Information systems for animal health: objectives and components

R.S. MORRIS *

Summary: As in most other technical and management fields, information management is fast becoming the key to effective action in animal health. A modern veterinary service requires effective systems for gathering relevant information from the field, processing it in ways which provide maximum value, and presenting it in a form which is easy for national policy-makers and field staff to use in implementing appropriate actions to achieve effective disease control. This paper describes seven objectives which should form the basis for developing an integrated national animal health information system. It also specifies six criteria which any information-gathering activity should be required to meet before it is allowed to commence. For each of the seven objectives, a description is given of how the particular component of the system can be used, with examples of how such information management procedures have been implemented in practice. Attention is drawn to other papers in this issue which describe various innovative techniques currently used to meet some of the objectives of a modern animal health information system.

KEYWORDS: Animal disease - Animal health - Animal productivity - Epidemiology - Information systems - International disease reporting.

INTRODUCTION

As decisions on animal health policy become more complex and the ramifications of these decisions more far-reaching, veterinary administrators have a growing need for more quantitative and reliable information to provide the basis for their actions. Field veterinarians also are making more extensive use of data organised into forms which can be analysed to help them evaluate progress in disease control and decide on future directions for their efforts.

These trends are occurring for two major reasons. Firstly, the economic and management environment in which official veterinary services are now operating places heavy pressures on veterinary staff to justify the effectiveness and cost-effectiveness of their activities, and to respond quickly and efficiently to changing circumstances.

Secondly, the choices which now have to be made in disease control programs are far more difficult than was the case with some of the more epidemiologically straightforward diseases dealt with in the past. The differences between a potentially

---

* Department of Veterinary Clinical Sciences, Massey University, Palmerston North, New Zealand.
successful disease control program and one which is unlikely to succeed are becoming more subtle, and both senior veterinary administrators and field veterinarians will need higher quality information if the past level of success of animal disease control programs is to be maintained. More comprehensive epidemiological and economic information on the consequences of possible animal health programs is now essential for decision-making.

Thus, throughout the last decade, various kinds of information systems for animal health data have been expanded in many parts of the world. Fortunately, many of the technical advances in information management which have occurred over the same period have made the development and use of information systems by veterinary services easier than would previously have been the case.

Many new ideas in information collection and management have been tried in recent years and valuable lessons can be learnt from reviewing the experience of others. Not surprisingly, there have been some notable successes and some disappointments. However, many valuable ideas and experiences have not been described in the scientific literature, in part because such systems are a means of achieving results and the findings, rather than the methods of obtaining them, have been reported. In addition, development at present is so rapid and diverse that many people working in the field tend to consider as premature reporting on techniques which they see as still under development.

In fact, the period when development of techniques is proceeding most rapidly is an ideal time to describe them, to assist novices in understanding developments and to encourage the exchange of ideas among people working directly on the topic.

This special issue of the Review contains a selection of invited papers, chosen to demonstrate a spectrum of innovative approaches currently being taken in various countries to collect, process and interpret data of value in the operation of veterinary services. The objective in selecting topics was less to attain comprehensiveness than to draw to the attention of OIE Member Countries developments which are of international importance and which may otherwise not have been as widely recognised as they deserve to be.

This introductory paper describes the various facets of a modern animal health information system and shows how each of the topics covered in other papers fits into the design of such a system.

USES OF ANIMAL HEALTH INFORMATION SYSTEMS

Criteria which any information system should meet

There is little point in developing efficient means of gathering data if the only outcome is to overwhelm the user with uninterpretable detail. All too often in the past, data-gathering has been undertaken with no clear objective, in the mistaken belief that "it must be useful". Under such circumstances, it rarely is.
Opit (6) has discussed similar issues in information systems for human health and summarises the dangers of inappropriate data collection in a series of statements known as “Finagle’s Laws”:

- the information you have is not what you want;
- the information you want is not what you need;
- the information you need is not what you can get;
- the information you can get costs more than you want to pay!

Though unnecessarily harsh, this statement contains sufficient truth to serve as a warning, and should be considered before commencing any development work on information systems.

