

# Epidemiological and Economical Approach In Animal Health Management

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## Summary

A variety of patterns for delivery of rural veterinary services during the past 200 years demonstrate that, for no country have purely or largely curative services been economically viable without direct or indirect governmental subsidization. The impacts of such efforts upon overall productivity were rarely, if ever, convincingly demonstrated ; yet veterinary curricula still continue to emphasize practice skills solely applicable to individual animal curative medicine. At the same time, governmental disease control programmes on a population level were almost exclusively mass campaigns conducted without benefit of sufficient baseline information on relevant distributions of diseases of causally related variables, therefore not optimally focused for best uses of scarce resources, not seldom able to accurately reflect their economic advantages in terms of benefits and costs.

During the past 20 or 50 years these situations have begun to dramatically after with accelerating adoptions of quantitative systems for livestock disease surveillance as the "cove" element of veterinary services delivery.

These are not only beginning to provide adequate baseline data for assessments of cost of uncontrolled diseases, but to convincingly show the economic and production gains disease control can provide. Beyond these, surveillance systems provide the data for sophisticated epidemiological analyses. These may be designed to demonstrate existence of herd health problems not ordinarily perceived by livestock owners or practicing veterinarians and to identify not only responsible etiological agents of the conventional types, but also host, environmental and managemental factors which may, directly or indirectly, result in increased frequencies of distinct diseases, or in covert conditions underlying less than optimal productivity.

It is well past time for professional veterinary curricula world-wide to catch up with the methodological practice skill advances of this on-going "epidemiological revolution" and train many more veterinarians in their use. If they do not, we can be assured that others will step in and perform these vital functions, within the livestock sector.

Two "engines" running in tandem appear to have generated most of the initial interest within Europe's ruling circles of the 18th century for creation of the first independent veterinary educational, research and services institutions. The more powerful of these "engines" was recognition of the urgency

of countering major threats to the still predominantly agricultural economies of Europe by the widespread occurrence then of unchecked and poorly understood animal plagues. This need for effective *preventive* barriers to spread of economically devastating "*contagions*" of livestock was brought to a head by governmental helplessness in the face of the invasion of western Europe, beginning with the German states in 1711, by rinderpest which traveled in the van of Charles XII's Swedish armies returning from Russia. Warning of impending "*ruin of the land*", the ruler of Brandenburg, Frederick William I, demanded of the medical authorities of his country that they learn the cause of rinderpest and halt its rapid and devastating advance. Europe's existing medical establishment's efforts to meet this challenge failed.

Joined to this preventive impetus, was a second "*engine*" of general equestrian concerns created mostly by politically powerful military, "*high society*", drayage and other commercial interests which lobbied for an improved standard of *curative* medicine for horses. Capitalizing upon these demands, a leading French equestrian and science dilettante, Claude Bourgelat, created a first school of veterinary medicine in Lyon in 1762. Concerned initially almost solely with diagnosis and cure of illnesses of the individual horse, the Lyon school patterned its intended product upon the existing example of private physicians supported through fees-for-services. That school, and the second Bourgelat started two years later at Alfort, quickly stimulated widespread enthusiasm for formal veterinary education throughout

Europe. One of the most dramatic and far-reaching immediate responses was from the governments of nine other European countries which sponsored students in Lyon's and Alfort's very first classes, men then destined to become veterinary pioneers in their own countries. Among these were a medical student, Peter Abildgaard, sent from Denmark and a natural sciences Ph.D. and protege of Linneus, Peter Hirnquist, sent from Sweden.

Critical of the Bourgelat curriculum's predominant emphasis upon the cure of the horse, Abildgaard broadened the species base and problem concerns within his own Danish college to include more emphasis upon farm livestock -- and upon protection of Denmark's animal industries from the economic onslaughts of rinderpest and other poorly studied livestock plagues. A pioneering researcher himself over very broad areas of medical science, Abildgaard provided strong impetus to that additional role for graduates of the new veterinary colleges. Thus, he and other veterinary pioneers gave a big push to growing recognition in still poorly developed medical research circles that -- as before with comparative anatomy and comparative physiology -- a *comparative* approach to an understanding of the etiologies and mechanisms of diseases, would, once again, prove the key to further biomedical progress.

