests that a group of people were infected at or about the same time--and, upon the basis of the incubation period of the disease in question, fix the probable time of this occurrence.

III. Formulate tentative hypotheses of the most probable source of infection as a basis of investigation.

IV. Draw up plans for:

A. Administrative measures to care for the sick and prevent spread;

B. Detailed investigation of all cases or an unbiased sample of cases;

C. Special investigations needed to establish collateral circumstances, using laboratory facilities, engineering and other expert consultation.

V. Analyze detailed data derived from case investigation as rapidly as they can be assembled, comparing the attack rates among various pertinent groupings. Try to identify the group (universe) selected for attack and discover the common source or sources to which the members were exposed.

A. Individual epidemiologic histories to classify exposed persons as to:

1. Exposure to specific potential vehicles.
2. Ill or not ill?
3. If ill, clinical data and bacteriologic findings to substantiate diagnosis.

B. Investigation of source and method of preparation and preservation of suspected foods.

C. Environmental conditions (collateral study) e.g. sanitary status of restaurant, water, milk supply, examination of food residues.

D. Demonstrate significant variations of incidence in contrasted population groups.

1. From simple data: in sections of the area and population concerned (city wards, sanitary districts):
   a. Attack rates by civil subdivisions from available population statistics;
   b. Comparative attack rates in racial, sex, age and occupation groups.
2. From more detailed records: in groups according to sources of water supply, milk supply, ice cream supply, character of residence, particular events or habits, etc.
3. Attack rates for those exposed and those not exposed to each suspected vehicle, or the reverse: frequency of exposure to suspected vehicle, among those attacked and those not attacked.

E. Assemble results of (nonstatistical) collateral investigations.

VI. Search for human or animal source of infection.

VII. Test various hypothese suggested or tentatively established, to ascertain which is consistent with all the known facts. There may be more than one hypothesis which fits all known facts. One must then seek further facts until an array is found which matches all deductions from one hypothesis

and is inconsistent with all others.

VIII. Base conclusions upon all pertinent evidence, not relying upon any single distribution or circumstance by itself.

SUMMARY

The veterinary profession has made numerous contributions to improve human health. Veterinary medicine occupies a particularly advantageous position among the sciences in its ability to make contributions to public health and epidemiology.

Subsequent to the integration of the veterinarian into non-veterinary areas of the public health field by the United States Public Health Service, the veterinarian found himself in demand as a qualified and appreciated member of the public health team. Because of his training and background in herd or population medicine, he frequently found his "niche" in the field of epidemiology.

Epidemiology is the ONE BASIC SCIENCE unique to population medicine and it is a basic science in which the veterinarian has shown particular expertise. I have attempted to give a very brief insight to the methods of epidemiology and what epidemiology can accomplish. The procedures outline is presented only to emphasize in an orderly manner the many facets involved in the study of these interactions between populations and their environments which result in disease and with their trends in time and distribution in space, causes, patterns and modes of transmissions. It is the epidemiologist who puts it altogether.

Nearly one-third of all veterinarians in the United

States are engaged in teaching, research, preventive medical practice or other areas related to public health and to epidemiology. The critical shortages of personnel in the health professions will continue to make demands of the veterinarian in the field of public health at local, state, national and international levels. The veterinarian will continue to make many contributions to human health and perhaps, more so in the field of epidemiology. The veterinarian is, ipso facto, an epidemiologist.

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APPENDIX I

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EPIDEMIOLOGY AND THE VETERINARIAN

by

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AN ABSTRACT OF A MASTER'S REPORT

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ABSTRACT

Veterinary medicine is the health profession that applies the principles of biomedical sciences to health and disease in animals, contributes to many areas of human need through research and in practice has important direct and indirect bearing on human health.

The contributions of veterinary medicine to the health of man are numerous. Among the accomplishments were the early identification of bacteria and viruses, recognition of arthropod vectors, development and practical application of diagnostic tests, development of disease control and eradication programs.

The veterinarian has benefited the health of man in all aspects of the biomedical sciences. As public health interest and practice developed, the team approach to problem solving became the keystone. Public health interests and utilization developed rapidly in the post-World War II years, and so did the knowledge and responsibilities. The veterinarian, a recognized member of the public health team, has been asked to assume an important role for which he is well trained and qualified--that of an epidemiologist.

Epidemiology is the ONE BASIC SCIENCE which is unique to population or herd medicine. Epidemiology is the medical aspect of ecology, the study of the interactions between populations and their environments which results in disease.

Epidemiology seeks to determine rational concepts of causation for various diseases and conditions, and with this knowledge predict epidemics, measure disease incidence, stress prevention and control or eradicate specific diseases. It is dependent on the study of the host, the agent, the environment and all their complicated interrelationships.