It is suggested that any information-gathering activity should be assessed in advance to decide whether it meets the following criteria:

- There should be a clearly defined purpose for gathering the data. This purpose must be agreed upon by all participants before data collection starts.
- The system for analysis and interpretation of the data should be worked out before data collection begins.
- Analysis of the data should be carried out promptly after it is received.
- There should be effective quality control procedures built into the undertaking to provide adequate assurance of the validity of the findings.
- There should be prompt feedback of some sort to the various suppliers of the data so that they know they are making a useful contribution. If possible, suppliers should also receive some tangible or intangible benefit from their involvement.
- Each individual data-gathering exercise should either have a defined endpoint or be subject to periodic critical review.

If all these criteria can be met, the prospects of a rewarding system are good.

**Appropriate objectives for national animal health information systems**

An appropriate set of objectives is:

- to provide periodic assessments of the productivity and overall health status of livestock populations in the country;
- to provide continuous monitoring of (carefully selected) specific diseases which are considered important to the country and for which such data will assist in the development and management of control policies;
- to provide information required to meet international disease reporting needs and to support declarations of disease status for trading purposes;
- to identify promptly and accurately any emerging disease syndromes which would require a response from veterinary services;
- to support current disease control programs and provide data to evaluate the effectiveness of these programs, both during their operation and in retrospect;
to obtain ancillary information from sources other than the veterinary service (this can be integrated with directly collected data and, hence, assist in providing an adequate spectrum of relevant data for decision-making at local and national levels);

- to provide a structured framework within which policy development and evaluation can take place, such as support to the Chief Veterinary Officer in making national policy decisions.

Each of these objectives will now be considered individually.

COMPONENTS OF THE INFORMATION SYSTEM

Assessment of productivity and health status of the livestock population

In recent years, complex multifactorial disease problems have grown rapidly in importance and the simpler contagious diseases have been brought steadily under control. As a result of this evolution of disease patterns, the focus of veterinary services is gradually changing from a geographical emphasis on area control of disease to a production system emphasis. This change means that management systems, in which the quantity and quality of useful products are increased through health care provided to the animals, can be developed and sustained. In other words, veterinarians are becoming less concerned with spread of epidemic disease and more concerned with reducing well-established endemic diseases which impair productivity and product quality.

Whereas more traditional disease information systems have concentrated almost entirely on monitoring disease outbreaks and movements of disease agents, there is now a need to collect information which can help set priorities and guide actions so that diseases occurring in the livestock population can be controlled.

This is best done by simultaneously measuring the productivity of animals in the population and assessing the impact various diseases have on reducing the level of productivity. Obtaining a “health and productivity profile” of sample units in the total livestock population is, therefore, highly recommended. As the diseases of interest occur almost universally, the number of sample units can be far smaller than would be the case for diseases which are unevenly distributed.

By linking production data, management information and disease data and interpreting the results through modern epidemiological analysis methods, the influence of various diseases on productivity can be assessed even when there are complex interactions between diseases and other factors. To achieve valid results, the study design must be suited to the objectives and appropriate epidemiological techniques used to overcome potential difficulties in interpreting the data usefully.

If these requirements are met, it is possible to gather data which allow action priorities to be set for disease control programs based on economic and other evidence of the expected gain from the control effort. In practice, it is usual to work with a small number of sample units (farms, villages, nomadic groups) to collect detailed data and document the relationships between health indicators and productivity indicators in the population. The measurement system can then be greatly simplified and implemented on a larger scale to measure a small number of key indicators,
selected in the light of experience with the intensive observation system. Since the relationships have been quantified in the intensive study, the significance of changes in these key indicators can be properly interpreted as they relate to the large-scale implementation of the information system.

In northeastern Thailand, for example, a study of health and productivity in a swamp buffalo population (4) demonstrated the major effect of lowered productivity due to nematode parasitism in young calves and trematode parasitism in adult animals, and the very minor impact of contagious diseases. This led to epidemiological studies, designed to evaluate possible control programs which were practical in the economic and management situation of this rice-growing area (and, hence, to the design of a field-control system which could be implemented at village level). This was done through farmers trained as "village keymen" to promote the program and sell the required drugs. A selected sub-group of these keymen is now being used in a pilot study to collect simple items of productivity and disease data, to monitor both the effectiveness of the existing control program and the severity of other significant health problems in the buffalo population. From this data, other components will be added to the overall control program to meet additional needs until a comprehensive service is in operation, targeted to the specific needs of farmers in the area.