I could give other examples of different pioneers and their novel approaches to veterinary education and professional roles throughout Europe --- innovations in social needs recognized, curricula devised and types of professional

products turned out. However, the point I want to make is that the impetus for veterinary schools and educated veterinarians came from *multiple sources with divergent needs and with very divergent expectations* of these schools, the functions their graduates would perform and the infrastructures, or "*practice mechanisms*", through which these functions would be realized. One result was that, to different degrees in different countries the new veterinary graduate came to assume roles in government service, including public health, in rural community leadership and in scientific research, as well as in clinical veterinary practice.

Private practice opportunities based on the physician model were immediately evident horses, and to some extent dairy cattle, in *urban* areas. Of necessity this was *curative* medicine practiced on individually valuable animals. That opportunity was not evident, however, in the countryside where the principal motive for introducing veterinary practice was some governmental desire to boost the general rural economy by improving the lot of the peasantry and of yeoman farmers.

In consequence, novel suggestions for employing these new graduate veterinarians in rural areas were made then. And a few of the approaches actually adopted to help make rural veterinary careers economically viable, while providing needed services to impecunious farmers, were extraordinary. Thus Peter Hirnquist -- in seeking a mechanism to support his new graduates in Sweden's countryside -- seized upon possibilities suggested by the only already

existing, widely organized instrument of the Swedish state, it's Church. Required to study music and examined in church organ, many of Sweden's first veterinary graduates held appointments as paid ministers of music and registrars of vital statistics in it's rural parishes *while* they came to know their parishioners and attempted to introduce the idea of paid veterinary service among them.

An alternative pattern adopted almost simultaneously with these beginnings of private practice was formation by governments of *official* veterinary services. This was largely in response to the rinderpest-animal plagues impetus for veterinary schools, and represented in part an extension to meeting these these civilian needs of an existing precedent in some countries of a military veterinary service. The designation of this new civil service as veterinary sanitary *police* reflected both of these realities.

Interestingly, these civil veterinary organizations pioneered in public service *per se*, in that they were among the first governmental services provided for the rural countryside, sometimes the very first evidences of governmental presence beyond tax-collection or conscription for the army. Out of these combinations of approaches and objectives ordinary farmers and their families were brought into active contact with the first well-educated class of individuals most had ever encountered, surely on their own farms.

Looking back now over this history of initiation and delivery of rural veterinary services from such unsure and diverse

beginnings over two hundred years ago to the present day, we can identify certain *persistent* problems and challenges, and make certain other generalizations, which should help us better to understand and face our rural future as a profession. These include the facts that :

1) Only in some *few* rural situations where individual animals of high intrinsic value were very prevalent did private curative veterinary practice *in Itself* prove economically viable without some form of direct or indirect "*prop*" or subsidy. This is still the case.

And, 2), unprecedented but poorly recognized personal demands were placed, at least until very recently, upon almost all rural veterinarians in private practice.

These were to have the interest and capacity to remain in close touch with the rapid progress of medical science, while at the same time, be content to live and work (very hard) among an uneducated populace in an environment which offered few if any social or cultural amenities. For rural veterinary practice, success -- and satisfaction -- still demands an unusually adaptable person.

The rural species of high enough individual value sustain a practice limited to a "*fire engine*" - type of curative response to medical emergencies were draft, carriage and riding horses; draft oxen and some dairy cattle. All but the latter subjects for practice have now virtually disappeared from those countries where modern, independent veterinary medicine began. Inadequate replacement to sustain practice has been provided by

the increased individual value of some other purebred breeding stock.

Throughout modern veterinary medicine's history, a variety of "*props*" have been used to help make this practice pattern of private curative medicine in rural areas a more economically possible venture. Ones commonly applied in the United States during the first half of this century included :

- 1) enlistment of up to 50 % of U.S. private practitioners on a part-time paid basis as vaccinators, specimen collectors and premises inspectors in governmental disease control efforts, a *preventive* activity,
- 2) evolution of some economically dependable "bread and butter" practice involving routine *preventive* administration of farmer-requested immunizations. Especially important was the "*tricky*" and potentially dangerous annual administration simultaneously of live virus and immune serum against hog cholera, a "*prop*" facilitated in America then by existence of dozens of veterinarian-owned laboratories for production and sale (only to veterinarians) of livestock vaccines, and
- 3) some, and eventually much, small animal curative practice to more predictably sustain an unpredictable demand for response to rural farm emergencies.

Elsewhere, such "*props*" to rural practice have included some of these and several others, including :

- 4) performance of routine on-farm

artificial insemination services, and

- 5) part-time governmental employment in local abattoirs.

These were in addition to some other more *general* practice support mechanisms, such as

- 6) provision of farmer cooperative-owned veterinary practice facilities and a guaranteed minimum income to rural veterinarians, as in the New Zealand "*veterinary club*" pattern,
- 7) similar practice arrangements provided to individual veterinarians by mostly multinational pharmaceutical or feed firms, the former a prevalent pattern in areas of South America, and
- 8) veterinary practice under the aegis of farmer insurance schemes, as with that of the Israeli Federation of Labor.

Indirect subsidization of private veterinary practice has been realized too in many countries through various governmental price support programs to farmers, especially in the dairy industry.

But even in the several most highly industrialized of capitalist states, complementary governmental food animal veterinary services, functioning almost exclusively at the population and preventive levels, were created to fulfill social needs which could not be met through private practice. Elsewhere in the world *completely* socialized veterinary services came into being at the individual animal and curative levels as well. That pattern represented either deliberate ideological objectives or, as throughout the Third World generally, a reflection of

current economic realities. Though I have heard both a German and American agricultural economist state in recent years that *all* rural veterinary services could or should be "*privatized*", I think that such suggestions reflect poor understanding not only of veterinary practice economics, but of the total participation requirement and other prerequisites for successful realization of most large-scale preventive veterinary medical efforts. On the other hand, there is considerable evidence that *some* monetary charges to farmers, even of a token nature, might improve the overall effectiveness of most completely socialized systems of veterinary practice.

As an example of an extreme consequence to private rural veterinary practice of many such previous events and circumstances is the present, and I think unnecessarily skewed, distribution of privately-provided veterinary services in the United States. For, of 25, 357 American Veterinary Medical Association members engaged in private practice in 1980, wholly large animal practitioners numbered only 1050 (*including* those treating pleasure horses exclusively or mostly). Just 262 had exclusively cattle practices and 30 exclusively swine practices. Whereas some 6922 additional veterinarians were in mixed practices that were 50 % or more large animal (again including pleasure horses), and about 4000 other veterinarians did *some* large animal practice, about 12,000 or nearly half of all private American veterinarians in 1980, conducted exclusively small pet animal practices.

Turning now from the perspective of history and these practical economic realities, I think we can reach some fairly optimistic conclusions nonetheless about the general future for both curative and preventive approaches to rural veterinary practice. For there are now significant changes in historic practice patterns being initiated, albeit still in a fairly disjointed manner, through a new and complementary technology resulting from the current epidemiological revolution. One very important prerequisite for their success will be that a proper, rationally-derived balance be sought continually *in each country and situation* in allocation of resources to curative and preventive efforts, whether governmentally or privately administered. That is, I do not think it will be a case in the future of preventive *versus* curative medicine, but of locally optimal balances. And that applies, in the first instance, to veterinary education, which now lags dangerously in this regard.

Wherever draft animals are the energy-providing mainstays for plant production and the rural economy generally, the major capital investment of many farmers -- as I believe they should *selectively* remain for the foreseeable future in many countries -- then curative veterinary services to livestock will always remain important and in demand. The same is true to some extent for dairy enterprises, even though some currently irrational and excessive culling in face of disease or injury is practiced by farmers in very large intensively managed dairies, as in large parts of my own state of California where 300 cow dairies are considered small and large dairies milk 2000-4000 cows.

The procedures of curative practice are well-established and workable research infrastructures to continually improve their quality either exist or we know how to institute them.

It is in the population and largely preventive aspects of veterinary practice, however, that changes and innovations will become most evident. Recently accelerating progress in implementing a new rural practice infrastructure in government based upon population-wide diagnosis (i.e., epidemiological surveillance) will continue. And with it new approaches and methods to study diseases as multivariate phenomena will become more widely adopted.

At the same time the idea of "*herd medicine*" at the level of individually managed herds and flocks is also rapidly realizing the level of scientific sophistication it too requires to pass from the "*romantic*" -- an idealistic but impractically implemented desire -- to the point of economically feasible "*reality*".