This general approach to information-gathering for health and productivity has been used in a number of countries. In this issue, Faugère et al. describe, through their work in Senegal, the application of this approach to Africa. Other similar studies have been undertaken in various countries of Africa (8, 9, 10, 11, 12, 13, 14) and in Latin America (7). The technique is notably being used in developing countries where the need for such data is especially apparent, but the measuring of endemic diseases and productivity levels is also being undertaken in developed countries; for example, through the National Animal Health Monitoring System (NAHMS) in the United States (2, 3) and also through the Animal Productivity and Health Information Network (APHIN) in Canada (1).

An essential requirement for the wider application of this general approach to field work has been the development of data-analysis and interpretation for situations in which multiple-linked items of information have been collected. This is far more challenging than traditional studies which concentrated only on a single disease in isolation, but the gain in understanding from the more comprehensive approach is greater. In this issue, Fourichon describes many of the techniques currently being used by epidemiologists to handle such data in ways which lead to valid conclusions; she also provides references to many additional techniques.

**Monitoring important diseases**

This has been the primary focus of disease information systems in the past and will remain a central component in the future. Other facets of such systems, however, will expand so that the total information system is more comprehensive.

The greatest limitation of specific disease monitoring systems in the past has been the concentration on data collection at the expense of prompt and informative data analysis and interpretive reporting of results. Since many systems have lacked effective quality control, field staff who have been expected to provide the raw data have seen (in the case of some poorer systems) that their efforts produced little practical result. Furthermore, failure to provide data, or reporting of clearly faulty data, was not challenged by supervising staff. Such systems inevitably spiral downwards into disuse.
However, with the advent of computer systems for data management and analysis, the defects of past manual systems are being overcome in many countries.

McLeod and Tyler describe in this issue the ways in which computer systems can be used to manage disease information. Although many senior veterinarians still have difficulty adjusting to the use of computers, field experience shows that the combination of a computer and effective programs to manipulate the data are essential to a genuinely useful disease information system. There are now programs available which make it much easier than before to organise and analyse such data, and effective systems can now be developed for most situations.

There are, however, numerous pitfalls for the inexperienced, and effective monitoring systems should comply with certain design rules (5). The single most important requirement is to focus on measurement of achievement; older systems have mainly measured indicators of workload (such as animal tests conducted), rather than objective measures of progress in controlling a disease. Accurate assessment of achievements in the two key areas of effectiveness and efficiency requires careful design of reporting formats and the analytical procedures which underlie them. There should be brief, standard reporting of a summary of progress, supplemented by flexible diagnostic reports which enable managers to identify why a particular aspect of program operation is not meeting expectations. Epidemiological skill is required to develop a monitoring system which acts as a solid support to field disease-control operations, but there are now examples around the world of successful systems which can be used as models.

Technological advances are also creating new possibilities for the conduct of surveillance systems. Mapping of disease outbreaks has historically been a valued tool of veterinary administrators, but such maps have been laborious to produce and difficult to transport. Until recently, technology offered little assistance, but this is changing rapidly. As the paper by Sanson et al. in this issue shows, computer-based geographic information systems (GIS), over the last five years, have become both far more powerful and easier to use on desktop computers. The cheaper GIS programs can be used to replace wall maps with colour graphic computer images on screen or paper, showing the locations of disease outbreaks. Many additional features can progressively be added in the computer version, however, and the relationships between disease occurrence and environmental features can be examined quantitatively. This technology has only recently been used in veterinary applications but is already proving valuable in the investigation of diverse problems.

As demonstrated by Hugh-Jones in this issue, remote sensing (particularly satellite imaging) is another technology which offers a low-cost way of obtaining data. Although it clearly would not be used to gather data readily obtainable from the ground, remote sensing can provide valuable insights into large-scale phenomena; it can also provide information which, for one reason or another, would be difficult to collect at ground level.

Development of practical information systems is also being enhanced by the availability of both low-cost automated laboratory tests and improved field tests. These make extensive surveillance much more practical in many circumstances and contribute to epidemiological investigations conducted within an information system.
International disease reporting and product certification

As world trade in animals and animal products has grown, new dangers concerning the spread of serious animal diseases have emerged. The need to strengthen the systems of disease reporting and certification has been recognised by the OIE, which has been moving over the last ten years towards a disease-reporting system structured along epidemiological lines. The paper in this issue by Blajan and Chillaud describes this evolutionary process. While much remains to be done, it is now becoming possible to exchange information more promptly and accurately, as well as to examine trends over time and patterns in the occurrence of disease.

If the system is to advance further, progressively higher standards of reporting by Member Countries and full compliance with the reporting procedure now in place are required. Most countries which participate actively in international trade already comply, and those which do not yet provide accurate or prompt reports of all major incidents will be encouraged to do so as they begin to see benefits through expanding access to international markets.

For those countries which are major sources of animal products in world markets, product certification is a major responsibility. In the past, certification has been largely based on trust between the certifying country and the receiving country. However, as the use of surveillance requirements for certification becomes more widespread, countries which claim to be free from major diseases so that they can gain access to high-price markets will have to support such claims with the necessary epidemiological evidence. At the same time, importing countries should be required to use epidemiologically sound criteria for refusing shipments of products on the grounds of disease occurrence.

The OIE is now involved with other international bodies in developing criteria which can be used to respond to requests from countries for international declarations on the status of major diseases (such as rinderpest and foot and mouth disease). These declarations will be based on a graded system of disease surveillance, thus requiring countries to install a national disease information system. The adequacy of this system, and of information generated from it, will provide important criteria for the OIE in making declarations of disease status. This, in turn, will give countries growing economic justification for building surveillance systems into a national animal health information system.

Identification of emerging disease syndromes

The frequency with which new disease problems emerge — whether they be as spectacular as bovine spongiform encephalopathy or more insidious, such as the emergence of anthelmintic resistance in major parasites — tends to be underestimated.

An important function of national epidemiological services is to identify and characterise such problems as promptly as possible. This is one of the greatest challenges in developing an animal health information system, and one for which there is no perfect answer. Diagnostic laboratories can play a vital role in this process, particularly if there is national collation of unusual diagnoses, so that emerging patterns which extend beyond a single region can be identified. This process can be assisted by incorporating diagnostic results into the national information system.
A second element of this system should be an "unusual disease incident" reporting system, whereby all veterinarians and paraveterinary staff are encouraged to report unusual findings, even if no emerging trend is perceived. When collated by the national information system epidemiologists and viewed on a larger scale, such findings may represent important new developments.

**Support for disease control programs**

When a control program is in operation for a particular disease, the information system should be used to monitor both progress of the disease and progress of the control program. While the principles mentioned above apply to general monitoring of diseases of national importance, there will frequently be additional elements when the disease is the subject of a control or eradication program.

One such additional element is the epidemiological investigation of aspects of disease transmission which do not conform with expected patterns. An example of this which is becoming more widely recognised for a number of important diseases is the interaction between the pattern of disease in domestic stock and the simultaneous occurrence of the disease in wildlife or feral animals. Such interactions present major epidemiological challenges, and experience in defining the extent and influence of wildlife reservoirs of infection is limited. In this issue Wilesmith offers suggestions, based in part on his experience in studying the interaction between tuberculosis in badgers and cattle in the United Kingdom, on how to investigate such problems, and demonstrates the techniques to be used in dealing with them.

**Ancillary information for decision-making**

To understand the context in which decisions on animal health matters are being made, the collection of data from sources beyond the veterinary service itself has become imperative. This requires collaboration with other specialists and drawing on new sources of information. The use of geographical and satellite data (as described above) is one example, but information on the social and economic context is another vital area. Such information can be integrated with animal health data to produce analyses helpful to policy-makers. A modern information system will allow this kind of integration to take place without difficulty. The paper in this issue by Sollod and Stem illustrates how widely diverse categories of information must be brought together to make sound decisions regarding nomadic and transhumant production systems. These systems present a real challenge to the development of disease control strategies.