These both will enable veterinary services to move beyond the diagnostic "*plateau*" reached after a century of phenomenal laboratory-provided inputs and of solely experimental resort to investigating medical unknowns. Since many medical experiments depend upon simulations of complex natural events, but with attempts to control all but a single variable, they may not resemble the state of nature sufficiently to provide the answers required. However, these well-accepted laboratory "*back-ups*" to practice now provide stable footing for initiation of scientific epidemiological

progress too, progress giving birth to a stage of preventive veterinary medical practice beyond the valuable yet often inefficient and still largely "shotgun" approach of *unselective* applications of often single "weapons" on a herd-wide basis, or in large-scale, area-wide mass campaigns.

The key to these advances in delivering veterinary services at both large geographical population and individual herd levels, is quantitative epidemiological intelligence -- that is modern surveillance plus intensive follow-up. One consequence of the development of sophisticated intelligence systems at both levels of practice will be that new patterns of interaction between governmental and private avenues of veterinary service are destined to arise in those countries where both exist.

There is not time here to describe the requisites for modern epidemiological surveillance and intensive follow-up as the future *core* for population-wide and local herd-level veterinary practice. I and others have attempted that elsewhere. Let me point out simply that, while the philosophical underpinning and most effective and unique approach of such efforts, *active* disease intelligence, was pioneered within governmental veterinary services in the last century, especially by Daniel Elmer Salmon, founder of the U.S. Bureau of Animal Industry, an orderly description of the total process of epidemiological surveillance, with more consistent patterns of implementation, were first introduced following World War II by Alexander Langmuir within the U.S. Centers for Disease Control. These were

efforts in which veterinarians as well as physicians were prominently involved. The most notable large scale success of this approach -- which permits more selective of focused actions in the field -- has been global smallpox eradication.

This largely developmental period is now giving way rapidly within veterinary medicine to a mature phase of preventive, population-based practice -- as fuller fruition of the ongoing epidemiological revolution. This is resulting from building programs of action upon the foundations of quantitative surveillance and intensive follow-up, an advance which makes use of rapidly evolving data handling and data analysis technologies. This whole process constitutes *epidemiological diagnosis*.

Epidemiological diagnosis provides a powerful third complement in practice to clinical and pathological diagnosis. Through attempting to identify, and determine the relationships between disease occurrence and other relevant variables, that is, to identify and analyze the "*webs of causation*" represented by naturally occurring diseases, epidemiological diagnosis not only yields information required for practice decisions, but may help set the stage for other more specifically reductionistic activities in the field or laboratory. In effect, epidemiological diagnosis is making of field-based practice -- as is already the case with laboratory-based practice -- an applied research activity, with all its elements of scientific method, practical results -- and personal satisfaction to the practitioner. Also, by providing the means to establish the costs of diseases to owners of livestock and the monetary value of veterinary

interventions and other services, epidemiological diagnosis helps provide economic stability to private rural practice in more affluent countries and markedly increases, and much better documents, the value of veterinary services provided by government.

Let me make from current efforts a few remarks about just *one* new approach to farm-level practice which is applicable also at the levels of the district, provincial or national "*herd*". I refer to the cross-sectional "*among herds*" approach, a complement to much more familiar longitudinal and cross-sectional "*within herd*" efforts. While the "*among herds*" format for delivery of veterinary services also permits use of such valuable "*within herd*" study designs and approaches to data analysis as cohort and case-control studies, times series and actuarial analyses, decision-tree plus other forms of decision analysis, and a variety of multivariate statistical methods, it offers other unique diagnostic possibilities.

Additional features of an "*among herds*" format include the facts that (1) it is not as dependent as the sole "*within herd*" approach to accumulating data over a prolonged period of time before they can be used to maximum advantage and (2) it is especially useful for *detecting herd problems not identifiable by the farmer*, or through usual veterinary routines. Complementing "*within herd*" methodologies, it helps identify not only such specific causal variables as living and non-living agents, and causally related characteristics of certain animals in the herd, but, in addition, it is especially valuable for identifying causal variables present in a particular herd's

environment *or* causal variables introduced or influenced by a particular farmer's managerial procedures and decisions.