**A structured framework for decision-making**

The final feature of a national animal health information system is the process of collating all the data to make more fully-informed decisions. Without this, the potential value of the information system cannot be fully exploited. An ever-expanding range of techniques is being used to carry out policy evaluations, and some of these, such as spreadsheet analysis, computer modelling, benefit-cost analysis and decision analysis, have been applied by veterinary services in various parts of the world. Fourichon describes some of these in her paper in this issue.

Risk analysis in relation to animal health decisions is presently receiving much attention. The paper presented by Hathaway in this issue describes the principles of this technique, and illustrates its application to some specific problems.
**CONCLUSION**

As the problems to be solved and questions to be answered become more complex, decision-making on animal health matters becomes more dependent on specific information. In virtually all spheres of modern community development, information is becoming the cornerstone of progress; information systems are the essential tools for constructive action.

This issue of the *Review* aims to illustrate some of the newer techniques and experiences in developing coordinated systems of information management to support veterinary services. It is not intended to be comprehensive, but to illustrate what is possible and what has been achieved.

An information system is not a monolithic system, but rather a structured approach to problem definition and resolution which, when appropriate, allows different categories of information to be related to each other. An information system does not require that all information be stored in a central place; it simply enables people to have access to the information they need, without undue difficulty.

It is noteworthy that some of the most impressive examples of integrating information effectively come from areas of the world where the problems would, at first sight, appear to be almost insurmountable. If achievement is possible under such circumstances, it must also be possible elsewhere. In developing information systems, the dangers of Finagle's Laws, outlined at the beginning of this paper, should not be forgotten; neither should the fear of doing the wrong thing discourage those involved from adopting new approaches to animal health problems. The papers in this issue illustrate that, with the right ideas and the right epidemiological techniques, difficult disease control problems can be solved effectively.

**SYSTÈMES D'INFORMATIONS ZOO-SANITAIRES : OBJECTIFS ET COMPOSANTES. – R.S. Morris.**

*Résumé:* La gestion des informations conditionne de plus en plus l'efficacité des actions intéressant la santé animale, comme d'ailleurs celles concernant la plupart des autres domaines. Un service vétérinaire moderne doit impérativement disposer de systèmes opérationnels pour réunir les informations pertinentes provenant du terrain, les traiter de manière optimale et les présenter sous une forme telle que les instances de décision et le personnel de terrain puissent facilement les utiliser dans le cadre des actions de prophylaxie des maladies animales. L'auteur décrit sept objectifs qui devraient servir de base au développement d'un système intégré d'informations zoo-sanitaires. Il présente également six critères auxquels devrait répondre toute activité d'informations, avant sa mise en œuvre. Pour chacun des sept objectifs, l'auteur indique comment chacune des composantes du système peut être utilisée et illustre par des exemples la façon dont ces méthodes de gestion des informations ont pu être mises en pratique. Il fait également référence à d'autres articles du présent numéro qui décrivent différentes techniques novatrices employées pour atteindre certains objectifs d'un système moderne d'informations zoo-sanitaires.

Resumen: Al igual que en la mayoría de campos técnicos y administrativos, la gestión de la información es, cada día más, la clave de la eficiencia. Un servicio veterinario moderno requiere sistemas eficaces capaces de recoger la información procedente del terreno, procesarla de manera que se saque el mejor provecho de ella y presentarla de tal forma que los responsables de los programas nacionales y el personal de terreno puedan aplicarla fácilmente a las acciones adecuadas, logrando así un control eficaz de las enfermedades. El presente artículo describe los siete objetivos que deben ser la base para el desarrollo de un sistema de información integrado de sanidad animal en un país, precisando así mismo seis criterios con los que debe cumplir previamente cualquier actividad de recogida de datos. Para cada uno de los siete objetivos, se explica cómo usar el respectivo componente del sistema y se dan ejemplos de aplicación práctica de dichos procedimientos de gestión de la información. Por otro lado, se hace referencia a los otros artículos del presente número que describen diversas técnicas innovadoras que se están utilizando para responder a los objetivos de un sistema de información de sanidad animal moderno.

PALABRAS CLAVE: Enfermedades animales - Epidemiología - Notificación internacional de enfermedades - Productividad animal - Sanidad animal - Sistemas de información.

REFERENCES