The second of these attributes, detecting problems not otherwise apparent to the herd's owner, provides the key to *sustaining* owner interest in herd-level programs *beyond* the point where the owner no longer perceives that the original problem which required veterinary assistance exists. That is the issue over which most early attempts at contractual herd-health programs in private practice have foundered.

In a nutshell, the "*among herds*" format depends upon comparing a particular herd of concern with the district or county "*herd*" of which it is a part for the level or frequency of occurrence of *any* disease, abnormality, reproduction or production parameter. Thus each herd of concern can be described for any particular parameter, say level of neonatal calf mortality experienced, as average, above average or below average in terms of the overall county/district neonatal calf mortality experience. Or, more specifically, the herd may be identified as, for example, in the seventh decile on a scale running from the lowest to highest calf early death rates experienced among individual herds in that county, or it can even be specifically ranked as, for example, the 78th farm from the best among all 103 county dairy farms with respect to early calf losses. The farmer then decides, with his veterinarian, whether that performance constitutes a "*health problem*" for *him* in terms of what is actually attained by other farmers in his own county. Up to this point this process



is strictly one of an in-place surveillance system.

But, *if* our farmer concludes that a problem demanding attention does exist, his herd can also be compared, often simultaneously, through methods of analytical epidemiology, for a number of hypothesized or candidate "*causal variables*" (whether agent, host, environmental, managemental) with the best, and/or the worst, performing county farms for neonatal calf mortality. Here the object is to identify specific variables causally associated, either directly or indirectly, with either good or bad performance for the disease/production/reproduction parameter studied, *and which might be manipulated to our farmer's advantage.*

Veterinary services delivery systems based upon the capacity for epidemiological diagnosis readily enable the criterion of "*health*" to become *optimal* production or reproduction, even where a specific illness or abnormality is not evident. Anything less than optimal is then defined as "*ill-health*". For this purpose of intimately involving veterinary practise in production outcomes, the "*among herds*" veterinary services delivery system has the psychological and "*reality*" advantages that optimal health/production/reproduction *standards* for comparison are not estimated or abstract standards, or ones based upon national or other remote "*best achievements*", or on best published results, but what is *currently* realizable under the same *general* conditions of farming within that that particular county's herd.

Milkshed areas of the Canadian

province of Ontario, and the County of Tulare in California, are two places where veterinary delivery systems research of this type has been in progress to establish more fully the requisites of quantitative area-wide ("*county*") and "*within herd*" surveillance for dairy farms and to test and demonstrate uses of analytic epidemiological diagnostic procedures based upon. This surveillance at the county reference herd level makes use of all already existing data collecting systems, such as Dairy Herd Improvement Association records in Tulare County, California, supplemented by cumulations over time of standardized individual "*within farm*" data and cross-sectional data obtained through specific surveys.

The county-level of such a system -- and the computer, statistical and other analytical back-up to use it for diagnosis -- could be provided by government and be available to private veterinary practitioners (in countries where these exist), as are government-provided diagnostic laboratory services. Or, alternately, a county veterinary society could provide this services to it's member practitioners, just as some now sponsor veterinary emergency clinics or laboratory facilities, or coordinate practitioner involvement in area-wide campaigns such as for vaccination of pets against rabies.

And obviously, *networks* of county systems can augment overall provincial and national surveillance efforts and applications. For, as can be seen, this same "*among herds*" approach may be applied just as easily at higher levels of populations in government-based

practice. For example, it has been used already on an "*among counties or control areas*" basis in some national disease control programs to help explain such things as differences in pre-control prevalences of a disease among different counties/control areas, or to investigate the causes of different rates of control progress from county to county, etc.

Ultimately, the rapidity of progress in preventive, population-based veterinary practice in the food production sector will depend upon the rate of adoption of this new surveillance-type infrastructure and these new diagnostic tools to veterinary

medicine's armamentarium. This is dependent upon the training of substantial numbers of veterinarians in an understanding of their nature and use, for too few veterinarians yet have any inkling of what is involved. If veterinary practitioners were that out of touch with recent immunological progress, for example, the profession would be rightly concerned. It should be even more so here. For, of one thing we can be certain. If veterinary services, individual veterinarians *and veterinary schools* fail to devote themselves sufficiently to these new practice tasks, others will be waiting to do this job for them.